甘肃省2026年国家级高等教育（研究生）教学成果奖申报

教学成果奖应用及证明材料

扎根陇原·工程赋能：新时代西部乡村建设高层次复合型人才培养模式探索与实践

1、教学研究及教学项目获奖

2、教学改革著作论文

3、相关科研论文

4、指导学生获奖

5、专利

6、成果应用及推广

三、 教学成果奖应用及证明材料

1、教学研究及教学项目获奖

2、教学改革著作论文

5、专利

甘肃省科技进步奖

证　书

为表彰甘肃省科技进步奖获得者，特颁发此证书。

项目名称：地理空间数据版权保护关键技术及应用

奖励等级：一等

获 奖 者：张立峰

2020 年 1 月 11 日

证书号：2019-J1-004-R3

甘肃省科技进步奖

证　书

为表彰甘肃省科技进步奖获得者，特颁发此证书。

项目名称：西北地区生态环境数字监测与智能评估关键技术及应用

奖励等级：二等

获 奖 者：张立峰

甘肃省人民政府

2025 年 4 月 30 日

证书号：2024-J2-056-R1

一、团队主要成员情况

姓 名	职称/职务	出生年月	政治面貌	学历学位	专业方向
闫浩文	教授/长江学者特聘教授/院长，JGSA 主编	1969-01	中国共产党	工学博士	地图制图学与地理信息工程
张国珍	教授/教育部长江学者创新团队负责人，省科技领军人才第一层次	1969-10	中国共产党	工学博士	资源环境遥感
周亮	教授/省飞天学者	1983-05	中国共产党	理学博士	地图学与地理信息系统
杨树文	教授/常务副院长	1975-09	中国共产党	工学博士	摄影测量与遥感
刘涛	教授/全国高校 GIS 新锐	1981-03	九三学社	理学博士	地图制图学与地理信息工程
金梅	教授/省科技领军人才，省政协常委民革甘肃省委副主委	1969-08	中国国民党革命委员会	经济学博士	经济地理
赵军	教授/全国模范教师	1975-08	中国共产党	工学博士	地图制图学与地理信息工程
范红超	兰州交通大学特聘教授，挪威科技大学教授/国家青年千人	1977-10	中国共产党	工学博士	地图制图学与地理信息工程
王瑞胜	兰州交通大学特聘教授，加拿大卡加尔里大学教授	1971-04	群众	工学博士	摄影测量与遥感

Michael Peterson	兰州交通大学特聘教授，美国内布拉斯加大学教授/美国地图学会前主席	1954-04	群众	理学博士	地图制图学与地理信息工程
张丽萍	教授/甘肃省教学名师	1968-01	中国共产党	工学硕士	交通工程测量
王世杰	教授级高级工程师/国家地方联合工程研究中心副主任	1971-01	群众	理学硕士	大地测量学与测量工程
孙建国	教授/研究生党委工作部部长	1974-08	中国共产党	工学博士	地图制图学与地理信息工程
张黎明	教授/地理信息科学系主任	1974-10	中国共产党	工学博士	地图制图学与地理信息工程
魏冠军	教授/测绘工程系主任	1976-11	中国共产党	工学博士	大地测量学与测量工程
张志华	教授/遥感科学系主任	1980-06	中国共产党	工学博士	摄影测量与遥感
杨维芳	教授/班主任	1970-02	中国共产党	工学博士	大地测量学与测量工程
杨军	教授/创新创业学院院长	1973-05	中国共产党	工学博士	地图制图学与地理信息工程
火久元	教授	1978-03	中国共产党	理学博士	摄影测量与遥感
王中辉	副教授/地理信息科学系副主任	1978-08	群众	工学博士	地图制图学与地理信息工程
杜萍	副教授/班主任	1976-11	群众	理学博士	地图制图学与地理信息工程
韩惠	副教授/班主任	1976-05	群众	理学博士	摄影测量与遥感
李雪梅	副教授/班主任	1983-10	中国共产党	理学博士	摄影测量与遥感
张立峰	副教授	1982-02	中国共产党	工学博士	摄影测量与遥感

Mikalai Filonchyk	副教授（白俄罗斯籍）	1986-11	群众	工学博士	摄影测量与遥感
苏小宁	副研究员 /班主任	1986-03	中国共产党	工学博士	大地测量学 与测量工程
杨国林	副教授/班主任	1978-09	群众	工学硕士	大地测量学与测量工程
李建章	副教授/班主任	1974-11	群众	工学博士	大地测量学与测量工程
段焕娥	副教授/班主任	1972-11	中国共产党	理学硕士	地图制图学与地理信息工程
朱睿	副教授/班主任	1983-11	群众	理学博士	地图制图学与地理信息工程
何毅	副教授/班主任	1987-03	中国共产党	理学博士	摄影测量与遥感
李轶鲲	副教授	1978-02	群众	工学博士	摄影测量与遥感
庞国锦	副教授/班主任	1985-10	中国共产党	理学博士	摄影测量与遥感
郭楠	副教授/班主任	1985-02	中国共产党	工学硕士	大地测量学与测量工程
牛磊	副教授/辅导员	1983-09	群众	工学博士	地图制图学与地理信息工程
禄小敏	讲师/班主任	1982-10	中国共产党	工学博士	地图制图学与地理信息工程
李伟	讲师/班主任	1989-11	中国共产党	工学博士	大地测量学与测量工程
金江磊	讲师/辅导员	1980-10	中国共产党	经济学硕士	人文地理

获奖证书

刘奔腾 同志《历史文化村镇保护模式研究（专著）》，荣获甘肃省第十五次哲学社会科学优秀成果一等奖。

特发此证

中共甘肃省委 甘肃省人民政府

二〇一九年一月十七日

甘肃省高等教育教学成果奖

获奖证书

证书编号：ED-2021025

获奖成果名称：思创专创双融合的红旅实践体系建设与人才培养模式探索

成果主要完成人：冯辉霞　张新红　张玺君　王文霞　徐　洁　张晓渝

成果完成单位：兰州理工大学

获 奖 等 级：省级二等

甘肃省教学成果奖评审委员会

2021年12月30日

第三届全国高等学校GIS教学成果奖

获奖证书

成果名称： 师资牵引、理工并举、实践创新的GIS专业教学实践与探索

完 成 人： 刘涛、张黎明、杜萍、朱睿、禄小敏、周亮、王中辉、张立峰、闫浩文、王强、段焕娥、杨树文、张志华、何毅、李雪梅

完成单位： 兰州交通大学

奖励等级： 二等奖

中国地理信息产业协会教育与科普工作委员会

二〇二一年八月

甘肃省教学成果奖

获奖证书

证书编号：20170073

成果名称：“工·艺相济”——工科背景下设计艺术类人才培养模式研究

获奖等级：教育厅级

主要完成单位：兰州理工大学

主要参加人：刘奔腾　朱守会　周　琪
张　涵　许韶华　苏建宁

2017年4月

荣誉证书

HONORARY CREDENTIAL

为表彰“智能与协同·2025第十三届高校GIS论坛”“优秀教学成果”奖获奖者，特发此证，以资鼓励。

成果名称：人工智能时代下的微波遥感课程教学改革与实践

完 成 人：何毅、刘涛、李文德、闫浩文、黄春林、周亮、杨树文、王文辉、张志华、郭建国

完成单位：兰州交通大学

高等院校地理信息系统(GIS)论坛组委会

二〇二五年十一月九日·上海

为表彰在促进建设科技进步中做出突出贡献的科技人员，特颁发此证书，以资鼓励。

证书号：**2010-JK2-R3**

获奖项目：**兰州市古建筑保护研究**

获奖者：**安玉源**

奖励等级：**贰 等**

二〇一〇年七月十九日

获奖证书

张新红同志：

您主持完成的《甘肃河谷城市公共步行空间无障碍设计研究》课题经专家组评审，被评为“甘肃省残疾人基本服务状况和需求数据动态更新调查成果应用研究”科研成果三等奖，特发此证。

课题组成员：张新红 刘奔腾 李鸿飞 闫海龙 李沁鞠 杨仕恩

课题承担单位：兰州理工大学

证书编号：GSDPF-SKYJ3-01

甘肃省残疾人联合会

2018年2月8日

中国指挥与控制学会
CHINESE INSTITUTE OF COMMAND AND CONTROL
CICC

CICC 科学技术奖

证 书

为表彰对指挥与控制科学技术进步作出杰出贡献者，特颁此证，以资鼓励。

奖励类别：CICC科学技术进步奖

奖励等级：二等奖

项目名称：基于认知心理学的空间关系与地图综合理论及应用

获 奖 者：张立峰

二〇一七年十二月

证书号：2017-J-2-02-07

自然资源科学技术奖

证　书

为表彰自然资源科学技术奖
获得者，特颁发此证书。

获奖类别： 科技进步奖

项目名称： 测绘地理信息数据安全关键技术与应用

奖励等级： 一等奖

获 奖 者： 张立峰

自然资源科学技术奖励委员会

2024年10月

证书号：JB2023-1-22-R11

荣誉证书

何毅、张立峰、陈宝山同志：

您（们）申报的《兰新高铁路基形变 InSAR 监测及机理分析》项目被评为第八届

全国铁路青年科技创新奖

全国铁道团委　　科技和信息化部　　劳动和卫生部

川藏铁路工程建设指挥部办公室

中国铁道学会

2022 年 12 月

证书

兰州理工大学、甘肃省应急测绘工程研究中心

完成的《基于GIS的典型区地质灾害致灾因子

优选与地表灾害过程模拟》项目被评为2017年

度甘肃省测绘科学技术（科技进步）一等奖。

主要完成人：牛全福 党星海 杜玉祥 李亚荣

张秀霞 周兆叶 魏玉明 杨鹏源 李旺平

二〇一八年十月

詹天佑科学技术发展基金会
ZHANTIANYOU DEVELOPMENT FOUNDATION OF SCIENCE AND TECHNOLOGY

证书号：ZDFST-2024-ZX-03-043

证书
CERTIFICATE

何　毅 同志：

荣获2024年度詹天佑铁道科学技术奖詹天佑高等院校奖青年奖特发此证，以资鼓励。

詹天佑科学技术发展基金会
2025年7月22日

中国测绘学会

CSGPC

测绘科学技术奖

证 书

为表彰测绘科学技术奖获得者，特颁发此证书。

项目名称：兰州市降雨诱发滑坡预警系统

奖励等级：二等奖

获 奖 者：张立峰　　名次：(04)

证书号：2021-01-02-12　　2021 年 10 月

HONORARY CREDENTIAL

荣誉证书

兰州理工大学土木工程学院：

贵单位推荐的论文《基于GIS的兰州地区滑坡灾害孕灾环境敏感性评价》，作者：牛全福、冯尊斌、张映雪、党星海，在“2018年甘肃省测绘地理信息优秀学术论文”评选活动中，荣获一等奖。

特发此证。

甘肃省测绘
地理信息职业教育集团

甘肃省测绘
地理信息学会

甘肃省地理
信息产业协会

西部战区陆军信息
工程科技创新工作站

二〇一八年十一月一日

聘 书

LETTER OF APPOINTMENT

兹聘请张立峰同志担任甘肃省应急测绘工程研究中心第三届学术委员会副主任委员，聘期五年，自2026年1月至2030年12月。

甘肃省应急测绘工程研究中心

2026年1月

获奖证书

何　毅同志：

被评为2022年度甘肃省高等学校青年教师成才奖。

特发此证，以资鼓励。

证书编号：QNCC2022012

甘肃省教育厅

2022年6月7日

荣誉证书

兰州交通大学　禄小敏、刘涛、张黎明、张立峰：

在“首届全国高等学校测绘类专业教师教学创新大赛”中荣获二等奖。

特发此证，以资鼓励。

中国测绘学会教育工作委员会

（代章）

2022年7月19日

荣誉证书

兰州交通大学 金龙，陈升，李涵林：

撰写的“基于R2AU-Net神经网络的InSAR相位解缠方法”论文在2023年全国大学生测绘学科创新创业智能大赛——科技论文竞赛中荣获一等奖。

指导教师：何毅

特发此证，以资鼓励。

中国测绘学会

2023年08月11日

甘肃省优秀学位论文

论文作者：张清

论文题目：地学知识图谱驱动的图神经网络广域滑坡易发性评估方法——以白龙江流域为例

指导教师：何毅

授予单位：兰州交通大学

论文类型：2024—2025学年甘肃省优秀硕士学位论文

证书编号：YS20240078

甘肃省学位委员会 甘肃省教育厅

2025年12月1日

甘肃省优秀学位论文

论文作者：火天宝

论文题目：环境因子约束的InSAR地表形变时空预测神经网络方法-以冻土区青藏铁路为例

指导教师：何毅

授予单位：兰州交通大学

论文类型：2024—2025学年甘肃省优秀硕士学位论文

证书编号：YS2024065

甘肃省学位委员会　　甘肃省教育厅

2025年12月1日

甘肃省优秀学位论文

论文作者：路建刚

论文题目：白龙江流域潜在滑坡InSAR识别与多模型滑坡易发性评估方法

指导教师：何毅

授予单位：兰州交通大学

论文类型：2024—2025学年甘肃省优秀硕士学位论文

证书编号：YS2024071

甘肃省学位委员会 甘肃省教育厅

2025年12月1日

甘肃省优秀学位论文

论文作者：高秉海

论文题目：融合静-动态时空数据的多模型集成滑坡灾害风险评估方法

指导教师：何毅

授予单位：兰州交通大学

论文类型：2023—2024学年甘肃省优秀硕士学位论文

证书编号：YS2024069

甘肃省学位委员会　　甘肃省教育厅

2024年11月25日

甘肃省优秀学位论文

论文作者：刘耀祥

论文题目：黄河源区泥炭地长时序变化特征及机理研究

指导教师：何毅

授予单位：兰州交通大学

论文类型：2023—2024学年甘肃省优秀硕士学位论文

证书编号：YS2024059

甘肃省学位委员会　　甘肃省教育厅

2024年11月25日

荣誉证书

HONORARY CREDENTIAL

张文博：

您的毕业设计（论文）**甘肃黄土高原植被覆盖度与遥感生态指数制图**，在“第一届全国高校土建类学科（专业）学位论文和优秀毕业设计”评选中荣获**二等奖**。

特发此证。

中国建筑金属结构协会教育分会

2023 年 10 月 11 日

获奖证书

兰州理工大学

路佳佳、王弈桐、李 萍、祖米莱提·赛福丁：

你（们）的作品《“声生”共振 基于留言板数据的城市治理问题的空间识别——以兰州市为例》在第十九届“挑战杯”全国大学生课外学术科技作品竞赛中荣获

二等奖

指导教师：张新红、刘奔腾

编号：2025-TZB19-MA20605H-247806

特颁此证，以兹鼓励

主办单位：共青团中央、中国科协、教育部、中国社科院
中国工程院、全国学联、江苏省人民政府

第十九届“挑战杯”全国大学生
课外学术科技作品竞赛
全国组织委员会
二〇二五年十一月

荣誉证书

兰州交通大学

豆玉洁同学：

你（们）的作品 D1679（北麓河流域热融滑塌数据集构建与分析）在 2024 易智瑞杯中国大学生 GIS 软件开发竞赛·遥感应用组比赛中，荣获

三等奖

作品指导老师：何毅，张立峰

特发此证，以资鼓励。

中国测绘学会

2024 年 11 月

电子证书编码：S2024040892

荣誉证书

兰州交通大学测绘与地理信息学院 何毅老师：

在“2023 易智瑞杯中国大学生 GIS 软件开发竞赛·遥感应用组”作品评选中指导 一等奖 学生作品 D1182《考虑环境因子的青藏线 SBAS-InSAR 多年冻土沉降监测与分析》，荣获：

优秀指导老师奖

中国测绘学会

2023 年 11 月

证书编号：Y2023043031

第2届全国高等院校斯维尔杯BIM软件建模大赛

获奖证书

优秀指导奖

证书编号：

2011060059

兰州理工大学

安玉源　闫幼峰　王立　陈伟东　孟祥武 老师

在第二届全国高等院校斯维尔杯BIM软件建模大赛中，所指导团队成绩优异，特发此证，以资鼓励

指导团队所获奖项

全能奖 全能奖 三等奖

全国高等院校斯维尔杯BIM软件建模大赛组委会

中国建设教育协会

深圳市斯维尔科技有限公司

二零一一年五月十五日

荣誉证书

NO.QG20210617

兰州理工大学 康正伟、余家伦、赵灏琳：

完成的“基于夜间灯光遥感数据的城市扩张分析——以兰州新区为例”在“南方测绘杯”第十二届全国高等学校大学生测绘科技论文大赛中荣获一等奖，

指导教师：牛全福

特发此证，以资鼓励。

全国高等学校测绘类专业竞赛联盟（武汉大学代章）　　自然资源部职业技能鉴定指导中心

（获奖者排名不分先后）

2021/7/29

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荣誉证书

兰州交通大学　王孙刚，丁钰杰，火天宝：

撰写的“中国西北地区日光诱导叶绿素荧光对植被干旱的响应”论文在 2022 年全国大学生测绘学科创新创业智能大赛——科技论文竞赛中荣获特等奖。

指导教师：张立峰

特发此证，以资鼓励。

中国测绘学会教育工作委员会

（代章）

2022 年 7 月 27 日

中国国际大学生创新大赛（2025）甘肃省分赛

天路卫士——青藏铁路廊带热融滑塌智能精准识别与预警平台 项目获得：

银奖

团队成员：陈剑、盛通、王欣悦、迟胤彤、刘庭毓、单文慧、火天宝
张清

指导教师：何毅

报送学校：兰州交通大学

证书编号：2025X307LC

甘肃省教育厅

二〇二五年九月

Certificate of Honor

Dr. **Lifeng Zhang** was rated as **"Outstanding Contribution Award"** in 2021 for a great contribution to the development and progress of *Journal of Geovisualization and Spatial Analysis*.

Journal of Geovisualization and Spatial Analysis

December 16th, 2021

关于2024年“师德标兵”评选结果的公示

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公　示

根据《兰州理工大学师德标兵评选实施办法（修订）》（兰理工党发〔2018〕36号）和学校2024年师德标兵评选表彰工作的通知,经各二级党组织推选，征求相关部门意见、学校师德标兵评选工作小组审查遴选、典型事迹宣传、学校奖励评审委员会评审，学校党委常委会会议审定，李安等4名教师被评选为师德标兵，现予以公示。

李　安　石油化工学院

张玺君　计算机与通信学院

刘奔腾　设计艺术学院

任育新　外国语学院

公示时间：2024年9月3日-7日

如有异议，请于公示期内向学校纪委监察一室或党委教师工作部反映。

监督电话：纪检监察一室：2911556

党委教师工作部：2973706

党委教师工作部

2024年9月3日

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工艺相济理念下的建筑学人才培养模式探索

The Architectural Training Model based in Combination of Engineering and Art

摘　要：人才培养模式是建筑专业建设的出发点和落脚点。学生成长需求、学科特点和社会发展成为影响当前建筑学专业建设的突出问题。通过梳理建筑学教育中的“工”“艺”分歧，提出了“工艺相融”的人才培养模式理念。以兰州理工大学实践为例，从培养目标、教学内容、教学实施、实习实践、师资建设和教学评价六个维度构建了建筑学本科人才培养模式。分析了探索践的优势和不足，为同类院校人才培养提供思路。

关键词：培养模式；建筑学专业；工艺相济

Abstract：：An architectural training model for undergraduate under the concept of *Combination of engineering and art* is constructed based on the needs of students' personal growth，characteristics of architecture，social development，and the analysis of the differences between *technology* and *art* in the concept of Architectural Education. Taking the practice of the school of design and art，Lanzhou University of technology as an example，this paper analyzes the advantages and disadvantages of its practical exploration，and puts forward some suggestions，which are expected to be used in the Architectural Education of other local engineering universities，and to provide inspiration for the talent training.

Keywords：Training Model；Architectural Major；Combination of Engineering and Art

1　引言

高等教育的任务之一是培养具有创新精神和实践能力的高级专门人才。2018 年《教育部关于加快建设高水平本科教育全面提高人才培养能力的意见》（教高〔2018〕2 号）中明确指出高校应主动对接经济社会发展需求，不断优化专业人才培养模式，持续改进人才培养质量机制。建筑业作为我国国民经济的五大支柱产业之一，与时俱进地培养“工艺兼修”的人才在其专业教育中的意义不言而喻。在新经济、新时代背景下，高校的建筑学本科需秉承“新工科”或者说“创意工科”的理念转型升级。[1] 顺应科技升级与创新探索建筑教育新范式，为国家和社会培育科技与人文相济、工科与艺术相融的专业人才成为建筑学教育工作者亟须探讨的议题。

2　工艺相济人才培养的必要性

2.1　个人成长需要

20 世纪以来，教育的本体功能发展经历了知识、智力和人三个阶段。与传统高等教育中注重于某一门类的专业知识传授不同，具备良好的科学、人文素养和健康的审美情趣是新时代大学生全面发展的内在要求。就个人就业层面而言，不仅需要接受全面扎实的建筑学专业教育，获得具有充分竞争力的就业能力，为未来的人生和事业储备能量，实现社会价值；更需要广博深厚的博雅教育，在个人成长的关键阶段，塑造健全人格，培

养人文素养，提升个人“软实力”，实现个人价值。

2.2 学科特点决定

建筑学从广义上说是研究建筑及其环境的科学，与其他专业相比具有涉及面广、概括性强的学科特点。一幢建筑从设计、施工到交付使用的过程可谓是综合性极强，对专业教育的影响和要求不言而喻。首先，建筑学专业学生需拥有广泛的知识面和解决综合问题的能力，以便成为建筑师后妥善应对各相关专业的要求，协调解决设计中的多方矛盾。其次，除了“坚固”“实用”之外，建筑的评判原则还包括“美观”。“美观”不仅体现具体的造型能力，还包含艺术观念、文化责任、人文理想，是对使用者的理解、对公共环境的关注和对美的表达。因此，培养学生丰富的想象力和共情力是建筑学学科特点赋予专业教育的任务。

2.3 社会发展要求

时下我国要提高自主创新能力和建设创新型社会，高校教育重点培养具有创新意识的应用型人才。要求建筑学人才具备较强的综合素质，包括理论功底、动手能力、科学素质、人文素养和创新意识等。建筑学高等教育强调工匠精神、人文精神与创新创业的有机融合，又反过来为社会创新发展提供了良好的价值引领和精神支撑，这也是“新工科”服务于新经济发展、解决人才供需矛盾和深化教育改革的内涵的体现。因此，社会的发展和创新需求要求建筑学人才培养要重视专业教育中综合能力的培养，充分发挥文化和艺术要素的育人功能。

3 工艺相济人才培养模式构建

3.1 人才培养模式概念再认识

高等教育中人才培养是一项系统工程，涉及培养理念和目标，培养机制和方法，培养保障和评价等多个环节，是多种要素经过科学设计形成的有机整体。人才培养模式就是这一活动的实践规范和操作范式。以发展的眼光看，人才培养模式应该充分考虑学生个人成长、学科专业特点以及社会和时代的发展需求，有的放矢，与时俱进，总结过去，面向未来，不断更新教育理念，修正和改革各个要素和环节，这也是教育进步的必经之路。具体到建筑学专业教育，特别是在“新工科”及“创意工科”建设背景下，人才培养应依据学科特点，及时更新培养理念，以就业和学生综合素质提升为导向，在充分提升专业教育水平的基础上，注重文化艺术要素在育人中的重要作用，优化教学实践的各个环节，努力输出专业扎实，全面发展的交叉字型创新型人才，形成重视人文与艺术培养的建筑学现代教育模式。

3.2 建筑学人才培养理念变迁

从古罗马的维特鲁威将人文学科（自由艺术）植入建筑教育的必修课程，到由工匠技艺传承和学徒制巩固的中世纪行会，再到文艺复兴时期的阿尔伯蒂在建筑学中追求的理性和科学的方法，又积极践行人文主义的艺术观。[2] 从17世纪把建筑与古典艺术相结合，将建筑设计更多地视作是艺术创作的鲍扎体系（Beaux-Arts），到20世纪初贯彻“形式与功能统一”及“现代学徒制”的包豪斯体系（Bauhaus），再到20世纪中期重新思考学术与实践的关系的“得州骑警”（Texas Ranger），直至近年来国内外各色建筑院校更为全面综合的教育体系。一直以来，以工艺技能训练为核心的行会（Guild）传统和以人文艺术学习为主的学院（Academy）传统间的分歧是建筑教育所讨论的核心问题，也是建筑学人才培养理念的主要分歧所在。

这一分歧的弥合也随着学生个人成长的需要、学科融合和建筑学综合性的凸显。行会传统与学院传统分歧也因社会分工过细而亟需弥合。即工科与艺术的相济相融的建筑学人才培养理念。要求培养兼具工科素养和美学素养、专业知识和动手能力，既严谨躬行又浪漫文艺的高素质建筑学人才，不是单纯的泥瓦匠（Mason）、建筑工人（Builder）或者艺术家（Artist）、理论家（Theorist），而是如同那些全能而才华横溢的前辈大师一般的建筑师（Architect）甚至建筑大师（Master）。

3.3 工艺相济的教育理念内涵解读

在上述基础上，我们提出“工艺相济”的建筑学教育理念。这一理念的内涵可以从三个方面理解。第一，“艺”不止局限于“艺术”，而是广义的“艺”，是与工程科技相对的人文主义，强调通识教育与专业教育并进，理论和实践互融，知识、能力和素养整体提升。第二，“工艺相济”说的是工科与艺术要素在建筑学人才培养水平提升中有机融合、相互促进的关系：平面艺术训练为三维空间塑造打下基础，严谨务实的工科训练又将虚空的艺术落实为可行的项目；工科给出朴素理性的工程答案，还需要艺术要素在美和感性上的升华。艺术要素对工科教育的质的提升还在于引入突破传统思维的创新创意设计理念，不断提高的工程技术也仅是工具，建筑设计中最重要的还是艺术灵感和迸发和创意设计思维的贯穿。[3] 第三，工艺相济的人才培养理念用以指导高校建筑学教育发展，不仅如上所述迎合和满足了个人乃至社会发展的需要，这种工科教育与艺术文化的融

合，或者说科学与人文的融合，实际上也可以看作是建筑学和建筑师身处特殊位置对斯诺命题的一种回应。[4]

在“工艺相济”的理念之下，以学生为中心，从培养目标、教学内容、教学实施、实习实践、师资建设和教学评价等人才培养的关键要素和环节出发，来构建布局科学、层次结构合理、体系完整的工艺相济的建筑学本科人才培养模式（图1）。

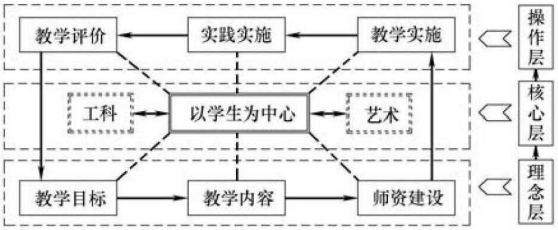

图1　培养模式

4　工艺相济人才培养模式应用

兰州理工大学建筑学专业创建于1987年，我校是甘肃省第一所创办建筑学的高校。经过近来30年来的学科调整和院系整合，目前该专业所在的设计艺术学院共有建筑学、城乡规划、环境设计、工业设计、产品设计和视觉传达设计等六个专业。“三工三艺”的专业构成涵盖工科和艺术两大学科门类，形成了以造型艺术为共性、具有工科性质文科背景的设计艺术类专业群。为打通设计类学院内教学资源的共享和交流，形成了交叉互融、工艺相济的课程体系提供了基础条件。

4.1　培养目标：工艺兼修，知行合一

兰州理工大学建筑学的培养目标强调知识结构、能力层面、素质条件三个层面上都达到“工”“艺”兼修。第一，知识结构。工艺相济不仅体现在通识教育与专业教育并行中，更体现在专业知识体系形成中工程教育与审美训练的并进。第二，能力结构。工艺相济体现在面对专业问题时的实践动手能力与创新设计能力兼具，也包括走入社会面中解决复杂问题时的综合能力和全局观念。第三，素质层面。工艺相济不仅体现在“准建筑师”兼具工匠精神与人文精神，审美水准高，艺术修养好，还包括其在道德情操、学术志趣、科学精神、创新精神、开拓思维、责任意识等等综合素质的协调发展上。

4.2　教学内容：专业互通，课程互融

在人才培养目标的指引下优化的课程体系，并在专业教育中理论结合实践，强化实践教育，为建设高水平人才培养体系打下重要基础。第一，厘清学科关系，打破专业壁垒，制定专业建设规划，帮助建筑学的学生形成开阔的设计观，拓展学科思维和专业视野。第二，以上述学科体系为基础共享丰富课程资源，针对建筑学综合广博、体系庞杂、学科交叉性强、知识更新快、实践性强等特点构建系统化、秩序化的课程体系。第三，加强注重实践的教学内容。“建筑艺术家并不需要极具天赋的人，恰当地说，他们更应该具备快速掌握人物并达到最终目标的实践能力。”落实学生为中心的教学理念，切实锻炼学生获得进入专业领域实践所必需的能力和可持续发展的能力。

4.3　教学实施：软硬兼施，教学相长

改革教学实施所需的硬件条件与教学方式、方法，以适应工科与艺术交叉和互融。第一，“工艺”共享的教学硬件建设。这不仅是教育资源的优化配置，也是借共享平台促进各专业学生交流互进的孵化器。在已有场地、设备的基础上建设各专业共享的研究所、工作室、实验车间等，形成一体化的资源共享平台。第二，交叉开阔的学术交流平台建设。搭建交叉学科与交流合作课程平台，国内外高校交流互鉴的教育联盟平台，校企合作的行科教协作平台等，能快速实现工、艺设计专业之间，理论与实践教育之间，学校与行业之间的有机融合、协同创新。

4.4　实习实践：创新创业，赛教融和

一方面是更新教学理念和方式方法手段。完善以学生“学”和“做”为中心的实训实践机制，建设问题导向课程、跨专业研讨课程、多元化实践课程等，为提供个性化教学模式提供有力支撑。[5] 另一方面是组织和鼓励学生科研、探索性设计、素质拓展活动。通过创新创业训练和学科竞赛的方式来培养学生动手能力、促进学生在学科交叉及专业深度上进行自主性学习实践、综合素质提升。推进工程专业教育与工程文化的深度融合，同时结合产学研平台构建“竞赛—项目—创业”递进式的实践阶梯，引导和促进教学成果转化。

4.5　师资建设：工艺并进，双师双能

教育质量提升，从根本上依赖于师资质量的提升。工艺相济的建筑学本科教育也要求教师队伍自身的工科素养和人文素养的共同提升。师资队伍建设凸显人文精神及“大设计”平台的跨专业师资共享，都能潜移默化地以艺术来影响学生。其次，通过校企合作、产学联盟

为学校输送企业导师。企业导师可以更好地把行业先进技术和理念引入实践教学，以实现专业教育与行业前沿技术的同步。校企合作联动、混合式师资团队，无疑也是就业为导向的应用型人才培养、校企信息共享与合作双赢的重要手段。

4.6 教学评价：教师与学生，质量与过程

工艺相济强调构建以学生综合能力和素质为核心的评价机制。以“教”与“学”的主体评价教学活动，是否达成人才培养目标，是否提升了师资队伍，是否做到了教学相长，主要；其次，由于建筑学教学中实践的重要作用以及工艺相济中“艺”的统筹升华效用，故教学评价不仅要关注教学质量，更要重视过程评价，重视实践评价，构建理论和实践有机结合的评价机制和创新考核方式。

5 结语

兰州理工大学地处西北欠发达地区。受地域条件的限制，建筑学师资队伍、生源质量、就业分配等一直是办学面临的挑战。学院利用自身专业设置资源，坚持工艺相济的建筑学人才培养模式。培养出的毕业生具有出口宽、上手快、适应能力强的特点，有效地提高了学生就业率和企业满意度，较好地完成了地方高校的建筑学高等教育的职责和任务。但我们也注意到，这一探索活动是建立在兰州理工大学的专业设置特点的基础上的。从模式建立的角度来说，工艺相济理念还应在校园文化建设、创新成果转化、地域文化挖掘三方面探讨。以此方能形成一种稳定、而成熟建筑学人才培养，为同类高校的建筑学本科人才培养拓展思路。

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艺术设计专业硕士实践教学质量评价研究

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【摘要】实践教学是艺术设计专业硕士培养中的重要环节，传统的教学质量评价方法对学科特征和课程特性的针对性不强。本文借鉴了 CDIO 工程教育理念及其评价标准设计了评价指标体系，运用 AHP- 熵权法和模糊综合评价法建立了专业实践教学质量评价模型。结果显示：（1）对实践教学质量的影响权重排序依次为教学过程、教学成效、教学资源、教学管理；（2）教学过程和教学成效的评价值均低于实践教学质量综合评价值，教学目标制定不明确、教学方法应用不到位等对评价造成了负向影响。

【关键词】艺术设计；专业硕士；实践教学质量；模糊综合评价

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Quality Evaluation Study on Practice Teaching of Professional Master of Art Design

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【Abstract】Practical teaching is an important link in the cultivation of master's degree in art and design, and the traditional teaching quality evaluation method is not very specific to the subject characteristics and curriculum characteristics. The evaluation index system is designed based on the CDIO engineering education concept and evaluation criteria, and the evaluation model of professional practical teaching quality is established by using AHP-entropy weight method and fuzzy comprehensive evaluation method. The results show that:(1)the order of influence weight on the quality of practical teaching is teaching process, teaching effectiveness, teaching resources, and teaching management;(2)The evaluation value of teaching process and teaching effectiveness is lower than the comprehensive evaluation value of practical teaching quality. The unclear formulation of teaching objectives and the inadequate application of teaching methods have a negative impact on the evaluation.

【Keywords】Art Design; Professional Master; Practice Teaching Quality; Fuzzy Comprehensive Evaluation

引言

随着《专业学位研究生教育发展方案（2020-2025）》的颁布和实施，高校研究生培养目标从精英型人才逐步向应用型人才转变。而应用型人才培养重点就是对其实践能力的强化，作为艺术设计专业硕士培养计划的关键一环，实践活动在增强育人效果，提升综合素质，培养学生实际操作能力方面有着重要意义。因此，探索突出艺术设计专业学科特色的评价方法，不仅有利于检测学生专业操作技能的掌握程度，也有助于学校管理部门发现实践教学的改进之处。

一、指标体系设计

CDIO 教育模式作为国际工程教育改革的重大创新成果，其“构思（Conceive）—设计（Design）—实施（Implement）—运作（Operate）”的理念和重视学生学习的综合评价体系被广泛地应用于各类教育和教学实践之中。首先，CDIO 模式以培养具有创新精神和专业操作技能的应用型人才为目标，注重适应社会需求的学生综合素养培养；其次，CDIO 模式以 12 条标准涵盖了人才培养的全过程和各环节，建构起了闭环反馈机制，使得教育改革创新具体化、可操作、可测量；再次，CDIO 模式将：“教育—管理—学习”看作一体，强调学生、教师、用人单位等教育主体广泛地参与评价。而艺术设计

教育着重培养学生创新、创意设计思维过程和解决实际问题的能力，这与 CDIO 强调基础知识储备、个人能力培养、团队交际协作和设计综合素质四位一体的理念是相同的。因此，本研究借鉴 CDIO 模式及其教学评价体系，设计了实践教学资源、实践教学管理、实践教学过程、实践教学成效 U_4 四个维度的艺术设计专业硕士实践教学质量评价体系，如图 1 所示。

图 1　艺术设计专业硕士实践教学质量评价指标体系

其一，教学资源通常是指一切可以帮助学生达成学习目标的教学组成要素，主要包括教学材料、教学环境及教学支持系统。在艺术硕士专业实践教学开展过程中，除了需要校内常规的实践资源，更需要校外的实际项目创作平台支撑，研究生采风调研、创作实施和学术交流等也需要充足的资金资助。充足人力和财力支持很大程度上决定着专业实践的完成质量。其二，任何应用型研究生实践教学均需要高效全面的管理服务作为支撑。学院在校院两级实践教学管理规章指导下，根据艺术创作的特点进一步制定符合艺术教学规律的管理办法，能形成更加严格、规范的工作机制。同时还应对实践场地和实践教材均制定更精准有效的管理办法，有效促进实践资源管理落实。其三，由于我国艺术硕士学位成立较晚，初期的课程体系直接参照同学科学术型学位的课程设置，无法充分体现专业学位的培养特色。实际上，艺术硕士专业实践除了满足用人单位对艺术生职业能力的需求之外，还必须紧密结合研究生偏好调整课程计划。通过合理的教学目标设定、丰富的教学内容和前沿的教学方法，调动研究生学习积极性与主动性。其四，从可雇佣性的视角来看，提高学生与经济社会发展相适应的岗位胜任力是专业实践教学的根本目的。设计创新能力、考试成绩和出勤情况，分别作为用人单位、学生自身、教务主管部门几分检验学生课堂学习能力的标准。此外，学生通过对实践环境、研究特色和导师队伍的了解形成课程成就的预期值，完成课程学习后会将实际获得感与预期值相比较，产生或积极或消极的心理感受，因此在本次研究中也作为实践教学成效的影响因子。

二、研究方法

（一）AHP- 熵值法确定组合权重

采用层次分析法（AHP）、熵值法分别确定实践教学质量评价体系中各层级评价指标的主观权重和客观权重的基础上，用 AHP- 熵值法确定综合权重。wj 表示 AHP 权重 μj 和熵值法权重 φj 线性组合后的最终权重，α 与（1-α）为主客观权重的重要性系数，且 $\alpha \in [0,1]$，即组合赋权的计算公式为：$w_j = \alpha\mu_j + (1-\alpha)\phi_j$。在本次研究中 α 值参考前人研究取 0.5，得表达式：$w_j = 0.5\mu_j + 0.5\varphi_j$。

（二）模糊综合评价模型

结合隶属函数，利用三个层次的模糊综合评价模型对实践教学质量系统做出总体评价。

1. 建立实践教学质量评价因素集：$U=U_i$（i=1, 2, 3, 4），U_i 代表一级指标，以 U_1 为例，其下设有三个二级指标表示为 $U_{11}=U_{ij}$（j=1, 2, 3），二级指标 U_1 对应的指标层 $U_{111}=U_{ijk}$（k=1, 2, 3）。

2. 量化评价等级标准建立评语集：设定评语集 V=｛优秀，良好，中等，一般，待加强｝=｛4.5，4，3.5，3，2.5｝，通过评价表调查，得到各个指标对实践教学质量的重要度大小，并以此确定目标层的评价矩阵与准则层的评价矩阵。

3. 建立隶属度矩阵：通过问卷调查，得出指标 U_{ijk} 隶属于评语集 V，设现在对每个 U_{ijk} 进行评价记作 f（U_{ijk}），则可建立模糊映射如下：

$$u_{jk} = f(u_{jk}) = (r_{j1}, r_{j2}, ..., r_{ijk}) \in F(V)$$

进而确定模糊判断矩阵 R：

$$\boldsymbol{R} = \begin{bmatrix} r_{111} & r_{112} & r_{113} & \cdots & r_{11k} \\ r_{211} & r_{212} & r_{213} & \cdots & r_{21k} \\ r_{311} & r_{312} & r_{313} & \cdots & r_{31k} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ r_{ij1} & r_{ij2} & r_{ij3} & \cdots & r_{ijk} \end{bmatrix}$$

4. 确定评价因素的权重：采用AHP-熵值法，求出准则层的指标集U_i对应的权重集$W=(W_1,W_2,W_3,W_4)$，因素层的指标集U_{ij}，相应的权重为$w=(w_{11}, w_{12}, \cdots, wij)$，$(i=1,2,3,4)$。

5. 进行模糊综合评判

本文存在三个层次的模糊评价集，若选定加权平均$M(\bullet,\oplus)$模型，则从最底层指标开始，将权重向量W和模糊判断矩阵R进行复合运算后，再对上一层综合评判，共进行三次模糊综合评价后得到评判结果。

三、实践应用

选取兰州大学、兰州理工大学、兰州交通大学、西北师范大学、西北民族大学等五所甘肃省高校为实践对象，以问卷调查方式获取评价数据。共向教学参与者发放540份问卷，其中用人单位150份、学生300份、教务主管部门90份，回收有效问卷524份，有效率为97.04%。经信度分析，得出实践教学质量评价量Cronbach's Alpha信度系数均大于0.8，说明量表信度良好，可以进行下一步分析。

（一）确定指标权重值

依前文所述的AHP-熵值法组合赋权方法，计算实践教学质量评价体系三个层次内各个指标的综合权重，并进行归一化处理，结果见表1。

表1　实践教学质量评价权重汇总

目标层	准则层	组合权重	因素层	组合权重	指标层	组合权重	AHP权重	熵值权重
U	U_1	0.2215	U_{11}	0.1447	U_{111}	0.7038	0.0943	0.0353
					U_{112}	0.2962	0.0157	0.0388
			U_{12}	0.306	U_{121}	0.3761	0.1029	0.0435
					U_{122}	0.6239	0.2061	0.0368
			U_{13}	0.5492	U_{131}	0.1999	0.0953	0.0444
					U_{132}	0.505	0.3132	0.0397
					U_{133}	0.2951	0.1726	0.0336
	U_2	0.1403	U_{21}	0.2202	U_{211}	0.2866	0.0287	0.0474
					U_{212}	0.5145	0.1011	0.0356
					U_{213}	0.1989	0.0132	0.0397
			U_{22}	0.7798	U_{221}	0.271	0.2143	0.0407
					U_{222}	0.729	0.6428	0.0431
	U_3	0.3542	U_{31}	0.1718	U_{311}	0.3817	0.0410	0.0402
					U_{312}	0.6183	0.0820	0.0494
			U_{32}	0.5137	U_{321}	0.8058	0.4773	0.0348
					U_{322}	0.1942	0.0797	0.0438
			U_{33}	0.3145	U_{331}	0.191	0.0355	0.0388
					U_{332}	0.809	0.2845	0.0304
	U_4	0.2840	U_{41}	0.3214	U_{411}	0.6354	0.2228	0.0375
					U_{412}	0.3646	0.1112	0.0381
			U_{42}	0.4742	U_{421}	0.7141	0.3930	0.0386
					U_{422}	0.2859	0.1310	0.0418
			U_{43}	0.204	U_{431}	0.3736	0.0523	0.0449
					U_{432}	0.2663	0.0327	0.0366
					U_{433}	0.3601	0.0471	0.0465

（二）模糊评价

艺术设计专业硕士实践教学质量评价体系的三个层次中，第二层次即因素层的模糊综合评价结果见表2，再与一级影响因素的评价权重进行模糊综合得到三级模糊综合评价结果，并用加权平均$M(\bullet,\oplus)$模型方法，最终得到甘肃省高校实践教学评价结果见表3。

表2　实践教学质量二级模糊综合评价结果

二级影响因素	特优	优秀	良好	一般	待加强	评价得分
U_{11}	0.1116	0.4752	0.3015	0.0716	0.0401	3.7849
U_{12}	0.1345	0.4905	0.2844	0.0611	0.0296	3.8091
U_{13}	0.1330	0.4746	0.3015	0.0509	0.0401	3.8017
U_{21}	0.1202	0.4835	0.3073	0.0579	0.0312	3.7993
U_{22}	0.1202	0.5305	0.2500	0.0668	0.0324	3.8315
U_{31}	0.1240	0.4284	0.3807	0.0382	0.0286	3.8062
U_{32}	0.1574	0.4981	0.2567	0.0620	0.0258	3.8314
U_{33}	0.1269	0.4256	0.3330	0.0735	0.0410	3.7193
U_{41}	0.1031	0.4389	0.3521	0.0725	0.0334	3.7461
U_{42}	0.1097	0.4704	0.3225	0.0687	0.0286	3.7945
U_{43}	0.1476	0.4765	0.3060	0.0464	0.0235	3.8453

表3　实践教学质量三级模糊综合评价结果

一级影响因素	特优	优秀	良好	一般	待加强	评价得分
60.66%实践教学资源	0.1273	0.4793	0.2966	0.0597	0.0371	3.8016
62.25%实践教学管理	0.1202	0.5023	0.2844	0.0615	0.0317	3.8244
58.68%实践教学过程	0.1361	0.4507	0.3235	0.0579	0.0318	3.7919
58.80%实践教学成效	0.1240	0.4640	0.3239	0.0603	0.0278	3.7892
59.86%实践教学质量评价	0.1269	0.4717	0.3104	0.0593	0.0316	3.7979

四、结果分析

（一）综合权重结果分析

由表1可知，四个维度的综合权重值：实践教学过程U_3（0.3542）>实践教学成效U_4（0.284）>实践教学资源U_1（0.2215）>实践教学管理U_2（0.1403）。首先，权重分布结果表明受访者认为实践教学中教学过程U_3最为重要，特别是教学内容中的学术创新活动所占权重最大，这也符合艺术设计专业硕士实践教学中注重学生创新能力培养的目标。其次，实践教学成效U_4也是评判实践教学的重要依据，用人单位评价U_{41}、学生评价U_{42}、教务主管部门评价U_{43}所占的权重相对均衡，其中学生作为教育活动的直接接受者其话语权相对最大，体现了以学生学习为重点和中心的评价理念。再次，实践教学管理U_2中实践场地管理U_{222}，实践教学资源U_1中实践教学资金投入U_{132}和实习实践基地U_{122}所占的权重较大，这也是实践教学的特征所决定的。

（二）构成要素分析

由表2可知，认为实践教学资源现状在优秀水平以上的受访者比率可占到60.66%。从二级指标教

学组成要素评价值分析得出，各高校实践教育经费、师资等的投入力度基本满足评价主体需要，而对提供的实践教学材料评价值相对较低，分析原因可能是由于甘肃省高校地处欠发达地区，不够重视社会实践教材与传统教学材料间的互补性。在四个影响维度中，认为甘肃省艺术设计专业硕士实践教学过程“一般”（0.0579）或“待加强”（0.0318）的评价值最为显著。多个评价主体对实践教学成效的评价得分低于实践教学质量综合水平，“特优”与“优秀”的评分人数比例占58.80%，认为要提高教学质量，必须重视教学产出的改进。这是由于目前高校实践教学对学生实践技能掌握程度的评定主体是教师，导致缺少听取学生意见有效的反馈。

（三）评价结果总体分析

由表3可知，甘肃省高校艺术设计专业硕士实践教学质量最终得分为3.7979，根据评价等级分类表可知其属于良好水平。其中，对实践教学资源评价和实践教学管理的评价值均高于综合评价值，可见，受访者对甘肃省各高校艺术设计专业实践教学流程中的资源投入和管理制度落实认可度较高。而实践教学过程、实践教学成效综合评价相较于教学质量评价综合水平稍有降低，说明该地区在提升实践教学质量时可以着重从这两方面对具体措施做出改进。

结语

本研究利用CDIO教育模式理念与艺术设计实践课的契合，基于艺术设计的学科特点建立的实践教学质量的模糊评判模型，将学、管、用等三类教学参与者纳入评价主体，兼顾各类相关者的认识和诉求以及综合评价活动中复杂的实际决策情境，使评价更具客观性。其次，本文经研究发现，从教学资源、管理、过程和成效四维度构成全周期闭环测定方法，能全面反映出实践课程的教学成效，具有较高的科学性，可推广应用于其他类型高校设计艺术实践课程的质量评价。

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测绘工程专业摄影测量学课程教学改革探讨

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摘　要：针对测绘工程专业摄影测量学课程教学中普遍存在的问题，进行课程教学改革探索，总结摄影测量学的理论框架和特点，主要从完善课程理论框架、加强实践教学环节和创新教学模式 3 个方面进行教改实践，取得良好的教学效果，对摄影测量学的教学具有指导意义。

关键词：摄影测量学；教学改革；模式
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作为大面积采集地物数据信息的重要技术，摄影测量在许多领域得到广泛的应用，《摄影测量学》课程也成为我国各高等院校面向测绘工程、遥感科学与技术等相关专业开设的一门专业基础课程[1]。由于摄影测量学的教学涉及大量的影像信息表达，尤其强调空间变换的思维过程，其课堂讲授的理论极为抽象，逻辑又非常严密，而且包含大量的实践环节，因此对于开设与空间信息相关课程较少的测绘工程专业学生来说，普遍反映该课程学习相对困难，对基本概念、基本原理和方法等理解不深。特别是近年来，随着各计算机技术、空间信息技术与模式识别等多种新兴技术的迅猛发展，摄影测量逐步摆脱了传统仪器的束缚，已进入数字摄影测量的实用阶段[2]，而高校测绘工程专业的《摄影测量学》课程从课程体系结构、教材、实习等各个环节都落后于现代摄影测量技术的发展。因此，如何在新形势下从课程的理论体系结构、实践教学及创新教学模式等方面进行改革，是一个值得深入探讨的问题。

1　课程理论框架与特点

传统的摄影测量学是利用光学摄影机获取相片，通过相片来研究和确定被测物体的形状、大小、位置和相互关系的一门科学。它包含的内容有：获取被摄物体的影像，研究单张和多张相片影像的处理方法，包括理论、设备和技术等。它的主要任务是测制各种比例尺的地形图、建立地形数据库[3]，其核心任务是将像方的像点坐标（x,y）转换为物方的大地测量坐标（X，Y，Z）。基于摄影测量学的涵义和任务，将课程的基本内容也划分为摄影和测量 2 个部分。摄影就是利用摄影相机获取符合要求的地面目标的构象；测量就是基于一定的算法将像点的坐标解算为对应的地面点坐标，包括像点的判读、量测和解析数据处理，其中解析数据处理是摄影测量的难点，主要包括 3 个方面的内容：单张相片的解析；立体像对的解析；多张相片的解析。《摄影测量学》的整体理论框架如图 1 所示。

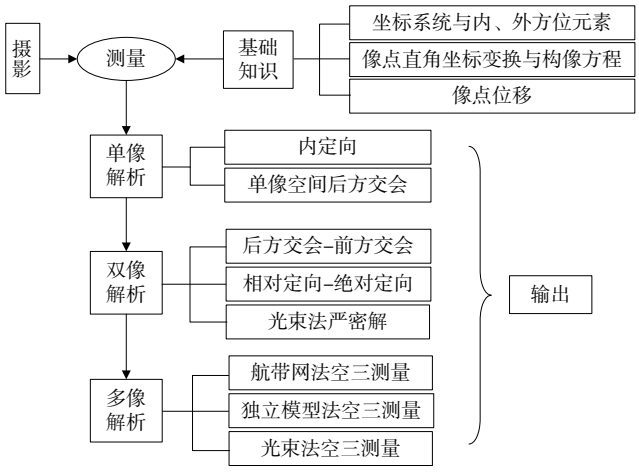

图 1　课程理论框架

摄影测量的特点是对影像进行量测和解译等处理[4]，该课程讲授中涉及一系列抽象的理论和严密的数学公式推导，其基本特点可概括为以下几个方面：

1）基本概念多，理论抽象，数学公式推导严密。课程涉及较多的基本概念，如内、外方位元素、相对定向、绝对定向、空间后方交会、前方交会、光束法、空三加密等，其理论的抽象性较强；并且有大量数学方程，如中心构像方程、共面条件方程等，这些数学公式的推导需要具备扎实的高等数学、线性代数、测量平差等知识做铺垫。因而要讲好该课程，对授课教师的要求也较高。

2）空间坐标系多，相互转换较为复杂。摄影测量的实质是将像点的平面坐标解算为对应地面点的三维

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坐标，因而涉及多个不同空间直角坐标系的转换，如像平面坐标系、像空间坐标系、像空间辅助坐标系、摄影测量坐标系以及大地测量坐标系等，像点在这些空间坐标系中的转换关系较为复杂。

3）学科交叉，新技术发展迅速，知识更新快。由于摄影测量是一门多学科相互交融的学科，是影像信息学的重要组成部分[5]。课程内容涉及计算机图形学、人工智能、模式识别，需要数学、物理等学科知识的综合应用，因此知识面广，且前后衔接紧密。尤其是进入 21 世纪，随着各种新型传感器及相关技术的进步，如传感器技术、机载 POS、无人机低空摄影测量、机载 LiDAR 以及与之相适应的数据处理技术等，进一步拓展和完善了全数字摄影测量的应用范畴，新技术的发展在很大程度上影响着高等院校测绘工程专业《摄影测量学》课程的教学。

2　传统教学中存在的问题

摄影测量学作为测绘工程专业的一门主干课程，该课程知识覆盖面广、内容多，又受到学时所限，授课时间较短，给教师教学和学生学习都增加了难度。目前在教学过程中普遍存在以下几个方面的问题 ：

1）课程理论框架方面，知识体系不完善。测绘工程专业大多采用的是传统摄影测量学教材，虽然也出版了一些相关教材，但是大多偏重于对摄影测量基本原理的阐述，过于偏重对传统摄影测量理论的讲解，部分章节内容已过时，尤其缺乏现代摄影测量新技术，知识体系不够完整。

2）与先修课程内容脱节，理论教学内容繁重。由于测绘工程专业的特点，开设摄影测量先修课程较少，使得教学中一些知识点必须重复讲授，导致理论教学内容繁重，而且教学效果不好。

3）教学环节上，重理论轻实践。当今摄影测量已步入全数字时代，需要将数字图像处理、模式识别和人工智能以及计算机视觉等理论引入到摄影测量学的教学内容中。然而对测绘工程专业，部分高校教师仍然偏重传统理论的讲授，对前沿技术的讲解较少。

4）实践环节，缺乏直观性。在实践环节，主要安排一些简单的编程来实现一些算法，但都是一些简单的函数或公式的计算，程序人机交互性差。在数字摄影测量商业软件 Virtuozo 的教学练习中，该软件虽然操作便捷、流程相对简单，但软件封装性太强，一些原理和流程隐藏于后台，在具体操作时看不到，缺乏透明度和直观性，给学生理论知识的熟悉和巩固带来一定的障碍。

3　教学改革探索与实践

教学改革的目的是为了提高教学质量、提高学生学习的兴趣、培养动手能力和创新能力。为此，需要从以下几个方面进行教学改革探索 ：

1）与先修课程全面整合，完善课程体系框架。我校测绘工程专业的培养计划中，摄影测量学先修课程中没有摄影测量基础课程，且总学时只有 48 学时，不能满足教学要求。因此必须考虑与该课程相关的先修课程之间的关系，合理安排教学内容，如图 2。

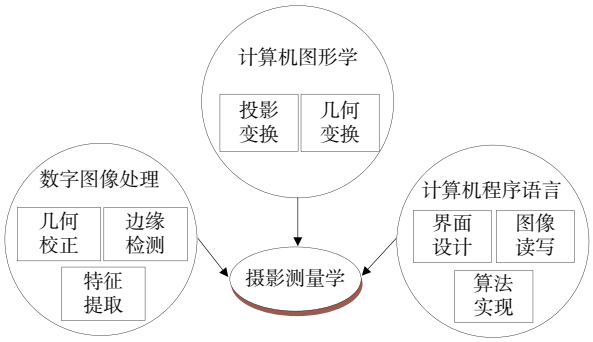

图 2　摄影测量与先修课程之间的关系

在学习摄影测量学之前，应先修计算机程序语言、计算机图形学以及数字图像处理等课程，通过计算机程序语言课程的学习，使学生掌握与该课程有关的图形界面设计、图像的读写以及一些简单函数、坐标系统的程序编写知识，为该课程的编程和软件学习打基础 ；通过计算机图形学课程的学习，熟悉坐标系统之间的变换、掌握透视投影与平行投影间的变换和联系，为该课程基本理论的学习作铺垫 ；通过数字图像处理课程的学习，可以掌握常用点特征、面特征的检测与提取方法，以及图像的几何校正等，为后续《摄影测量学》课程的学习打下坚实的基础，降低《摄影测量学》课程的讲授难度，减小由于课时限制带来的压力。

目前，基于当代信息技术的全数字摄影测量已彻底淘汰了传统的摄影测量仪器[6]。现代摄影测量技术的发展对传统摄影测量学的课程教学提出了更高的要求。为适应目前摄影测量新技术的发展和课程教学的需要，摄影测量教师必须注重自身的知识更新，精心备课，从基本概念和原理出发，从复杂而庞大的知识体系中理出一条学习该课程理论的主线，讲授中紧紧围绕这条主线和知识框架体系，突出重点内容，同时，要鼓励学生独立思考，有意培养学生发现问题、分析问题和解决问题的能力。

2）理论联系实际，建立合理的实验教学体系。摄影测量学是一门实践性很强的专业课，必须做到理论联系实际，注重课程实践环节的教学。在课程实践环节，

设计了课内实验和课程设计 2 个环节（如图 3），内容安排上充分考虑学习的难度与综合性，尽量符合学生循序渐进的学习过程。

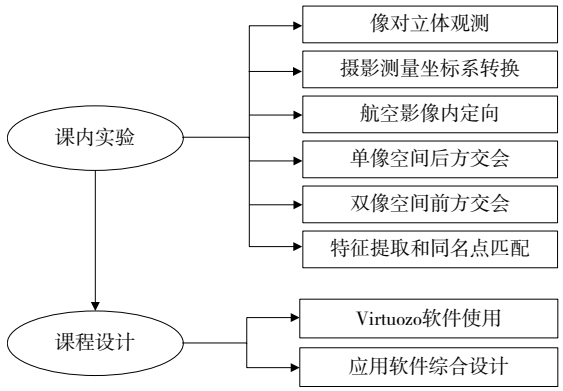

图 3　课程实践环节教学体系

课内实验包括 6 项，分别与课程理论学习进程相适应。其中，内定向、单像空间后方交会、双像空间前方交会、特征提取和同名点匹配 4 个实验要求学生编程实现，也就是利用所学计算机编程知识，采用简单的函数或模块实现摄影测量学中复杂数学公式的计算过程，目的是让学生将书本公式转换为编程语句，用数据流方式可视化地得出计算结果，加深对数字摄影测量的理解，增强学习的乐趣和主动性。

课程设计主要安排在课程学习结束之后的 2 周内集中进行，主要内容安排 Virtuozo 软件使用和应用软件综合设计。Virtuozo 软件使用要求学生完成从数据的准备到 4D 产品的生成全过程，主要包括测区参数设置、内定向、相对定向、核线匹配、DEM 与 DOM 以及等高线的生成、数字化测图、拼接和出图等工作。由于在课内实验环节已经掌握了关键理论的编程实现过程，在用 Virtuozo 进行数据生产时，不仅很容易掌握软件的各种操作，而且能理解各功能处理中数据计算过程，大大加深对该软件的熟练程度。应用软件综合设计是要求学生在课内实验编程的基础上，模仿 Virtuozo 商用软件的人机交互界面，丰富和完善自己编写的程序功能。该环节能帮助学生形成良好的编程思维。

3）创新课堂教学模式，激发学生的学习潜能。创新教学模式改革就是要把传统的以教师为中心、以“讲授”为主的教学方法和组织形式，转变为以“学”为主的教学模式[7]。为激发学生的学习热情，结合摄影测量学的教学与科研现状，经常给学生介绍一些学科的最新发展动态，交流课题组的研究成果和心得体会，培养学生自主学习的激情和求知欲望。同时为加强理论联系实际，解决教育资源稀缺问题，通过建立校企合作的实习基地，为学生提前接触工程与实际生产提供良好的实践平台，既可实现校企之间教学科研的良性互动，也激发学生的学习兴趣，使他们学会学习，主动学习，从中体验学习的快乐。

4　结　语

《摄影测量学》是一门理论与实践并重的课程，尤其是对测绘工程专业来说，该课程教改的探索和实践，对于培养学生扎实的摄影测量技能，贯通理论学习到实践应用的全过程具有非常重要的意义，为培养社会需要的创新型人才探索出一条行之有效的教学方法，对摄影测量学的教学具有指导意义。

本文结合我校测绘工程专业实际情况和当代摄影测量学的发展趋势，在总结摄影测量学的理论框架与特点的基础上，分析目前该课程教学中存在的主要问题，重点从完善课程理论框架、加强实践教学环节和创新教学模式 3 个方面进行了教学改革探索，并在实际教学中得到有效实施，不仅使教学更适应创新教育的要求，而且激发了学生自主学习的热情和求知欲望，取得良好的教学效果。

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地理学基地班专业课双语或外语教学的探索与实践

杨太保　于永涛　郭万钦　曾　彪　马俊飞　谢爱良　王　凤*

摘　要　国家理科基础科学研究和教学人才培养基地是国家为加强基础理论高水平人才培养采取的重大举措。在人才基地中如何进行双语教学，提高基地人才培养的水平和国际竞争力，是一个需要探索和完善的课题。本文简要介绍了兰州大学地理系基地双语教学的理念探索与教学实践。

关键词　地理学基地班　人才培养　双语教学　外语教学

兰州大学地理学科的形成可以追溯到1946年地理系的成立。1952年院系调整后，国家在兰州大学设立自然地理学专业。从1952年至20世纪80年代，可以说是兰州大学地理学科的初创和形成时期。20世纪80年代至90年代是地理学科发展和现代地理科学基础奠定的时期，这一时期以李吉均院士为代表的学术带头人把地理学科真正引入到现代地理学科的前沿，在研究青藏高原、黄土高原、干旱区地理、东亚季风系统、西部人地关系等方面具有国际学术界公认的优势和特色。20世纪90年代，兰州大学地理系进入了快速和全面发展的时期，在李吉均院士领导下，不仅在学术思想，而且在科学研究手段和学术研究组织上都进入了快速与国际接轨的时期。这一时期，国家考虑区域布局和兰州大学地理学科的实力，兰州大学地理科学系在1991年被教育部首批批准为"国家理科基础科学研究与教学人才培养基地"，当时是我国地理科学的第一个人才培养基地。以此为开端，兰州大学地理学科作为我国地理生态环境的教学研究中心逐步形成。1995年，兰州大学地理科学系发起成立了联合中科院和甘肃省的"西部资源科学研究中心"；1997年兰州大学地理学科进入"211"重点建设学科行列；1998年，设立了地理系博士后流动站；2000年兰州大学地理学科进入一级学科博士点，同年批准设立了教育部西部环境重点实验室和国家自然科学基金委员会与德国基金会联合成立的"中德干旱环境联合研究中心"(挂靠兰州大学)；2001年教育部西部资源环境网上合作交流研究中心在兰州大学正式挂牌，同年自然地理学成为国家级重点学科。因此，20世纪90年代是兰州大学地理学科全面和快速发展的时期，已经初步形成了国家的地理生态环境教学和研究的中心。

进入21世纪，兰州大学地理科学的发展目标是把兰州大学地理学科建设成为在国际上有影响的地理生态环境研究中心，这一过程实际已经开始，多年来李吉均院士始终瞄准国际科学发展的前沿，强调与各国科学家的合作，提高中国科学家的世界影响。多年来，先后与英、德、美、法、日、俄、比等十多个国家开展了广泛的学术交流和合作，以我校为主在兰州等地举办了多次国际学术会议，多人在国际学术组织中任职，并且与德国联合成立了"中德干旱环境研究中心"。表明

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资助项目　教育部世行贷款21世纪高等教育教学改革项目(1282B05031)。

在国际化的科学研究中，兰州大学地理学科取得了初步的成绩。鉴于兰州大学地理科学系地处我国三大自然区的交汇地带，多年来的学术领域，如青藏高原隆升与环境效应、干旱区环境演变、季风气候历史的地质记录等方面也是近年来国际地学热点，对全球环境变化研究具有重大的意义。因此，有条件也有必要把兰州大学地理学科建成国际学术中心作为新世纪的目标，全方位、深层次与国际科学研究潮流接轨，为此必须为人才培养提出新的更高的要求。

把兰州大学地理学科建成新世纪国际地理生态教学和科学研究中心，必须要求人才培养的高水平和较强的国际竞争力，其中重要的因素之一则是在提高学术水平的同时，提高学术交流和合作的层次和水平，其中提高专业外语水平已经是相当紧迫的任务。

教育部 2001 年 8 月 28 日印发了《关于加强高等学校本科教学工作提高教学质量的若干意见》的通知，提出为适应经济全球化和科技革命的挑战，本科教育要创造条件使用英语等外语进行公共课和专业课教学，明确对本科教育提倡双语教学。如果说，教育部提倡的双语教学是面向所有本科教育层次的话，那么作为国家理科基础科学研究和教学人才培养基地的本科层次教育如何进行双语教学，则应当有更高的要求和目标。

国家理科基础科学研究和人才培养基地的培养目标基本定位是为国家在基础科学领域培养未来的研究和教学人才，是高水平人才，随着我国经济和科学的全球化进程，这些人必须具备较强的国际竞争力，在未来若干年内他们中有相当一部分人应成为国际学术带头人，因此对他们除了较多的人文素质和专业素质要求外，还要求他们应该具备更高的国际交往素质，当然外语水平只是这种素质中一种基本素质。

在基地班中进行双语教学，其主要目的是：解决教材内容老化问题，加快知识更新速度，教学和科研与国际接轨，提高学生的外语应用和专业交流能力。具体做法是：

1. 鼓励专业课采用外文原版教材，外语教学或双语教学。在这里特别强调使用外文原版教材为主，适当增加中国区域特色的教学内容。这主要是考虑到一些外文原版教材，大多经过了多年的教学实践检验，内容全面、科学，在国际上影响大，如由康奈尔大学 Myle C· brady 等主编的土壤学教材《The Nature and Properties of Soils》从 1922 年首版至 1999 年已出版第 12 版，目前第 13 版也已出版。在国际土壤地理教育中享有极高声望。由 A· N· Strahler 和 A· H· Strathler 编著的《Elements of Physical Geography》也多次再版，是自然地理学的经典教科书。由于这些教材更新再版周期短，又有长期的教学理念和传统，又在国际同类学科的教学中广泛使用，因此是我们已引进和使用原版教材的首选。其次由于地理科学是一个区域性很强的科学，因此在引进原版教材的同时，必须在教学上留出相当的时间将中国区域特色的内容贯穿进去。在双语教学或外语教学中，反对形式化，强调质量，不鼓励“中文教材，外语讲授”的做法。

2. 聘请外籍教师进行专业课堂教学。近年来，我系利用科研合作机会每年都聘请外教直接进行专业教学，收到了良好的效果。国外教授直接面对中国学生。对某一门专业课，采取国际教材，按照国外大学的教学惯例，进行教学。可以使学生不仅在专业上、外语上，而且在教学习惯和科学思维上都可以把外籍教师与中国教师做一个比较，开阔眼界，在比较中选择和提高，对学生大有益处。

3. 要求学生必须参加由国外学者讲演的学术报告。由于我系的国际合作初具规模，每年有 10～20 人次的国外学者来访，有些是国际知名学者，几乎每人来访都要面向我系师生作学术报告，因此对基地班做出规定，凡是由国外学者的学术报告，无论专业兴趣如何，都要参加，并且每年作为课程进行管理（地理学前沿讲座），目的是使学生尽快熟悉国际学术领域，同时也是外语教学的最好和最为有效的方式之一。

4. 组织中外联合实习。从 2001 年开始每年组织基地班学生与柏林自由大学本科学生，由两校教师带队，进行联合野外实习。实践证明，学生在短短的 2～3 周实习中，专业水平和外语交流

水平大大提高，是进行双语或外语教学的最有效的形式之一。

5. 让基地班高年级学生参与教师的科研工作，特别是有国际合作的教师的科研活动，可以直接为本科生提供专业和外语的锻炼和提高机会，对此要对教师提出要求，尽量吸收学生参与国际交流和合作，让他们不仅在外语、专业而且在科研合作组织、实践、协调等诸多方面均得到实践机会。

以上是兰州大学地理学科基地班在双语教学或外语教学过程中的一些做法。总之，双语教学或外语教学是以培养学生的外语、专业以及国际交流能力为核心的。因此在实践上，我们不仅重视课堂外语教学，强调质量，而且在其他学术活动方面，只要是有利于培养学生上述能力的都纳入双语或外语教学的环节。实践证明，双语或外语教学必须提倡全方位进行，必须避免形式主义，必须追求质量和效果，以培养能力为核心，努力形成双语或外语教学的环境和氛围，培养具有较强国际竞争力的新一代高水平人才。

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2. 考察和调整学籍管理中的相关规定。如对重修、试读和退学等的界定及适应性等方面给予考察和调整，保证人才培养的水平；再如对于重修成绩的登录，如一律以及格成绩登录，则不利于调动学生的学习积极性，从学生的心理发展角度考虑，特别是低年级学生，有时这样也会造成一些不良影响，如打击自信心等，造成学生培养上的被动。

3. 加强和规范助教工作，保证考试形式多样化的进行。实行考试形式多样化后，由于考试成绩中平时成绩比重加大，教师进行诸如批改作业、论文，组织讨论的工作量增大，特别是班级学生较多的情况更是如此，可考虑在政策管理上和实际操作中鼓励和加强研究生以及其他教辅人员参加助教工作。

4. 加强多样化考试中对教师的规范、约束与监督。实行考试形式多样化后，一些诸如论文报告、课堂讨论、口试等的考试形式会经常出现。在对这些考试进行评分时，教师的权利和主观性大大增加，要求教师要公正、严格，并且评分尺度掌握恰当。届时，可考虑通过诸如学生问卷调查，专家评估抽查以及加强教师职业道德教育等方面来达到规范、约束和监督目的。

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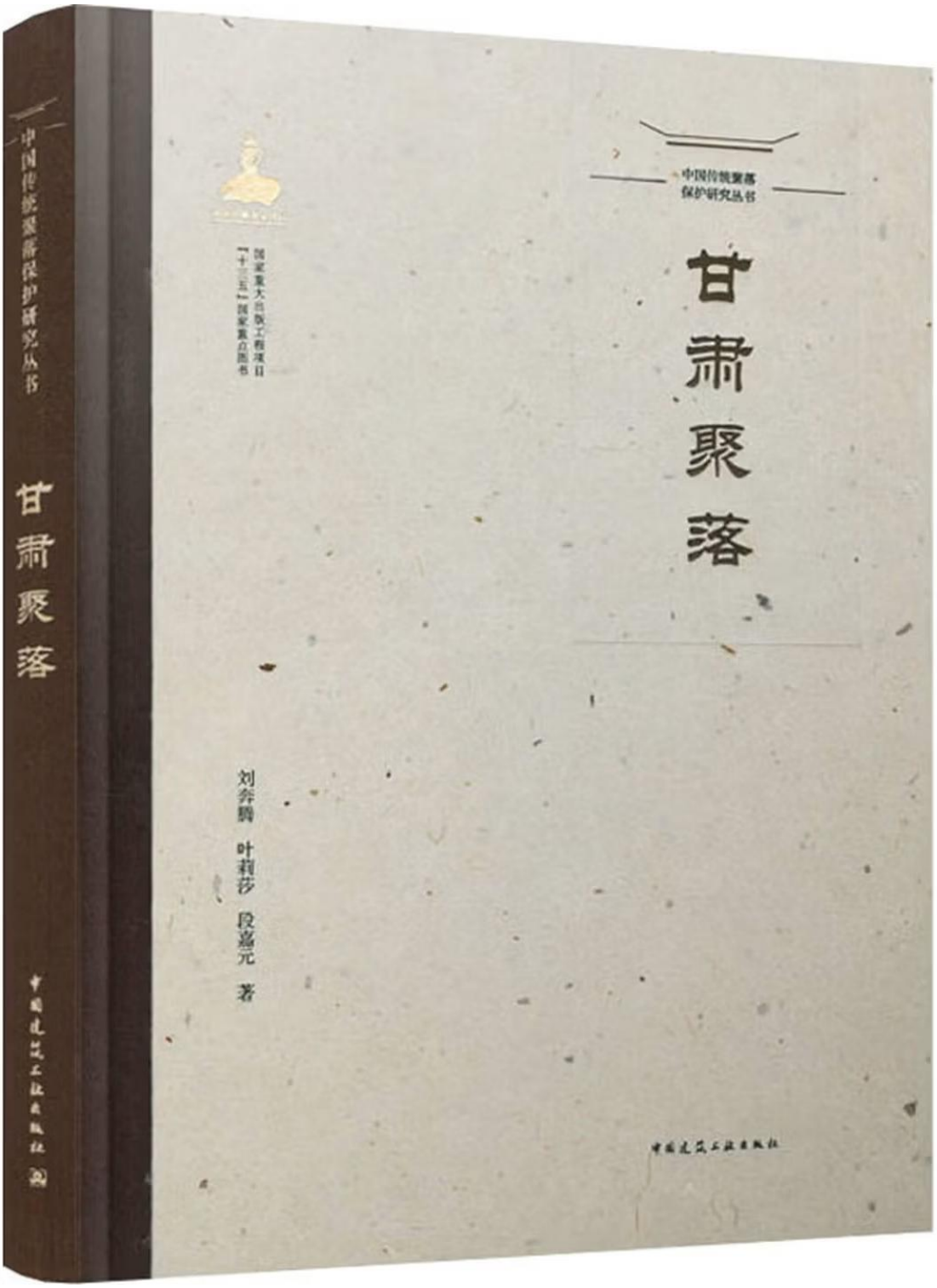
中国传统聚落保护研究丛书
甘肃聚落
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"十三五"国家重点图书
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保护研究丛书
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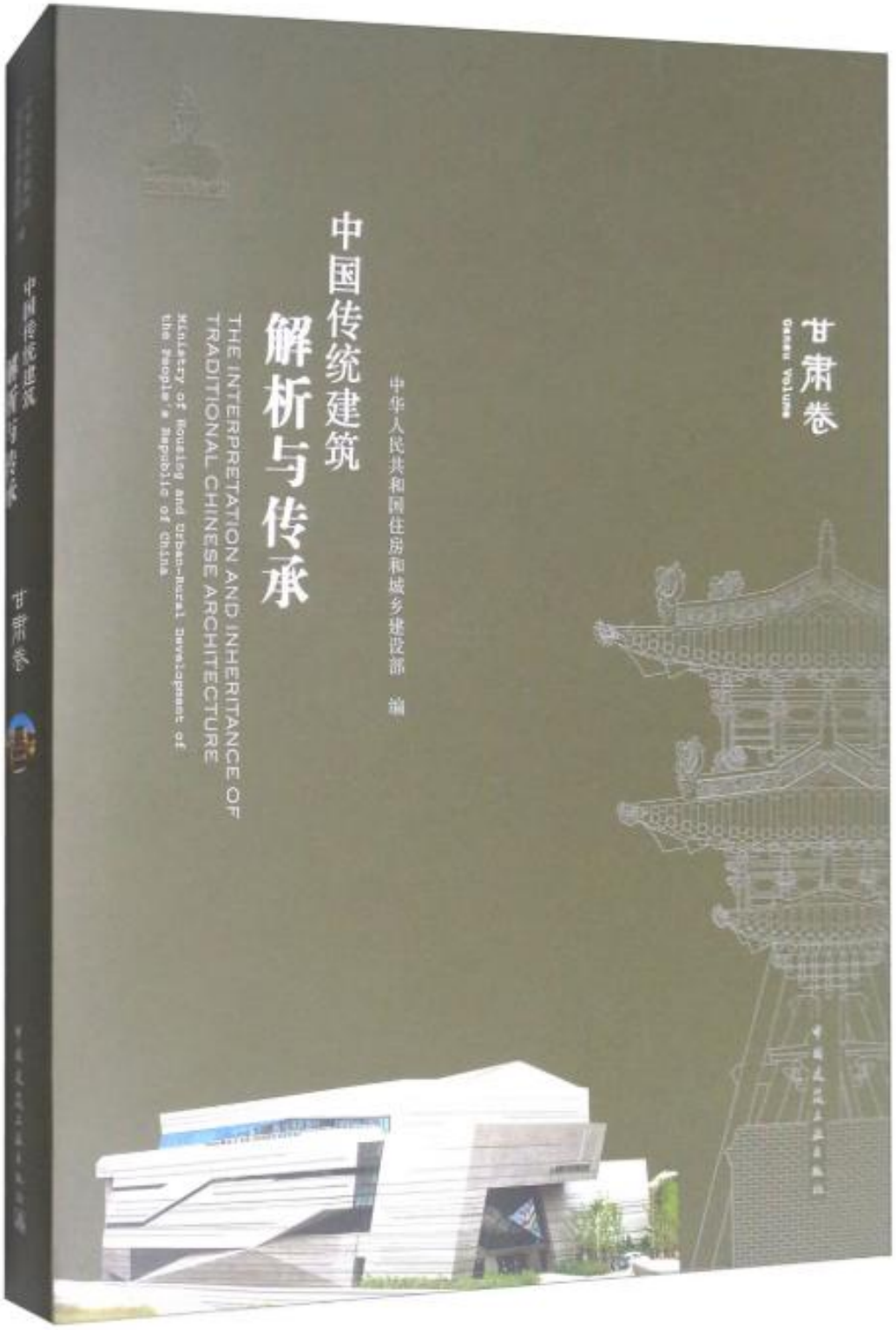
刘奔腾 叶莉莎 段嘉元 著
中国建筑工业出版社

《甘肃聚落》简介：

本书基于研究团队常年的实践积累，以地域文化视角对甘肃传统聚落进行了梳理、归纳和总结。从地理环境、历史文化及民族风俗入手探索了河西走廊、陇东、陇南、陇中、甘南五个地区传统聚落的风貌特征、生成因素和构成规律。依照市、镇和村三种聚落类型的差异，分别遴选五个地区的典型聚落展开案例研究。挖掘了甘肃不同地域传统聚落营建技艺的典型性与差异性，揭示了传统聚落物质空间与非物质文化的关联性。基于传统聚落的保存状况和发展情境，提出了甘肃传统聚落保护与传承的建议策略。本书建立在较为充分的一手调研资料上开展研究，涵盖了传统聚落的类型规整、价值甄别、机理构建和保护传承等内容。本书可供建筑、城乡规划、风景园林、人文地理、文物保护等相关专业的读者及文化旅游爱好者参考阅读。

目录：


中国传统建筑
解析与传承
THE INTERPRETATION AND INHERITANCE OF
TRADITIONAL CHINESE ARCHITECTURE
中华人民共和国住房和城乡建设部 编
甘肃卷
Gansu Volume

《中国传统建筑解析与传承》简介：

《中国传统建筑解析与传承：甘肃卷》通过对甘肃地域五个片区的传统建筑的梳理，整理出甘肃省传统建筑多元融合的特征。并通过对现代建筑的调查，呈现交融的文化、建筑的形式和新生的事物。对当下现代建筑对传统建筑的传承具有十分重要的意义和具有研究性的资料文献。

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二、材料演变之砖混木盖

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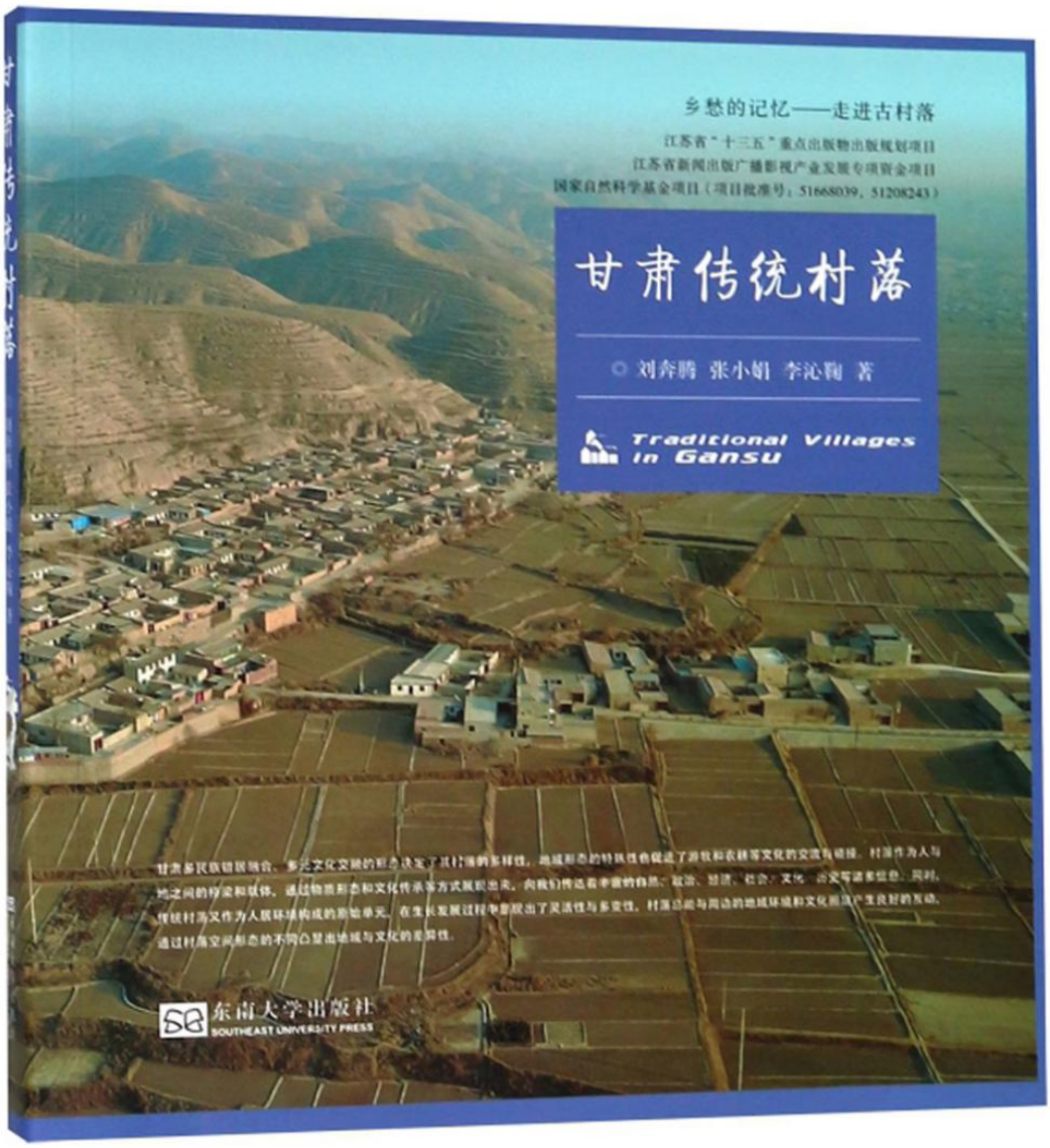
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Traditional Villages in Gansu
东南大学出版社
SOUTHEAST UNIVERSITY PRESS

《中国传统建筑解析与传承》简介：

《甘肃传统村落》按地域类型划分，以六盘山为界，将甘肃地域分为四个片区，即陇中地区、陇东南地区、甘南地区、河西地区。各个地区均囊括了大量的优秀传统村落，《甘肃传统村落》从各村落基本信息、选址和格局、传统建筑、非物质文化遗产、人居环境现状五个方面进行介绍。因地域差异和历史时期不同而形成的传统村落，受不同的环境因素、建造技艺等的影响，以及地域文化和民族宗教信仰等方面的差异，在空间结构和空间形态上各有特色。

陇中地区：陇中又称陇西高原，位于六盘山、陇山以西，秦岭以北，黄河以南，属于典型的黄土高原地貌。陇中地区属于周秦故地，关陇咽喉，自古胡汉杂居，历史地域文化特色十分鲜明。陇中主要包括定西市六县一区，兰州市之榆中县，白银市之会宁县、靖远县，天水市之武山县、甘谷县、秦安县，平凉市之静宁县。这些县域在历史、物产、气候、人情、风俗、语言、民族等方面，是一个文化板块，具有很大的相似性和包容性。

陇东南地区：陇东南是甘肃省人口相对密集，但经济发展和城市化水平偏低的地区。广义上包括庆阳、平凉、天水（秦州区、麦积区、清水县、张家川回族自治县）、陇南四市及其所属的 31 个县区。陇东南地区是我国古代文明的重要发源地，这一地区有着大量的史前考古学文化遗存，亦是周秦文化的重要发祥地。

甘南地区：甘南地区地处青藏高原和黄土高原过渡地带，境内山谷多，平地少，地势西高东低，位于黄河上游，在甘肃省中部西南面。甘南地区主要包括甘南藏族和临夏回族两个自治州，甘南是藏、汉文化的交汇带，被费孝通先生称为“青藏高原的窗口”和“藏族现代化的跳板”；临夏历史悠久，被誉为“中国的彩陶之乡”，同时也是唐蕃古道重镇，“茶马互市”中心，历代兵家必争之地，有“河湟重镇”之称。

河西地区：河西地区指张掖、武威、酒泉、嘉峪关，因位于黄河以西，自古称为河西，其地斜处祁连山与北部山系间，东南起自乌鞘岭，西北止于疏勒河下游，势成一狭长的天然走廊，亦称河西走廊，是中原地区通往西域的咽喉要道。

甘肃多民族错居融合、多元文化交融的形态决定了其村落的多样性，地域形态的特殊性也促进了游牧和农耕等文化的交流与碰撞。村落通过物质形态和文化传承等方式的展现，向我们传达了自然、经济、社会、文化、历史等诸多信息。同时，传统村落作为人居环境构成的原始单元，在生长发展过程中显现出了灵活性与多变性，通过村落空间形态的不同凸显出地域与文化的差异性。

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一、清水县贾川乡梅江村

二、秦州区天水镇庙坪村

三、秦州区天水镇天水村

四、麦积区麦积镇街亭村

五、麦积区新阳镇胡家大庄村

六、麦积区琥珀乡罗家村

七、麦积区三岔乡吴砦村

八、麦积区麦积镇永庆村

九、麦积区伯阳镇**村

十、麦积区花牛镇董沟村

第二节陇南市传统村落

一、两当县左家乡权坪村

二、康县平洛镇中寨村

三、康县岸门口镇朱家沟村

四、宕昌县两河乡王院村

五、宕昌县哈达铺镇上街村

六、宕昌县哈达铺镇下街村

七、宕昌县狮子乡东峪村

八、西和县兴隆乡下庙村

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十、文县铁楼乡强曲村

十一、文县碧口镇白果村郑家坪社

十二、礼县宽川镇火烧寨村

十三、礼县崖城镇父坪村

十四、成县黄渚镇柏湾村

十五、成县黄陈镇石榴村

第四章甘南地区传统村落


国家自然科学基金资助项目（项目批准号：51208243）
项目名称：基于历史空间信息系统的河西走廊传统村镇形态变迁研究
A PATTERN-RESEARCH ON
HISTORIC CULTURAL TOWNS & VILLAGES CONSERVATION
历史文化村镇
保护模式研究
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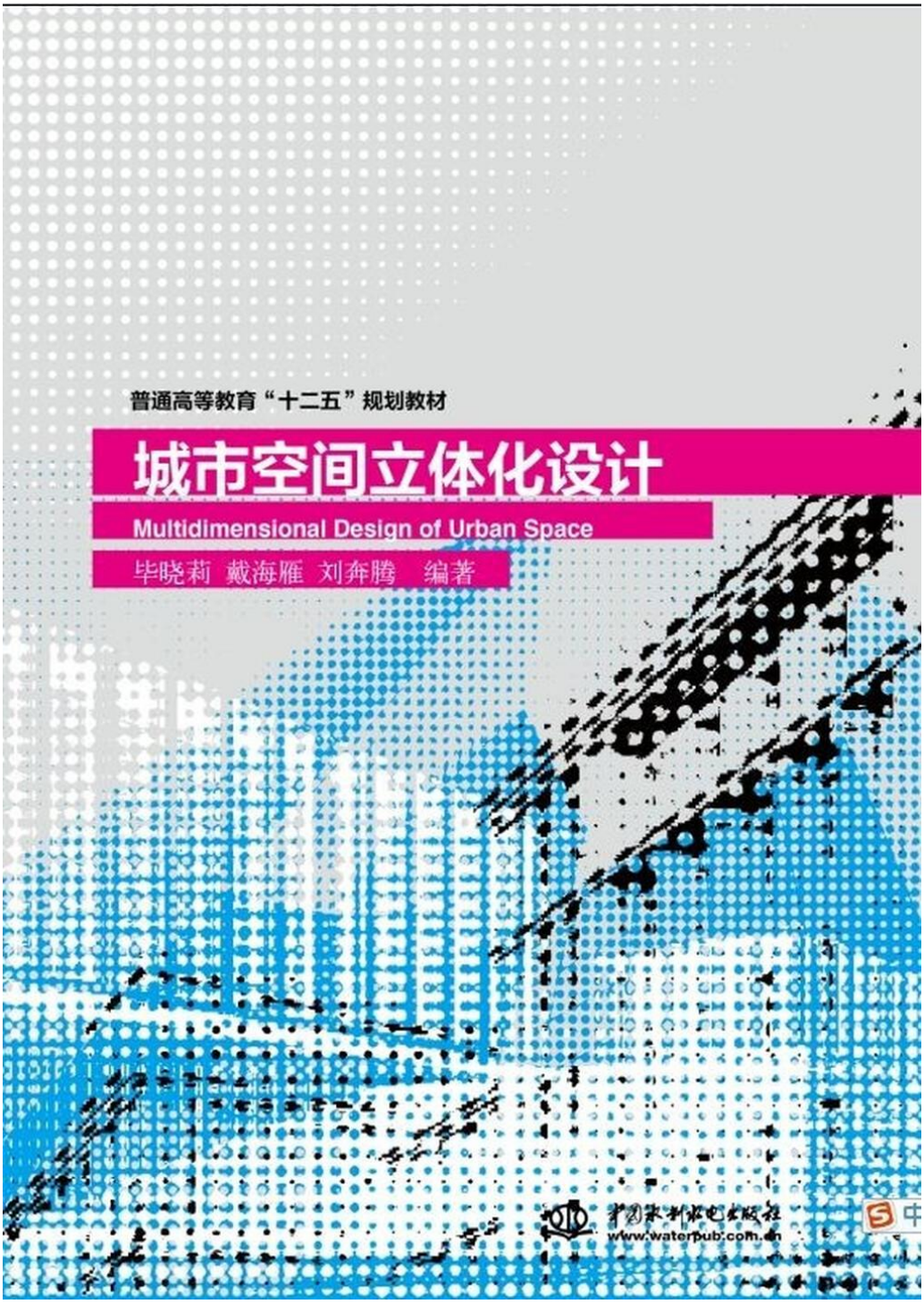
《历史文化村镇保护模式研究》简介：

《历史文化村镇保护模式研究》在系统分析我国历史文化村镇近三十多年来的保护历程的基础上，对当前社会转型时期江南历史文化村镇的保护工作所面临的困境进行了归纳总结。进而运用建筑学、经济学、社会学、管理学等方法动态地剖析了各社会群体在保护中的行为和动机，揭示了当前历史文化村镇保护问题产生的根源。并在此基础上，进一步探讨江南历史文化村镇保护的理论方法，以及社会环境和空间环境的特点，从而提出了具有中国特色的针对江南地区历史文化村镇的保护模式，并指出历史文化村镇保护之目标。

《历史文化村镇保护模式研究》从保护与发展这一辩证统一的关系角度，选取江南这一特定地域的历史村镇作为研究对象，通过分析社会经济发展与历史遗产保护的对立与统一，提出既有针对性又具有普遍借鉴意义的保护模式。强调对已有保护理论的再思考，旨在构建适宜中国村镇特色的保护理论与方法。

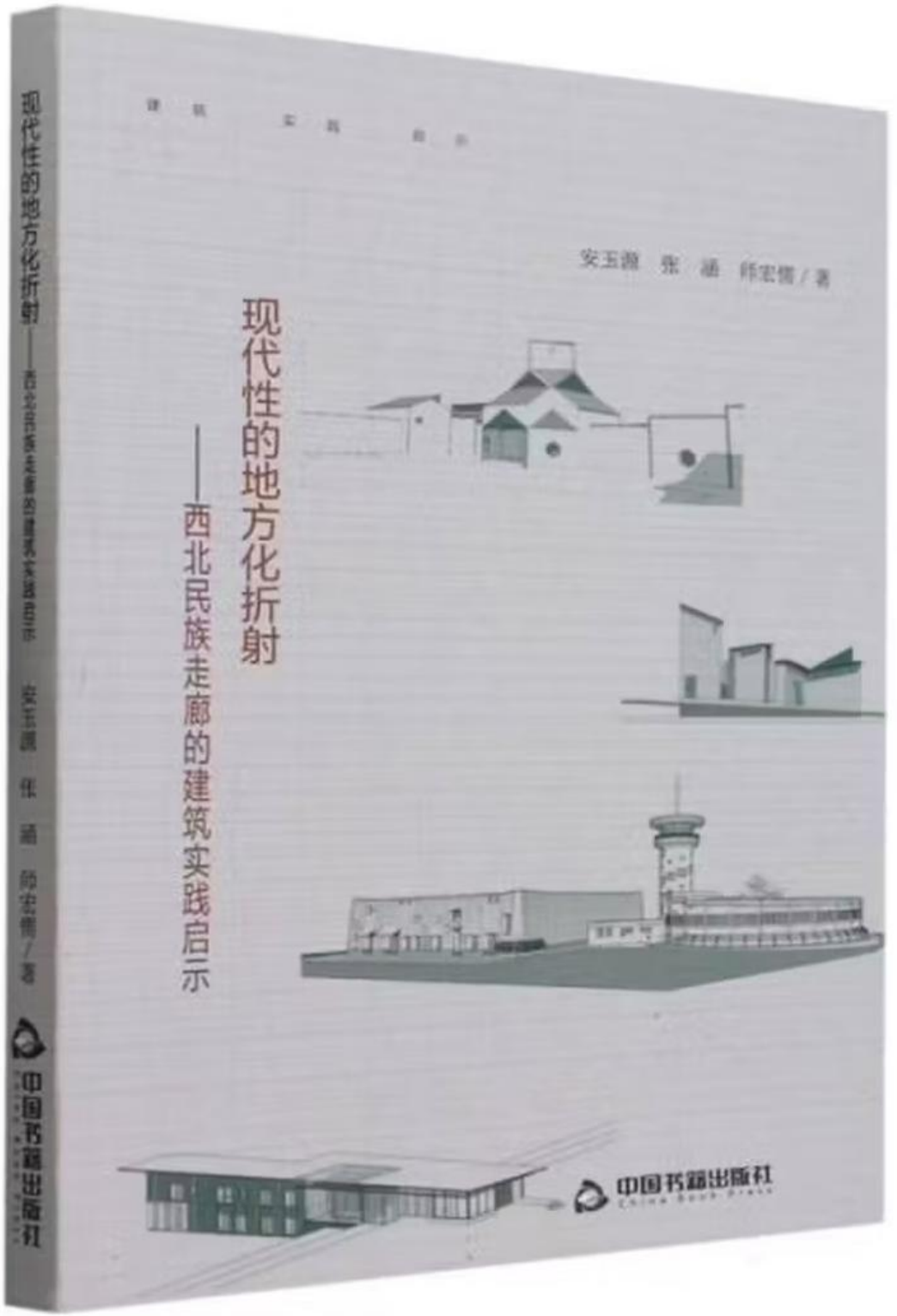
目录：



《城市空间立体化设计》简介

《城市空间立体化设计》共 8 个章，分别为绪论；城市空间立体化设计历史与现状；城市空间立体开发与城市安全；城市空间立体化设计与道路交通系统；城市空间立体化设计策略与方法；城市空间立体开发的国际宪章、国外法规、国内法规；兰州城市空间立体设计；重庆渝中半岛城市空间立体设计。尤其侧重于城市地下空间规划设计相关问题，力求从城市设计和建筑设计两个层面提出城市空间立体化设计的策略与方法。

2-10 现代性的地方化折射



《现代性的地方化折射—西北民族走廊的建筑实践启示》简介：

本书旨在聚焦于“现代性”与“地方性”这一对范畴，探讨建筑现代性中呈现的地方化折射思想。通过上篇地域时空下现代建筑地方性解读与批判，梳理 视野下现代建筑呈现的现代性之中交织地方性的思想。同时，通过下篇本土语境下的现代建筑地方性启示与实践，聚焦本土尤其西北地域实践下中国建筑的现代性融合地方性的探索，以期思考在当代西北本土建筑创作中，作为中国西北多民族共同体存续的典型——西北民族走廊的建筑实践启示。本书可供建筑专业学生、教师及建筑从业者、建筑爱好者借鉴、参考。

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33.在地建造——高黎贡手工造纸博物馆

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内 容 提 要

本书是交通版高等学校土木工程专业规划教材之一，全书共为16章，重点介绍基本理论、基本知识、基本技能。

第一～六章主要介绍测量学基础知识；第七章为小区域控制测量；第八章主要介绍现代测绘技术GNSS的原理及应用；第九章为大比例尺数字地形图测量；第十～十六章主要介绍土木工程专业各工程方向的应用测量技术。

本书可作为普通高等学校土木类、建筑类、水利类、农林类各专业教材，也可供相关工程技术人员的参考书。

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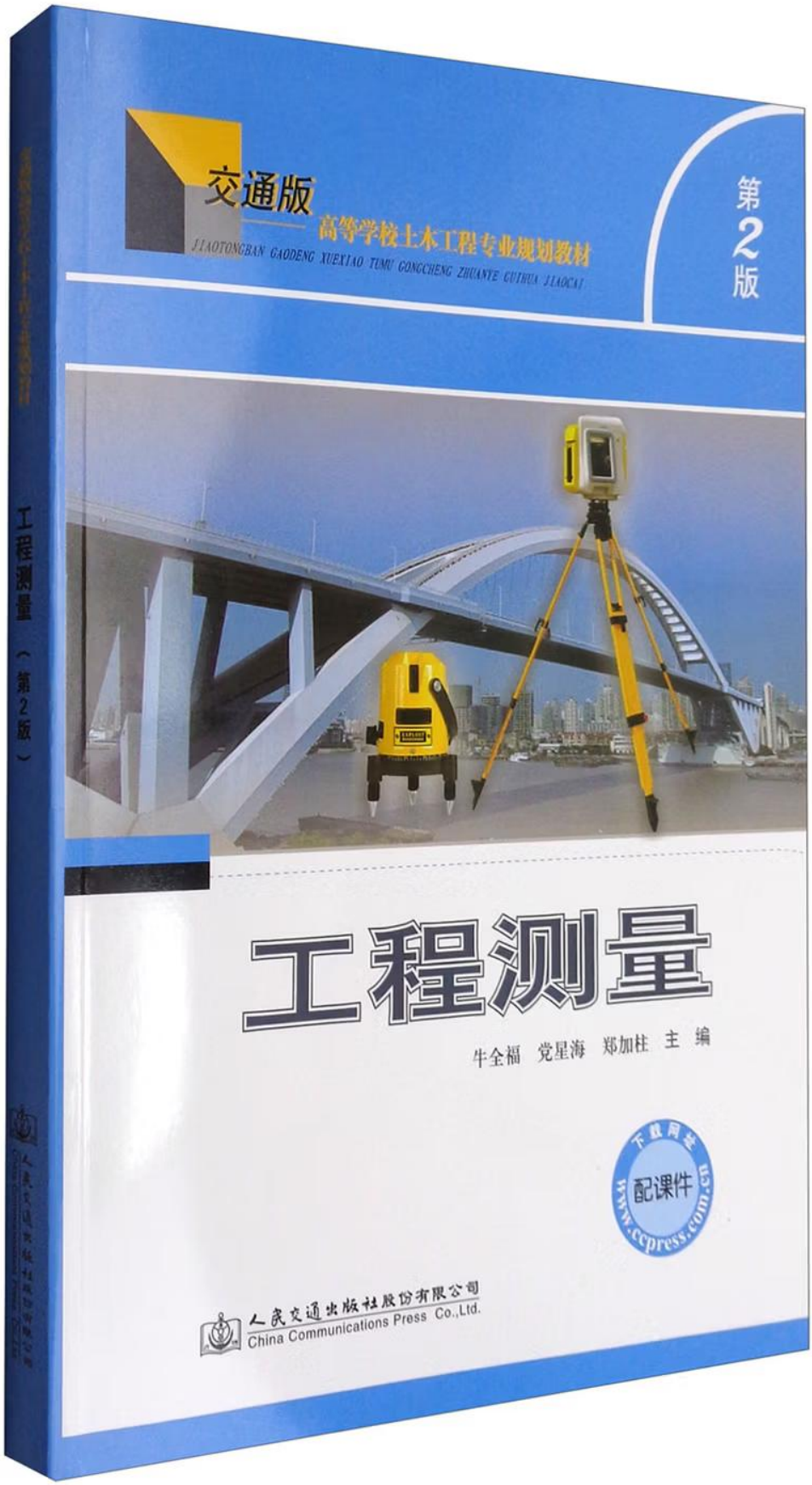
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工程测量（第2版）

《工程测量》简介：

《工程测量（第二版）》是交通版高等学校土木工程专业规划教材之一，《工程测量（第二版）》共为16章，**介绍基本理论、基本知识、基本技能。

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第二节光学经纬仪

第三节水平角测量

第四节竖直角测量

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第三节误差传播定律及应用

第四节等精度独立观测量的*可靠值与精度评定

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煤炭高等教育“十四五”规划教材

摄影测量学基础

林 卉 王志勇 主编

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Introduction to Photogrammetry

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本书编委会

高等教育“十二五”规划教材

数字摄影测量学

Shuzi Sheying Celiangxue

林　卉　王仁礼　主编

中国矿业大学出版社

内 容 简 介

本书系统介绍了数字摄影测量的理论基础、基本过程、基本算法以及数字摄影测量新技术等。全书分为两部分共十七章：第一部分为数字摄影测量理论基础，内容包括数字影像获取与处理基础、数字影像解析基础、影像的特征提取与定位、数字影像匹配、影像的自动定向、数字高程模型(DEM)采集与编辑、影像正射纠正与配准、数字摄影测量系统；第二部分为数字摄影测量的新发展，内容有线阵扫描影像摄影测量、雷达摄影测量、三维激光扫描数据处理、低空及近景摄影测量和高分辨率卫星航天摄影测量，每章附有思考题。全书力争用通俗易懂的语言来叙述相关内容，并对相关的理论与算法进行比较深入的分析和连贯的推导。全书既立足基础知识、基本原理与基本方法，又面向学科前沿、发展趋势，反映了当代数字摄影测量的新发展与新水平。

本书可作为摄影测量与遥感、遥感科学与技术、测绘工程、地理信息系统等专业本科生和研究生使用的教材，也可供有关影像获取与信息处理专业的师生、工程技术人员和研究人员参考。

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孙华生　朱　玉　孙小荣

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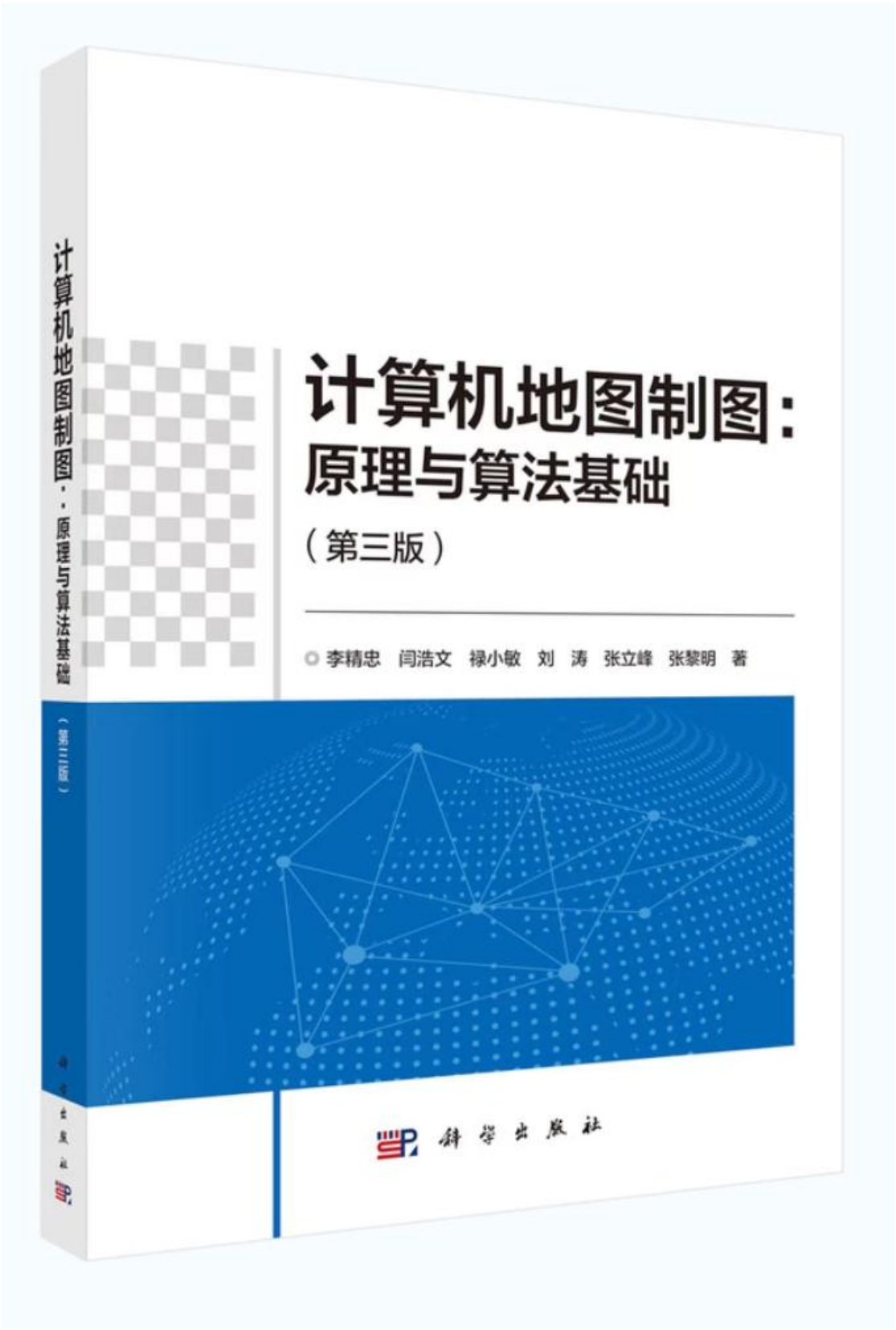
2-14 遥感原理与应用


普通高等教育“新工科”建设系列教材
遥感原理与应用
Principles and Applications of Remote Sensing
牛全福 王晓艳 张彦丽 编著

2-15 计算机制图制作原理与算法基础



01 内容简介

计算机地图制图（CAC）是地图学与地理信息系统学科的基础之一，旨在解决地理空间数据在媒介上的可视化问题。

本书分为9章：第1章绪论，讨论CAC的起源、基本过程和硬件设备；第2章介绍了CAC的理论基础；第3章讨论CAC的数据模型；第4章论述矢量数据处理算法；第5章介绍栅格数据处理算法；第6章介绍数字高程模型数据处理算法；第7章介绍网络地图制图；第8章介绍地图数据数字水印算法；第9章介绍计算机地图制图的软件及发展趋势。

本书的主要特点是突出算法实践，如拓扑生成、曲线光滑、地图综合等，结合经典理论与现代技术，兼顾软件工具与发展趋势，兼具理论深度与应用广度。

02 作者简介

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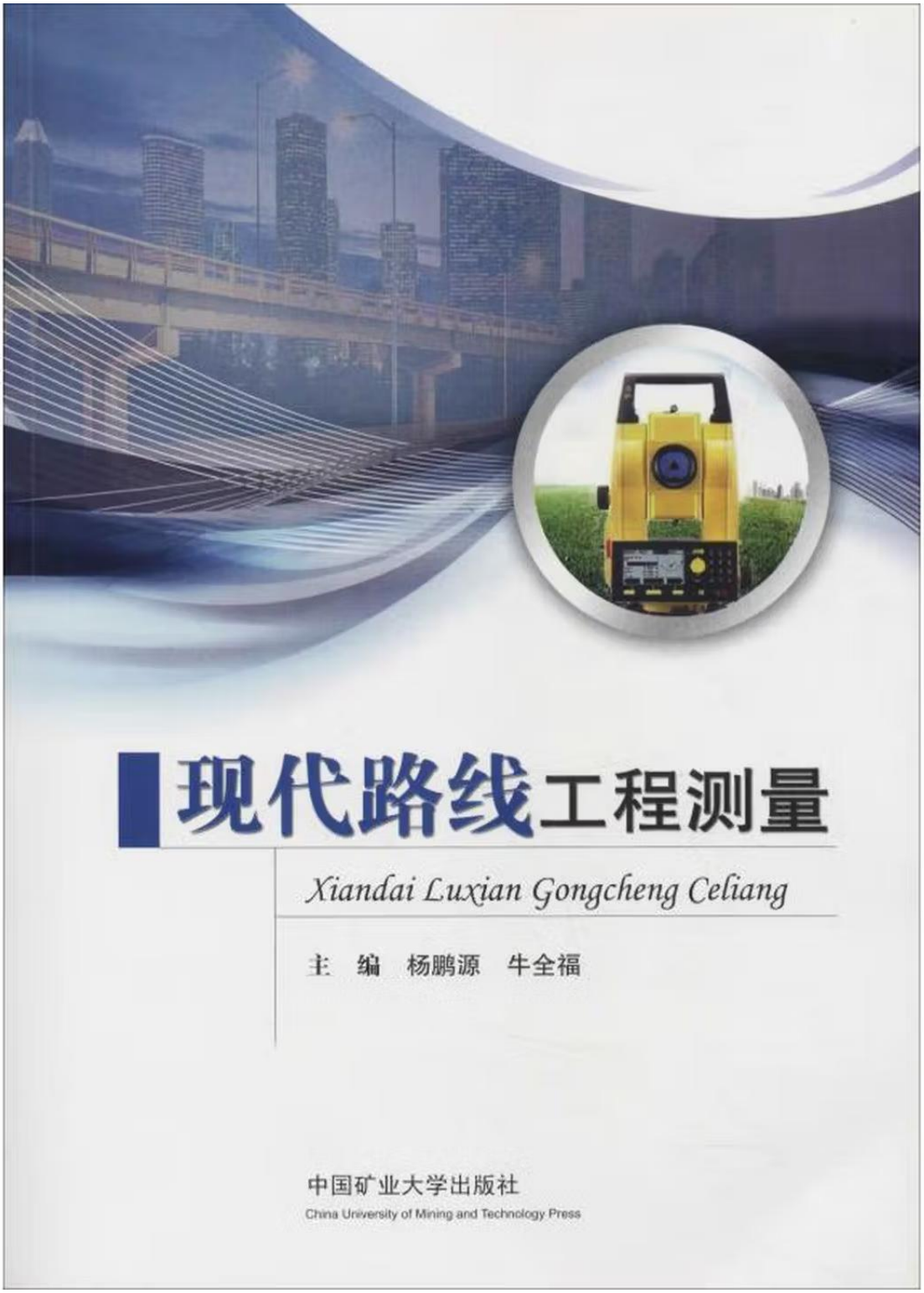
现代路线工程测量
Xiandai Luxian Gongcheng Celiang
主 编 杨鹏源 牛全福
中国矿业大学出版社
China University of Mining and Technology Press

《现代路线工程测量》简介：

《现代路线工程测量》共分十四章，内容包括：绪论、高程控制测量、角度测量、直线定向与距离测量、平面控制测量、GPS 技术在路线测量中的应用、大比例尺数字化地形图测绘、路线工程施工放样基本方法、路线中线测量、路线断面测量、道路施工测量、桥涵施工测量、管线工程测量、输电线路测量。全书既立足于测量学基础知识、基本原理、基本技术与基本方法，以理论为基础，以路线工程从勘测设计到施工验收为主线，又增加了现代测绘技术，如 GPS 技术和数字化测绘技术以及全站仪测量技术在路线工程测量中的应用。《现代路线工程测量》可作为高等学校土木工程、道路桥梁与渡河工程、给水排水科学工程、工程管理、建筑学、城市规划等专业的教材，也可供相关工程技术人员参考。

目录：

Research Article

Lifeng Zhang*, Hongyu Pu, Haowen Yan, Yi He*, Sheng Yao, Yali Zhang, Ling Ran, and Yi Chen

A landslide susceptibility assessment method based on auto-encoder improved deep belief network

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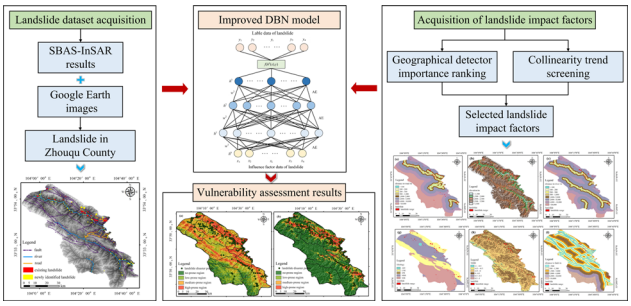
Abstract: The landslide susceptibility assessment is an essential part of landslide disaster risk identification and prevention. However, the binarization of the hidden layer limits the parameterization ability of the conditional probability of visible layer, making the training process of restricted Boltzmann machine more difficult and further limiting the accuracy and efficiency of deep belief network (DBN) model in landslide susceptibility assessment. Therefore, this study proposed a landslide susceptibility assessment method based on Auto-Encoder (AE)-modified DBN. Zhouqu County, Gansu Province in the People's Republic of China, was selected as the study area. Historical landslides in Zhouqu County were identified using small baseline subset interferometric synthetic aperture radar technology and optical image. Landslide factors were screened based on a geographical detector and stepwise regression method. The Logcosh loss function and determinant coefficient R^2 index were used to evaluate the training process of the AE model, and the balanced cross entropy loss function was used to evaluate the entire network training process. In addition, the area under the curve (AUC) of the synthetical index model (SIM), support vector machine (SVM), and multilayer perceptron (MLP) were compared and evaluated. The results indicated that the proposed model could significantly improve the accuracy of landslide susceptibility assessment. The AUC value of the proposed model was 0.31, 0.12, and 0.11 higher than that of SIM, SVM, and MLP, respectively. Therefore, the improved DBN model based on AE proposed is reliable for early landslide identification and prediction.



Graphical abstract

Keywords: landslide susceptibility assessment, InSAR, geographic detector, Auto-Encoder, deep belief network

1 Introduction

Zhouqu County is in the middle reaches of the Bailong River Basin. The Bailong River Basin is one of the four high-incidence areas of geological disasters in China. Wide-spread geological disasters, such as landslides and debris flows, are frequent, particularly in Zhouqu County. There are many mountain peaks in the region, with overlapping peaks. It is a typical structural and eroded mountain [1,2]. During the 1970s and 1990s, Zhouqu County experienced four large-scale debris flow disasters and two large-scale landslides (Xiliu slope landslide and Suoertou landslide) [3,4]. After the Wenchuan earthquake in 2008, landslide disasters in Zhouqu County became more frequent. For example, the landslide in Nanyu Township on July 12, 2018, caused the water level of the Bailong River to rise, washing away some roads. On July 19, 2019, the Yahuokou

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Hongyu Pu, Haowen Yan, Sheng Yao, Yali Zhang, Ling Ran, Yi Chen: Faculty of Geomatics, Lanzhou Jiaotong University, Lanzhou 730070, China; National-Local Joint Engineering Research Center of Technologies and Applications for National Geographic State Monitoring, Lanzhou 730070, China

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Research papers

LSTM time series NDVI prediction method incorporating climate elements: A case study of Yellow River Basin, China

Yan Guo [a,b,c], Lifeng Zhang [a,b,c,*], Yi He [a,b,c,*], Shengpeng Cao [a,b,c], Hongzhe Li [a,b,c], Ling Ran [a,b,c], Yujie Ding [a,b,c], Mikalai Filonchyk [a,b,c]

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ARTICLE INFO

Keywords:
NDVI time series prediction
Multivariate LSTM
Climate Elements
Deep Learning
Yellow River Basin

ABSTRACT

Accurate prediction of the trend of Normalized Difference Vegetation Index (NDVI) time series in the Yellow River Basin (YRB) is crucial for the assessment of the hydrological and ecological environment in this region. Currently, the NDVI time series prediction model is primarily based on traditional models and single-variable neural network models. Nevertheless, these models present challenges in considering the limitations of multiple factors, causing the NDVI time series prediction results to lack reliability. To predict NDVI time-series in the YRB of China, this study constructed a multilayer multivariate Long-Short Term Memory (LSTM) neural network model including climatic components. The initial important climatic elements in this region were identified using GeoDetector. Then, the relationship between NDVI and climatic factors in the YRB of China is established. Finally, numerical scale data are used to train and predict a multilayer multivariate LSTM model with climatic components. According to the results, the three-layer multivariate LSTM neural network NDVI time series prediction model developed in this study has the best performance among the evaluated indices. When compared to existing time series prediction models, the proposed model in this study takes into account the common constraint effect of various climate factors on NDVI. This leads to a significantly improved prediction accuracy, presenting new opportunities for enhancing the prediction model. By analyzing the NDVI time series prediction outcomes for the YRB, it has been determined that the ecological environment of the area will continuously improve in the future. This study offers significant technological and theoretical backing for assessing the hydrological and ecological environment of the YRB and comparable ecologically vulnerable regions in China.

1. Introduction

There exists a complex and interrelated link between hydrological processes and ecosystems (Gou et al., 2023). A comprehensive comprehension of this interaction is vital for the sustainable management of local water resources, the preservation of the health of ecological environments, and the adaptation to climate change (Pradhananga and Pomeroy, 2022; Chen et al., 2023a). The hydrological process entails numerous elements, including rainfall, evaporation, transpiration, and runoff. Ecosystems influence hydrological processes through plant transpiration, soil water retention, and water cycling (Xie et al., 2023; Pesántez et al., 2023). The most significant interdependence between the two is the effect on water resources (Pradhananga and Pomeroy, 2022; Pesántez et al., 2023). Consequently, the influence of hydrological processes on ecosystems is often portrayed through their effect on vegetation cover (Fang and Pomeroy, 2023). On this basis, the NDVI is considered the most useful indicator for measuring the coverage and growth status of surface vegetation in a given region (Xu et al., 2022). This contributes to a greater understanding of the link between hydrological processes and ecosystems. The monitoring and prediction of long-term NDVI changes can provide insights into the processes and future trends of vegetation change (Zhang et al., 2023a; Fu et al., 2022). This information facilitates a timely understanding of the vegetation cover of the regional hydrological and ecological environment, which in turn can help to develop appropriate measures to protect the environment and manage water resources (Rahman et al., 2022).

Located at the crossroads of arid, semi-arid and semi-humid regions in China, the YRB serves as an important ecological barrier and corridor

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Nonlinear effects of agricultural drought on vegetation productivity in the Yellow River Basin, China

Yujie Ding [a,b,c], Lifeng Zhang [a,b,c,*], Yi He [a,b,c,*], Shengpeng Cao [a,b,c], Andrei Gusev [d], Yan Guo [a,b,c], Ling Ran [a,b,c], Xiao Wei [a,b,c], Filonchyk Mikalai [a,b,c]

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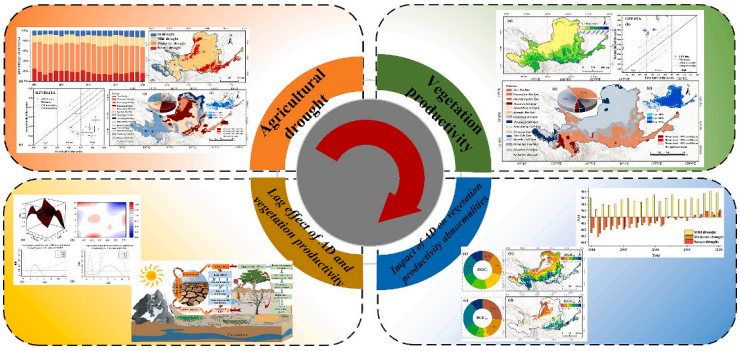
HIGHLIGHTS

- A new indicator (kTVDI) was developed for monitoring AD in the YRB.
- The nonlinear hysteresis effect of AD on VP was determined using DLNM in the YRB.
- The nonlinear effects of moderate and severe AD on VP were greatest at months 1 and 7.
- Forests can withstand longer and more severe AD than grasslands and croplands.

GRAPHICAL ABSTRACT



ARTICLE INFO

Editor: Fernando Pacheco

Keywords:
Kernel normalized drought vegetation index
Agricultural drought
Vegetation productivity
Lag nonlinear effect
Yellow River Basin

ABSTRACT

Agricultural drought (AD) is the main environmental factor affecting vegetation productivity (VP) in the Yellow River Basin (YRB). In recent years, the nonlinear effects of AD on VP in the YRB have attracted much attention. However, it is still unclear whether fluctuating AD will have complex nonlinear effects on VP in the YRB, and there are scant previous studies at large scale on whether there is a threshold for nonlinear effects of AD on VP in the YRB. Therefore, this study used a newly developed agricultural drought index to explore nonlinear effects on VP revealing the nonlinear effects of AD on VP in the YRB. First, we developed a kernel temperature vegetation drought index (kTVDI) based on kernel normalized difference vegetation index (kNDVI) and land surface temperature data to study the spatiotemporal variation of AD in the YRB. Second, we used GPP data from solar-induced chlorophyll fluorescence inversion as an indicator to explore the spatiotemporal variation of VP in the YRB. Finally, we used several statistical indicators and a distributed lag nonlinear model (DLNM) to analyze the nonlinear effect of AD on VP in the YRB. The results showed that AD decreased significantly during 2000–2020, mainly in the southeast of the Loess Plateau, while GPP increased significantly in 80.93 % of the YRB. Meanwhile, moderate and severe AD stress limited VP growth, with the negative effects gradually decreasing, while mild AD had an increasingly positive promoting effect on VP. AD stress resulted in a VP

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remote sensing

MDPI

Article

Spatial and Temporal Analyses of Vegetation Changes at Multiple Time Scales in the Qilian Mountains

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Abstract: The Qilian Mountains (QLMs), an important ecological protective barrier and major water resource connotation area in the Hexi Corridor region, have an important impact on ecological security in western China due to their ecological changes. However, most existing studies have investigated vegetation changes and their main driving forces in the QLMs on the basis of a single scale. Thus, the interactions among multiple environmental factors in the QLMs are still unclear. This study was based on normalised difference vegetation index (NDVI) data from 2000 to 2019. We systematically analysed the spatial and temporal characteristics of the QLMs at multiple time scales using trend analysis, ensemble empirical mode decomposition, Geodetector, and correlation analysis methods. At different time scales under single-factor and multi-factor interactions, we examined the mechanisms of the vegetation changes and their drivers. Our results showed that the vegetation in the QLMs showed a trend of overall improvement in 2000–2019, at a rate of 0.88×10^{-3}, mainly in the central western regions. The NDVI in the QLMs showed a short change cycle of 3 and 5 years and a long-term trend. Sunshine time and wind speed were the main drivers of the vegetation variation in the QLMs, followed by temperature. Precipitation affected the vegetation spatial variation within a certain altitude range. However, temperature and precipitation had stronger explanatory powers for the vegetation variation in the western QLMs than in the eastern part. Their interaction was the dominant factor in the regional differences in vegetation. The responses of the NDVI to temperature and precipitation were stronger in the long time series. The main drivers of vegetation variation were land surface temperature and precipitation in the east and temperature and evapotranspiration in the west. Precipitation was the main driver of vegetation growth in the northern and southwestern QLMs on both the short- and long-term scales. Vegetation changes were more significantly influenced by short-term temperature changes in the east but by a combination of temperature and precipitation in most parts of the QLMs on a 5-year time scale.

Keywords: vegetation change; driver; EEMD; Geodetector; QLMs

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1. Introduction

The ecological environment is an important barrier to human survival on earth. In recent years, with the active promotion of urbanisation and rapid industrialisation, the ecological environment has been changing drastically. Protection of the ecological environment and its rational exploitation have become increasingly important in the context of sustainable development [1]. Surface vegetation is a sensitive indicator of environmental change that can directly respond to the overall ecological environmental situation [2] and then provide reliable information for ecological environment construction and protection. As an effective index for characterising surface vegetation changes, the normalised difference vegetation index (NDVI) can fully reveal the spatial pattern of vegetation cover

Spatiotemporal Characteristics and Prediction of Ecological Safety in the Yellow River Basin of China

Xiao Wei, Lifeng Zhang, Yi He, Binghai Gao, Sheng Yao, Yujie Ding, Yan Guo, and Ling Ran

***Abstract*—The Yellow River basin (YRB) is a major ecological functional area in China, and its ecological safety development and change have extremely significant impacts on the natural environment and human society. However, existing studies on the YRB lack spatiotemporal characteristics analysis and prediction of ecological safety with vegetation as the core. Therefore, this study proposes to construct an ecological safety index (ESI) of the YRB based on the comprehensive multidimensional ecological safety evaluation system "vigor-pressure-state-response," using the normalized difference vegetation index, vegetation carbon sink indicator parameters, temperature, precipitation, the digital elevation model, population density, and the per capita gross domestic product from 2000 to 2020. The spatiotemporal characteristics of the ESI were then analyzed for the YRB, and a long-term and short-term memory network model was constructed to predict the ESI trend of the YRB over the next 10 years. According to the results, from 2000 to 2020, the ESI of the YRB showed a fluctuating upward trend, and the annual average of the ESI changed abruptly in 2015 due to drastic changes in hazardous areas. The ESI in most areas of the YRB showed a significant upward trend, the stability of ESI changes was weak in some areas, and the overall spatial distribution showed significant positive spatial agglomeration characteristics. Further, the response of ESI to landscape complexity in different reaches of the YRB varied. Most of the middle reaches were positively correlated with landscape complexity, while most of the upper and lower reaches were not significantly or negatively correlated. Notably, over the next 10 years, YRB's ESI growth will slow down, with areas with degradation increasing, areas with significant growth decreasing, and areas currently showing stability improvement.**

***Index Terms*—Ecological safety, evaluation system, landscape indices, long-term and short-term memory network (LSTM), Yellow River basin (YRB).**

I. Introduction

ECOLOGICAL safety is a complex issue involving many aspects of nature, economy, and society. It represents the overall integrity and health of the ecosystem. It is essential for protecting ecosystem stability, preventing environmental disasters, achieving sustainable development, and promoting human health and well-being [1]. Due to the extremely complex aspects of ecological safety and the many influencing factors, the intensity, duration, and spatial scope of ecological safety are often quantified by constructing an ecological safety index (ESI) [2], [3], [4], [5]. The composite index method is widely used in ecological safety evaluations. The focus of this method is on constructing a standard index system to characterize ecological safety [6]. Currently, the more commonly used index system for evaluating ecological safety is the comprehensive multidimensional ecological safety evaluation system based on the "pressure-state-response" (PSR) framework. PSR is centered on the "state" dimension, which represents the environmental characteristics of an ecosystem. The "pressure" dimension reflects the impact of many elements of damage to the natural environment. Social and natural manifestations make up the "response" dimension [7]. However, due to the differences and characteristics of the study areas, there have been other multidimensional index systems similar to PSR. These frameworks generally include dimensions such as climate, natural environment, social, and economic conditions, and other factors [8].

The Yellow River basin (YRB) is a crucial component of China's ecological safety and is an essential ecological functional area in China [9], [10]. However, the ecological safety of the YRB also faces many challenges. First, due to the complex terrain, there are abundant geomorphological types in the region, which leads to the diversity of land use and vegetation distribution and increases the vulnerability of the ecosystem. Second, the spatial distribution of temperature and precipitation is obviously unbalanced, and the difference between the east, west, south, and north is obvious, which poses a challenge to vegetation growth and water resource allocation [11]. Furthermore, social factors, such as continued population growth, accelerated industrialization, and urbanization, have led to the overexploitation and pollution of water resources, making ecosystems more fragile [12]. All these factors have intensified the ecological safety problems in the YRB, restricting the sustainable development of the natural environment and economic society in the region [13]. Therefore, given the urgent need to formulate an ecological protection strategy for the YRB, it is necessary to analyze and predict changes in ecological safety within the YRB. This has important practical significance for improving the local ecological environment and coordinating the contradiction

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Spatiotemporal evolution of agricultural drought and its attribution under different climate zones and vegetation types in the Yellow River Basin of China

Yujie Ding [a,b,c], Lifeng Zhang [a,b,c,*], Yi He [a,b,c,*], Shengpeng Cao [a,b,c], Xiao Wei [a,b,c], Yan Guo [a,b,c], Ling Ran [a,b,c], Mikalai Filonchyk [a,b,c]

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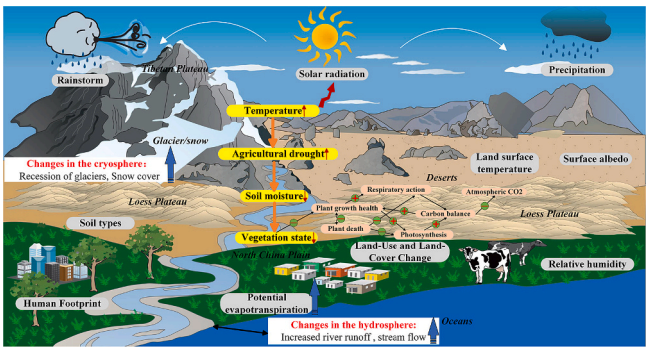
HIGHLIGHTS

- The spatiotemporal variation in AD under different climatic zones and vegetation types in the YRB were analyzed.
- SEM was introduced to quantify the driving factors of AD changes in the YRB.
- Temperature and PET were the main driving forces behind the changes in the TVDI.

GRAPHICAL ABSTRACT



ARTICLE INFO

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TVDI
Structural equation modeling
Human activities
Yellow River Basin

ABSTRACT

Ecological protection and high-quality development of the Yellow River Basin (YRB) are major national strategies in China. Agricultural drought (AD) is one of the most important stress factors of the ecological security of the YRB. Currently, there is a lack of exploration of the spatiotemporal evolution of AD in the YRB under different climatic zones and vegetation types, and the mechanisms by the driving factors influence AD remain unclear. The Temperature Vegetation Dryness Index (TVDI) for the YRB in China during 2000–2020 was calculated using Land Surface Temperature (LST) and the Normalized Difference Vegetation Index (NDVI). We analyzed the spatiotemporal evolution of AD from the perspective of upstream of the YRB (UYRB), midstream of the YRB (MYRB), and downstream of the YRB (DYRB), as well as different climate zones and vegetation types. The driving factors were selected based on the Pearson correlation analysis, Geographical detector, and Mantel test. Structural equation modeling (SEM) was employed to quantify the direct and indirect effects of the driving factors on AD in the YRB. We found a slowing trend of AD in the YRB, mainly in the Loess Plateau, which is distributed in UYRB and MYRB, but an increasing trend for AD in DYRB. Temperature, which is the most direct influential factor, has exacerbated AD in UYRB and MYRB. However, surface solar radiation (SSR) has the greatest constraining effect

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Spatiotemporal Prediction of Alpine Vegetation Dynamic Change Based on a ConvGRU Neural Network Model: A Case Study of the Upper Heihe River Basin in Northwest China

Lifeng Zhang, Haowen Yan, Yi He, Sheng Yao, Shengpeng Cao, and Qiang Sun

***Abstract*—Accurate and comprehensive vegetation prediction methods are essential for effective agricultural planning and budgeting. Most existing vegetation prediction methods rely on sampling points rather than on overall spatiotemporal characteristics, making it difficult to accurately forecast vegetation changes. Hence, we built a neural network model with encoding and decoding modules based on a convolution gate recurrent unit (ConvGRU) and applied it to spatiotemporal normalized difference vegetation index (NDVI) predictions for the upper Heihe river basin (UHRB) in the Qilian Mountains, China. Based on MODIS NDVI raster data for the UHRB for 2000–2020, the analysis of the region's spatiotemporal characteristics showed that the NDVI varied significantly over time. To avoid the gradient disappearance problem during ConvGRU model prediction, we proposed several numerical scaling methods for preprocessing the data before conducting training and prediction. We then constructed a spatiotemporal prediction model based on the ConvGRU, trained and predicted the numerically scaled data, and used various metrics to evaluate the model. The results showed that the grouping tan*h*-ln function fitting was the least erroneous, and the ConvGRU model using data scaled by this method performed well across various metrics according to the test-set results. Also, unlike traditional time series prediction methods, the model accounted for spatiotemporal correlation features, and the output data of the prediction model were continuous and intuitive. Therefore, the proposed method is suitable for predicting dynamic vegetation changes. The NDVI prediction trend analysis indicated that the vegetation in the UHRB should improve in the future.**

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***Index Terms*—Deep learning, Qilian mountains, spatiotemporal prediction, vegetation dynamic change.**

I. Introduction

VEGETATION is a primary producer and an important component of terrestrial ecosystems. It links soil, hydrology, atmosphere, and other ecological elements, and has an irreplaceable regulatory role in the global material and energy cycle [1]. In recent years, multiple vegetation changes have occurred due to dramatic climate change and anthropogenic disturbances, which may have long-term impacts on forest resources, the climate, and food production [2]. Moreover, vegetation significantly affects surface stability, radiative properties, hydrological properties, and the global carbon cycle and atmospheric components [3], [4]. Therefore, regular monitoring and prediction of vegetation indices are important to ensure vegetation stability, maintain sustainable food production, prevent socioeconomic losses, effectively guide regional ecological restoration and environmental management, and reflect ecosystem status and functioning [5], [6].

The rapid development of remote sensing technology has led to the easy acquisition of satellite image time series data. It has become the main means to quantitatively assess vegetation growth, biomass, and coverage, and has been widely used in vegetation change monitoring at different scales [7]. The normalized difference vegetation index (NDVI) closely reflects vegetation coverage, biomass, leaf area index, and so forth. It is the most commonly used academic indicator for characterising the status of surface vegetation [8]. Moreover, it is sensitive to vegetation growth and potential, can effectively identify dynamic changes in surface vegetation coverage, and is considered the best surface vegetation indicator [9]. This index is a powerful tool for studying the ecological environment and is commonly used for vegetation prediction and management [10]. It is also widely used to monitor and predict agricultural production and to assess ecological and environmental changes [11].

The Qilian mountains form the boundary between the Qinghai–Tibet Plateau and the arid and semiarid inland areas of Northwest China, providing an important ecological protection barrier for the Hexi Corridor [12]. The Heihe river basin represents a typical Qilian mountain watershed, the vegetation

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RESEARCH ARTICLE

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Spatiotemporal simulation and prediction of solar-induced chlorophyll fluorescence (SIF) across large-scale grasslands via multi-source data synergy: a case study of Northern China

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ABSTRACT

Solar-induced chlorophyll fluorescence (SIF) is a direct quantitative indicator of photosynthesis. High-precision modeling and cross-scale prediction of SIF are crucial for deciphering multiscale ecological response mechanisms and assessing regional carbon sinks. However, existing SIF prediction models rely excessively on the simple stacking of spectral and meteorological variables, neglecting the process-based response mechanisms to stress factors. This limitation results in difficulties effectively capturing the nonlinear interactions among environmental factors and their compound effects on SIF within areas of high landscape heterogeneity. To address these limitations, this study taking the grasslands of Northern China as a case study, developed a multi-source data-driven spatiotemporal prediction framework for SIF. Through a synergistic multistep mechanism involving feature selection, spatiotemporal decoupling, hybrid modeling, and surface extension, this framework couples geographical spatiotemporal heterogeneity with ecological process-driven mechanisms. It achieved the high-precision simulation and dynamic prediction of SIF distribution across multiscale grassland areas. The results demonstrated that the hybrid LSTM + Transformer model significantly outperformed traditional architectures. Its gated memory units and self-attention modules performed synergistically to effectively capture cross-climatic zone photosynthetic synergy and the fluorescence suppression effect under low-temperature stress. Further analysis revealed that the fraction of absorbed photosynthetically active radiation (FPAR), the leaf area index (LAI), and surface solar radiation (SSR) predominantly govern SIF variations by regulating canopy light energy allocation and phenological rhythms. Future projections indicate that grasslands in Northern China will exhibit a trend of slow growth but enhanced spatial heterogeneity. This research not only provides critical methodological support for carbon sink function assessment and degradation restoration monitoring in Northern China's grasslands and similar large-scale regions but also offers a novel perspective for advancing ecosystem process modeling under global change.

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KEYWORDS
SIF; spatiotemporal prediction; LSTM + transformer; multi-source data; grassland ecosystems

1 Introduction

As core carriers of global terrestrial carbon and nitrogen cycles as well as critical substrates for biodiversity conservation (Bai and Cotrufo 2022; Sha et al. 2022), grassland ecosystems provide irreplaceable systemic value to regional ecological security through their ecological service functions (Wei et al. 2024). However, under the dual pressures of climatic warming–that is, drying trends and intensified human activities–approximately 23% of global grasslands have exhibited significant degradation (Shi et al. 2021; He et al. 2025). Notably, those of Northern China–which function as both a core ecological barrier within the Eurasian Steppe Belt and a crucial carbon sink zone–are experiencing degradation levels far exceeding the global average (Bardgett et al. 2021). This degradation manifests concretely as diminished water conservation capacity, weakened windbreak and sand fixation functions, and a severe deterioration in habitat quality

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Spatiotemporal Dynamic Change and the Driving Mechanism of Desertification in the Yellow River Basin

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***Abstract*—The yellow river basin (YRB) plays a crucial role in maintaining national ecological security, and controlling desertification is a critical factor in strengthening the foundation for the high-quality development of the basin. However, there are fewer studies on the spatiotemporal patterns of desertification change in different regions of the YRB, and the mechanisms affecting desertification change are not yet clear. The objective of this article was to construct a desertification difference index (DDI) to characterize the degree of desertification in the YRB based on surface Albedo and normalized difference vegetation index. We analyzed the spatiotemporal patterns of desertification in different regions of the YRB. We used geographical detector and correlation analyses to screen out the main drivers affecting desertification change. We found that the DDI increased significantly at a rate of 0.5×10^{-3}/a from 2001 to 2021, indicating a slowing down trend of desertification in the YRB. The spatial concentration of desertification was a high degree of agglomeration and significant spatial autocorrelation. Precipitation (PRE) and surface radiation were the primary factors influencing desertification in the YRB. The most important factor influencing desertification in the upstream of the YRB and midstream of the YRB areas was PRE. However, human footprint has exacerbated desertification in the downstream of the YRB. This article aims to reveal the driving mechanisms behind desertification in the YRB. The objective is to provide a reference for combating desertification and improving the ecological environment in the region.**

***Index Terms*—Desertification, human footprint (HFP), remote sensing, spatiotemporal patterns, yellow river basin (YRB).**

I. Introduction

DESERTIFICATION is the process of land degradation in arid, semiarid, and dry subhumid areas. This is due to the interaction of natural factors, such as climate change and excessive human economic activity [1]. This natural hazard has the potential to cause land degradation, biodiversity and habitat loss, and species endangerment [2]. It is important to note that these hazards can have significant and long-lasting effects on the environment. Globally, desertification exacerbates the severity and frequency of dust storms, food shortages, and poverty, and poses a threat to human health and well-being. It leads to the degradation of arable land, forests, and grasslands, affecting about one-sixth of the population [3]. Recognizing this urgency, the United Nations General Assembly included combating desertification as 1 of the 17 sustainable development goals (SDGs) in 2015, with the 2030 Agenda for Sustainable Development (2030 Agenda) [4]. SDGs Target 15.3 focuses explicitly on combating desertification and rehabilitating degraded land and soil, and strives to achieve a land-degradation-neutral world by 2030 [5]. The yellow river basin (YRB), as a national ecological protection barrier, has a particularly prominent desertification problem. Therefore, it is important to scientifically quantify the fine-scale spatiotemporal evolution of desertification and the driving mechanisms. This will provide data and theoretical support for the formulation of desertification control policies and the achievement of the goal of land degradation neutrality.

Monitoring desertification dynamics is crucial for preventing and managing desertification. Zhao et al. [6] used human–computer–visual–interactive–interpretation to monitor the desertification process in the YRB from 2000 to 2020 and found an improvement in the desertification condition. Zhang and Jin [7] used the normalized difference vegetation index (NDVI) to investigate the spatiotemporal changes in vegetation cover in the three river source regions. They quantified the combined effects of climate change and human factors on vegetation conditions. Sun et al. [8] analyzed the process of grassland restoration in the northern region from 2001 to 2015 using the moderate resolution imaging spectroradiometer (MODIS) NDVI and landscape index. They found that the overall condition of the grasslands had improved and the area affected by desertification was less than the recovered area. Meanwhile, surface Albedo is a key parameter in the radiant energy balance at the surface. This parameter determines the amount of radiant energy that is absorbed by the subsurface and varies depending on the type of ground object [9]. An increase in Albedo indicates a degradation

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The Displacement Analysis and Prediction of a Creeping Ancient Landslide at Suoertou, Zhouqu County, China

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***Abstract*—The ancient Suoertou landslide seriously threatens the surrounding population's lives and property. Monitoring and predicting this landslide is crucial to ensure the affected areas' safety. The previous research on the landslide's displacement characteristics and mechanisms has lacked detailed analyses. In addition, its future development trends must be understood. Therefore, we conducted a detailed analysis of the ancient Suoertou landslide's displacement characteristics and mechanisms using small baseline subset interferometric synthetic aperture radar monitoring results from 2018 to 2023. Furthermore, by applying a gated recurrent unit prediction mode that incorporates the refined displacement characteristics and mechanisms, we forecasted the landslide's displacement trends. The results show that this landslide is currently undergoing overall slow displacement with violent fluctuations in localized areas. Tectonic movement, precipitation, human activities, river erosion, and other factors interact, forming a vicious development displacement mechanism. According to our prediction, the displacement of this landslide will be in a trend of fluctuating increase from June 2023 to June 2024. In particular, the local area will undergo abnormal displacement acceleration. The results of the current research provide a scientific basis upon which to monitor landslides, promote their management, and reduce the risk of losses due to landslide disasters.**

***Index Terms*—Displacement mechanism, gated recurrent unit (GRU), Suoertou landslide, two-dimensional decomposition, wavelet analysis.**

I. Introduction

ANCIENT landslide displacement is among the most significant hazards of landslide disasters [1]. After lengthy historical developments, such landslides' surroundings have evolved into human settlement areas. Therefore, if an ancient landslide undergoes accelerated displacement, leading to collapse, incalculable losses will result for the surrounding human populations [2]. Zhouqu County, situated in the middle section of the Bailong River Basin, stands out as one of China's areas most significantly affected by landslide disasters [3]. Due to historical tectonic movements, the region is characterized by numerous large-scale ancient landslides [4].

In recent years—due to influences such as human activities, earthquakes, mudslides, heavy rainfall, and other triggering factors—multiple ancient landslides have been successively reactivated. For instance, in July 2018, the ancient Jiangdingya landslide was revived. It blocked the Bailong River channel and caused the flooding of surrounding villages and power stations [5]. In July 2019, the ancient Yahoukou landslide underwent a resurgence, partially blocking the Min River and causing the inundation of surrounding villages [6]. The disaster chain that results from the dam failures of such landslide-blocked rivers due to these ancient landslides seriously threatens people's safety, as well as the ecological environment in the Bailong River Basin.

The Suoertou landslide is the largest ancient landslide in Asia. It is located in Zhouqu County, in close proximity to the Bailong River, and has been in a creeping state since the 1970s. It is the most threatening deformed ancient landslide in the vicinity of Zhouqu County. If the landslide is collapsed, it will seriously endanger the lives and properties of nearly 50 000 people around Zhouqu County and downstream along the Bailong River. However, the previous research on the ancient Suoertou landslide has mainly focused on analyzing lithological [7] and overall sliding characteristics [8]. The detailed characteristics and mechanism of its landslide displacement have not been systematically analyzed, and the site's future sliding trend was unclear. This ambiguity poses significant landslide prevention challenges. Therefore, a detailed analysis of the ancient Suoertou landslide's displacement and mechanisms—along with predictions of its future development trends—has great scientific significance in the prevention, monitoring, and reduction of this landslide disasters.

Interferometric synthetic aperture radar (InSAR) [9] has been widely used in recent years to detect displacements and study large landslides' mechanisms. It has the ability to monitor the overall displacement processes of landslides over long periods with high efficiency, stronger anti-interference, and a wider monitoring range compared to GNSS [10], [11], [12]. Ma et al.

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兰州传统民居与新式民居冬季室内热环境对比研究

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摘要 提升民居室内热环境舒适度,是改善寒冷地区乡村人居环境的关键举措。选取兰州青城古镇两栋具有代表性的民居,通过实测获取冬季的室内温、湿度数据,基于实测数据对比分析了传统民居与新式民居冬季室内热环境的特点。进而采用Ecotect Analysis模拟建筑失热情况,探明冬季室内热环境的影响因素,基于此提出传统民居与新式民居各自的改善措施。研究表明:传统民居冬季室内热环境的波动比新式民居更稳定,但新式民居冬季室内温度更高;根据两种民居的建筑失热情况,建议传统民居改善门窗密封性及正面墙体保温隔热性,新式民居加设墙体保温板或使用导热性能更好的墙体材料,以提高冬季室内热环境舒适度。研究结果可为类似地区传统民居与新式民居冬季室内热环境的改善提供借鉴与参考。

关键词 室内热环境;传统民居;新式民居;兰州地区;Ecotect Analysis软件
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随着我国乡村振兴政策的提出,乡村传统民居与新式民居室内热环境成为诸多学者的研究重点。文献[1-6]中研究了陕西、宁夏、西藏等多地民居的室内热环境,为西北地区的相关研究建立了基础;杨真静等[7]对重庆江津区龙塘村夯土民居进行了温、湿度测试,发现夏季室内热环境要优于冬季;李效梅等[8]发现贵州传统石木结构民居传热系数、建筑能耗等指标不满足当地的规范要求,因此提出了相应的改善措施;郑锐锋等[9]通过对浙西南地区丹址村典型民居的室内热环境实测、满意度调查研究,提出了基于气候适应性的设计策略;郑文亨等[10]分别测试了桂北山区旧民居与新民居的夏、冬季环境参数,发现新旧民居室内热环境并没有显著差异,但整体而言,夏季湿环境均优于冬季;Allinson等[11]发现使用稳定夯土(SRE)能够明显降低室内相对湿度的波动;Cardinale等[12]基于实测数据评价了意大利南部的两类乡土建筑室内热环境舒适度。

兰州地处黄土高坡的重要节点,其传统民居受到西北文化、气候因素的影响,表现出独特的地域特点[13]。李金平等[14]对兰州落地炕与架空炕农房室内环境进行了对比研究,发现架空炕房间室内平均温度高于落地炕房间。近年来随着乡村经济的迅速发展,大量的砖瓦式新民居逐渐成为乡村民居的重要组成。部分学者也对兰州地区新式民居室内热环境进行了相关研究,如吴永诚等[15]基于Ecotect软件对兰州乡村被动式太阳房进行了模拟优化。根据相关研究分析,兰州冬季寒冷的气候特征对民居室内热环境产生了较大的影响,但有关传统民居与新式民居冬季室内热环境对比的文献数量较少。研究基于实测数据对比分析兰州青城古镇传统民居与新式民居冬季室内热环境的特点,并结合软件模拟探明影响因素,提出了各自的改善措施,为兰州地区乡

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类型学下兰州市工业遗产地景观设计研究

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摘　　要： 文章通过对兰州市工业遗产地进行实地调研，在梳理历史的基础上研判价值，用类型学的方法归纳出兰州工业遗产的特点，因地制宜地提出采用分级保护的改造思路。研究表明，工业遗产地的景观更新，不仅能改善城市景观环境，而且能促进工业建筑遗产的保护与再利用。

关 键 词： 遗产保护；景观设计；模式研究
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Study on the Landscape Design of Lanzhou Industrial Heritage Sites in the View of Typology

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Abstract: The research carried out field research on the industrial heritage sites in Lanzhou firstly.And the characteristics of industrial heritage were summarized by means of typology. Put forward the reform idea of adopting classified protection according to local conditions. Research shows that the renewal of landscapes in industrial heritage sites can not only improve the urban landscape environment, but also promote the protection and reuse of industrial heritage.

Key words: heritage protection; landscape design; model study
Internet: www.artdesign.org.cn

一、兰州市工业遗产概况

（一）历史脉络与发展

兰州作为甘肃的省会城市，是石油化工、装备制造与冶金有色的老工业城市。40多个工业行业中，产品品种达到2万余种。兰州工业建设历史悠久，陕甘总督左宗棠1872年（清同治十一年）将西安机器局搬迁至兰州畅家巷，成立了兰州制造局，成为兰州近现代工业史的一个开端。新中国成立后，在“一五”“二五”政策带动下，兰州作为国家四个重工业城市之一，成立建设了兰炼、兰化、西固热电厂等8个企业，随后又从沿海迁入一部分企业，丰富了兰州工业门类。在20世纪60年代的“三线”建设中，兰州仍然作为重要的工业的城市而继续发展。

（二）兰州工业遗产现状

工业生产的特殊性使之前的建筑形式不能满足新的生产技术。工业遗产建筑在生产模式的改变下被社会淘汰，加之企业响应政府的号召搬迁到新区，留下大量工业遗产建筑。兰州现存的工业遗产有20多个，根据实地调研，文章归纳总结了部分现存的工业遗产现状。

兰州万里航空机电厂：成立于1956年，“一五”期间重点项目之一。坐落在兰州市万新路71号。现遗存苏联援建厂房建筑，外形保存完好，建筑物有明显的“苏联式建筑”特征，且留有部分工业设备，但已不做任何使用用途，厂区内有部分新建厂房。厂区家属院内现存工业时代建筑，现仍在居住使用中，建筑外形保存完好。

兰州畜牧与兽医研究所：最初为“国立兽医学院”，于国民成立，现更名为“中国农业科学院兰州畜牧与兽药研究所”。坐落于兰州市硷沟沿335号。现存建设初期的中国传统建筑，经过修缮与保护现存完好，已作其他用途。

兰州制造局：建造于同治十一年，旧址在现兰州市中山路附近，现已搬迁至兰州市土门墩南湾。现有一座以原有建筑为原型的重建中国传统建筑。

兰州石油化工厂：我国“一五”时期重点项目之一。厂区坐落于兰州市西津西路194号。现遗存建设初期工业厂房一座，厂房有明显的“苏联式建筑特征”。建筑外形与结构均保存完好，现已不作生产用途。

兰州炼油化工总厂：始建于1956年，有着“共和国之子”的称号。厂区坐落于兰州市福利东路161号。现厂区存有大量苏联援建厂房与工业设备，整个厂区仍在使用中。

兰州蓝天浮法玻璃厂：始建于1958年，是国家在西北建设的第一个平板玻璃厂。现已搬迁至兰州新区，原厂址在兰州市西固东路177号。厂区被完整保留，但已规划作为其他用途用地。

（三）兰州市工业遗产特征

通过对兰州市工业遗产地的现状调研，发现兰州市工业遗产具有以下突出特点，文章后续将围绕这些特点，对兰州市工业遗产地进行类

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陇南山区城镇街道景观美感评价

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摘要:对城镇街道景观美感进行评价,分析街道景观评分的现实成因,是当前城镇更新工作中亟待加强的课题.针对陇南山区城镇街道的美学特征与景观特性,从形态美、舒适度、文化美三个维度选取29个指标建立评价指标体系.运用层次分析法构建评价模型,以陇南典型的山区城镇康县的中街为例对该模型进行了具体应用.结果表明:经指标权重分析,独特性、色彩协调度、绿化覆盖率、乡土文化感是体现街道景观美感的重要指标;康县中街景观美感得分74.922 4,评分等级为Ⅱ良好;空气清新度(88.872 7)、山水可见度(88.050 1)、绿化覆盖率(81.880 4)、植物乡土性(81.593 0)、建筑形态的独特性(80.356 3)5项指标得分评价等级为Ⅰ优秀,变化感(56.829 3,Ⅲ一般)、科教感(61.316 6,Ⅱ良好)、安静度(63.737 6,Ⅱ良好)得分较低;现实成因与评价结果相符,表明采用的指标体系与评价模型对陇南山区城镇街道景观美感评价具有良好的理论意义和应用价值,可以在陇南山区其他同类型城镇进一步推广.

关键词:街道景观;美感评价;层次分析法;陇南山区

中图分类号:TU986.1 **文献标志码**:A

Aesthetic Evaluation of Street Landscape in Longnan Mountainous Area

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Abstract: Evaluating the aesthetic feeling of street landscape and analyzing the realistic causes of the score are the primary topics to be strengthened in the optimization of street landscape in mountainous areas. According to the aesthetic characteristics and landscape characteristics of streets in Longnan mountainous area, 29 indexes are selected from the three dimensions of formal aesthetic sense, comfort and cultural aesthetic sense to establish an evaluation index system. The analytic hierarchy process is used to construct the evaluation model, and the model is applied to Kang county Middle Street which is typical. The results show that according to the index weight analysis, uniqueness, color coordination, greening coverage and local culture are important indexes to reflect the aesthetic of street landscape; the Middle Street landscape aesthetics score is 74.922 4, and the grade is II, air freshness is (88.872 7), landscape visibility is (88.050 1), greening coverage is (81.880 4), plant localism is (81.593 0) and uniqueness of architectural form (80.356 3) scored excellent in grade I; the scores of sense of change is (56.829 3, Ⅲ general), sense of science and education (61.316 6, Ⅱ good) and quietness (63.737 6, Ⅱ good) were low. The realistic causes are consistent with the evaluation results, which shows that the index system and evaluation model have good theoretical significance and application value for the aesthetic evaluation of street landscape in Longnan mountainous area. It can be further popularized in other similar towns in Longnan

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面向传统村落旅游的乡土景观吸引力评价
——以兰州市永丰村为例

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摘要：以兰州市永丰村传统村落为对象研究乡土景观吸引力评价方法. 基于外部空间、内部空间、历史文化构建乡土景观吸引力体系，利用层次分析法和因子分析法设计了复合评价指标，借助问卷数据对永丰村乡土景观吸引力强度进行实证验算. 结果表明：历史文化是乡土景观吸引力的核心内容，保护和合理利用历史文化资源是乡村旅游的第一要义；外部空间是乡土景观吸引力的形象特征，尊重地域环境和彰显村落特色是吸引外界游客的重要动因；内部空间是乡土景观吸引力的内涵外化，整治历史建成环境是吸引游客深度体验的物质基础. 因此，激活并整合传统村落的物质和非物质乡土景观资源是提升旅游吸引力的有效途径.

关键词：传统村落；乡村旅游；景观吸引力；评价体系
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Evaluation of vernacular landscape attraction for traditional village tourism
—A case study of Yongfeng Village in Lanzhou City

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Abstract: Taking the traditional villages of Yongfeng Village in Lanzhou City as the object, this paper studies the evaluation method of rural landscape attraction. Based on the external space, internal space, history and culture, the attraction system of rural landscape is constructed. The composite evaluation index is designed by using the analytic hierarchy process and factor analysis, and the empirical calculation of the attraction intensity of rural landscape in Yongfeng Village is carried out with the help of questionnaire data. The results show that history and culture are the core contents of the attraction of rural landscape, and the protection and rational use of historical and cultural resources are the first essence of rural tourism; the external space is the image characteristics of the attraction of rural landscape, and respect for the regional environment and highlight the characteristics of villages are the important motivation to attract the external tourists; the internal space is the connotation externalization of the attraction of rural landscape, renovating the historical built-up environment is the material basis for

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面向人居环境的黄土高原乡村建设质量评价

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摘要：乡村建设作为黄土高原乡村振兴工作的主线，对其进行质量评价研究具有重要的现实意义. 首先，以人居环境理论为支撑，结合黄土高原地区的地域特点，从生产、生活、风貌、风俗和治理五个维度构建指标体系. 其次，采用层次分析法和熵值法计算权重，运用模糊综合评价法建立评价模型. 最后，以黄土高原典型的农业大县庄浪县为例进行了实证研究. 研究表明：(1) 以庄浪县为代表的黄土高原地区乡村建设质量评价值处于良好等级. (2) 基于人居环境理论的乡村建设质量评价五维度权重中，风俗和治理维度得分较高，生产和生活维度的满意度有待提升. (3) 通过IPA象限图分析发现，各指标不同维度的重要度和满意度表现差异明显，其中粮食生产能力提高和住房条件改善是目前乡村建设水平提升的关键. 总之，受自然环境和社会经济条件影响，黄土高原地区在乡村建设方面所取得的成就和存在的问题均带有明显的区域特征.

关键词：人居环境；乡村建设；质量评价；模糊评价法；黄土高原地区

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Quality assessment on rural construction of human settlements in loess plateau

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Abstract: As the main line of the rural revitalization strategy, it has great practical significance to conduct quality assessment research in the Loess Plateau. Firstly, supported by the theory of human settlements, based on the regional characteristics of the Loess Plateau, the indicator system was constructed from five dimensions, namely, production, life, style, customs and governance. Secondly, AHP and the entropy value law were used to determine the weight, and the fuzzy comprehensive assessment method was used to establish the evaluation model. Finally, taking Zhuanglang County, a typical agricultural county in the Loess Plateau, as an example, an empirical study was carried out. The research shows that: (1) the quality assessment value of rural construction in the Loess Plateau represented by Zhuanglang County is in a good grade. (2) Among the five dimensions weights of rural construction quality assessment based on the theory of human settlements, the scores of the custom dimension and the governance dimension are high, and the satisfaction of the production dimension and the life dimension need to be improved. (3) Through the analysis of the IPA quadrantal diagram, it was found that the importance and satisfaction of different dimensions of each indicator are significantly different, and the improvement of food production capacity and housing condition is the key to promote the current rural construction level. In summary, affected by the natural environment and socio-economic conditions, the achievement and problem of rural construction in the Loess Plateau reveal an obvious regional characteristic.

Key words: human settlements; rural construction; quality assessment; fuzzy assessment method; Loess Plateau area

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民航老机场遗产旅游价值评价体系研究及应用
——以嘉峪关民航机场为例

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摘　要：本文通过对机场遗产独特价值的研究，借鉴了德尔菲法和SPSS因子分析的评价方法，构建了一套以定量为主、定性和定量相结合的机场遗产价值评价体系，用以综合评价机场遗产，着重解决机场遗产的认定与分级，明确民航机场遗产具体的保护对象，结合嘉峪关民航老机场的资源特征，构建嘉峪关民航机场的价值评价体系，并在此基础上对嘉峪关民航机场遗产旅游资源进行价值评价，提出相对应的保护活化方法。

关键词：民航机场；遗产旅游；价值；评价体系；嘉峪关

随着城市进程的逐步加快，在经济体制转型和产业结构与用地结构调整等多重压力下，一些承载着城市枢纽交通的原有机场在拆与保，废弃与再利用之间存在着激烈的碰撞，而在这种碰撞过程中，前者往往占据了上风。以嘉峪关民航机场为例，嘉峪关民航机场作为市级文物保护单位，现处于废弃状态。国内的其他老旧机场正经受着前所未有的破坏与毁灭，而且大多数城市尚未将机场遗产的保护与再利用付诸行动。机场遗产的保护与再利用的前提是进行机场遗产的综合评价，因此建立一套客观的、科学的评价指标体系，对我国机场遗产进行客观的评价与对比，进行分级界定，合理有效地进行管理和开发利用具有非常重要的意义。

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生态宜居视角下的黄土高原乡村建设质量评价*

—以陇东地区为例

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提 要: 探索兼顾系统性、动态性和实践性的乡村建设质量评价体系,科学测度黄土高原生态宜居水平,对乡村高质量发展具有重要的现实意义。基于PSR理论框架构建了黄土高原乡村建设质量评价模型,应用组合赋权和模糊综合评价法,从乡村压力、状态、响应3个维度、12个因素、39项指标层面进行实证研究。结果表明: 陇东黄土高原乡村建设质量为良好偏一般,有较大的提升潜力; 劳动生产压力、休憩游乐压力、生活居住响应以及劳动生产状态是制约黄土高原乡村建设质量的主要因素; 文中构建的评价模型及指标体系能客观指明乡村的动态发展,具备较强的操作性和较好的实用性。

关键词: 乡村建设; 质量评价; PSR模型; 生态宜居; 黄土高原
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生态宜居是实施乡村振兴战略的重要任务之一,也是乡村生态保护和宜居建设的现实需要[1]。2018年中央一号文件指出生态宜居是建设美丽乡村的关键,党的二十大报告进一步强调了建设宜居宜业乡村的重大意义。黄土高原地区地理位置特殊,地形气候条件复杂,先天性的脆弱生态与长期以来不合理的生产活动和资源利用方式导致地方经济薄弱、乡村转型缓慢、人力资本流失、"空心化"等问题突显[2-3],乡村生态宜居受到了严重挑战。聚焦黄土高原生态宜居问题的研究,特别是对生态宜居下乡村建设质量进行科学评估,既是该地区乡村发展面临的问题也是精准实施乡村建设行动的前提。

围绕生态宜居议题,诸多学者在吴良镛人居环境科学框架的基础上对乡村空间演变、路径探索、治理和优化、建设模式等方面给予充分讨论[4-7]。在经历理论研究和实践探索后,学者普遍将生态宜居作为乡村的发展理念、建设目标,根据不同的地理空间尺度、乡村发展特点构建生态宜居的评价要素对乡村人居环境质量、建设满意度、可持续发展进行了探索和研究。如曾菊新等[8]重点关注生态功能,姚治浩等[9]综合考量宜居的物质要素和精神要素,董冬等[10]、颜梅艳等[11]、梁晨[12]分别基于村民感知满意效果、乡村"三生"功能衡量人居环境水平并提出优化建议。但总体来看测度指标多以反映经济性和建设性的物质性指标为主,研究方法多采用层次分析法[13]、熵值法[14]、因子分析法[15]、结构方程模型[16]等方法。近年来,针对乡村生态宜居水平进行单独评价成为热点。如蔡雪熊等、李松睿等[17-18]构建生产、生活、生态的指标体系用以衡量生态宜居水平。武永霞[19]基于生态宜居总目标从自然环境宜居、生产环境宜居、生活环境宜居、社会环境宜居进行了实证评价分析。综上所述,学者们对生态宜居展开了较为翔实的研究,但以下三个方面还有待进一步深入讨论: 1) 当前绝大多数评价研究仅探讨阶段性的建设状态,局部的特征无法反映出乡村系统全貌的建设成果; 2) 较少以系统思维来考量各指标要素之间协同关系及其对乡村整体建设水平的影响; 3) 对西部地区尤其是黄土高原地区生态宜居的特征挖掘不够。

乡村建设是一个持续、动态的过程,并无最终的建成形态。只有不断地协同、优化乡村各要素,使之相

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丝路视野下城市历史环境保护研究 *
——以嘉峪关市为例
A Study on the Protection of the Urban Historical Environment from the perspective of Silk Road: a Case Study of Jiayuguan City

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Liu Benteng Li Yufang Wang Renzhi

摘要 以丝绸之路的文化视野梳理嘉峪关城市历史环境的综合价值，并且在定性评价的基础上，运用因子分析法对历史环境进行定量的评价。从而得出影响嘉峪关城市历史环境保护的主因子依次为丝路交通因子、军事工程因子、工业遗产因子、区域环境因子、区域文化因子和民俗工艺因子。结合丝路城市特色，依照评价结果从区域环境、区域文化、物质文化遗产和民俗工艺四个层面构建历史环境保护体系。最后，从宏观、微观层面分析当下面临的问题，根据综合得分排序分主次制定相应的保护策略。研究立足于“丝绸之路经济带”语境，强调用动态保护的思维协调历史保护与城市发展，探讨历史环境的整体性保护方法，对丝绸之路城市的建设具有指导意义。

关键词 城市历史环境；价值评定；保护发展；嘉峪关市

ABSTRACT From the cultural perspective of the Silk Road, this paper provides a comprehensive overview of the value of the historical environment of Jiayuguan City. Furthermore, based on qualitative evaluation, factor analysis was used to quantitatively analyze the historical environment. The results indicated that the main factors affecting protection of the historical environment in Jiayuguan City are the Silk Road traffic factor, the military engineering factor, the industrial heritage factor, the regional environmental factor, the regional cultural factor, and the folk cutom craftsmanship factor. According to these results, the characteristics of Silk Road cities are combined and a historical environmental protection system is constructed based on four levels: regional environment, regional culture, material cultural heritage, and folk custom craftsmanship. Finally, this paper analyzes the current problems from the macroscopic and microscopic levels, and formulates corresponding protection strategies based on the overall score ranking. In the context of the "Silk Road Economic Belt", this study highlights the use of dynamic protection thinking to harmonize both historical protection and urban development, thereby achieving overall protection of the historical environment. These findings are significant for the construction of the Silk Road City.

KEY WORDS urban historical environment; value assessment; protection and development; Jiayuguan city

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文化旅游背景下传统村落乡土景观保护研究——以兰州市永丰村为例

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摘要：乡土景观作为传统村落重要的物质和文化载体，在旅游商业开发的冲击下面临着乡土风貌破坏、乡土文化遗失的双重挑战。文章通过分析传统村落乡土景观的价值构成要素，揭示了乡土景观保护对传统村落发展的重要意义。在建立文化旅游与乡土景观互促机制的基础上，从空间整合、文化传承、时令保护三方面提出面向文化旅游的乡土景观保护策略。并选取甘肃省兰州市榆中县金崖镇永丰村为实证研究案例，从宏观、中观、微观三个层面进行乡土景观设计。理论和实践的相互验证表明，乡土景观保护能有效促进传统村落的文化旅游，进而实现传统村落活态保护的目的。

关键词：传统村落；乡土景观；文化旅游；永丰村
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Study on the Protection Strategy of Traditional Village Vernacular Landscape under the Background of Cultural Tourism: A Case of Yongfeng Village in Lanzhou City

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[Abstract] As an important material and cultural carrier of traditional villages, vernacular landscape is facing double challenges of vernacular features destruction and vernacular culture loss under the impact of tourism commercial development. Through the analysis of the value elements of the traditional village landscape, this paper reveals the significance of the protection of the rural landscape to the development of traditional villages. On the basis of establishing the mechanism of mutual promotion between cultural tourism and vernacular landscape, this paper puts forward the strategies of protecting local landscape for cultural tourism from three aspects: space integration, cultural heritage and seasonal protection. Taking Yongfeng Village in Lanzhou City, Gansu Province as an empirical case, this paper carries out local landscape design from macro, meso and micro levels. The mutual validation of theory and practice shows that the protection of local landscape can effectively promote the cultural tourism of traditional villages, and then can realize the purpose of the living protection of traditional villages.

[Keywords] traditional village; vernacular landscape; cultural tourism; Yongfeng Village

引言

中共“十九大”提出乡村振兴的战略目标，其中产业振兴和文化振兴是其重要内容。文化旅游作为产业振兴和文化振兴重要手段，近年来在各级政府的推动下急速发展。传统村落作为一种历史文化资源丰富的村落类型，具有发展文化旅游的先天优势。同时文化旅游对传统村落是一柄双刃剑，合理的旅游开发是传统村落发展的有效途径之一。但是不少传统村落在急功近利的商业开发下，其乡土风貌受到严重破坏，进而威胁到乡土文化传承与发展。

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艺术设计专业硕士实践教学质量评价研究

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【摘要】实践教学是艺术设计专业硕士培养中的重要环节，传统的教学质量评价方法对学科特征和课程特性的针对性不强。本文借鉴了 CDIO 工程教育理念及其评价标准设计了评价指标体系，运用 AHP- 熵权法和模糊综合评价法建立了专业实践教学质量评价模型。结果显示：（1）对实践教学质量的影响权重排序依次为教学过程、教学成效、教学资源、教学管理；（2）教学过程和教学成效的评价值均低于实践教学质量综合评价值，教学目标制定不明确、教学方法应用不到位等对评价造成了负向影响。

【关键词】艺术设计；专业硕士；实践教学质量；模糊综合评价

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Quality Evaluation Study on Practice Teaching of Professional Master of Art Design

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【Abstract】Practical teaching is an important link in the cultivation of master's degree in art and design, and the traditional teaching quality evaluation method is not very specific to the subject characteristics and curriculum characteristics. The evaluation index system is designed based on the CDIO engineering education concept and evaluation criteria, and the evaluation model of professional practical teaching quality is established by using AHP-entropy weight method and fuzzy comprehensive evaluation method. The results show that:(1)the order of influence weight on the quality of practical teaching is teaching process, teaching effectiveness, teaching resources, and teaching management;(2)The evaluation value of teaching process and teaching effectiveness is lower than the comprehensive evaluation value of practical teaching quality. The unclear formulation of teaching objectives and the inadequate application of teaching methods have a negative impact on the evaluation.

【Keywords】Art Design; Professional Master; Practice Teaching Quality; Fuzzy Comprehensive Evaluation

引言

随着《专业学位研究生教育发展方案（2020-2025）》的颁布和实施，高校研究生培养目标从精英型人才逐步向应用型人才转变。而应用型人才培养重点就是对其实践能力的强化，作为艺术设计专业硕士培养计划的关键一环，实践活动在增强育人效果，提升综合素质，培养学生实际操作能力方面有着重要意义。因此，探索突出艺术设计专业学科特色的评价方法，不仅有利于检测学生专业操作技能的掌握程度，也有助于学校管理部门发现实践教学的改进之处。

一、指标体系设计

CDIO 教育模式作为国际工程教育改革的重大创新成果，其“构思（Conceive）—设计（Design）—实施（Implement）—运作（Operate）”的理念和重视学生学习的综合评价体系被广泛地应用于各类教育和教学实践之中。首先，CDIO 模式以培养具有创新精神和专业操作技能的应用型人才为目标，注重适应社会需求的学生综合素养培养；其次，CDIO 模式以 12 条标准涵盖了人才培养的全过程和各环节，建构起了闭环反馈机制，使得教育改革创新具体化、可操作、可测量；再次，CDIO 模式将：“教育—管理—学习”看作一体，强调学生、教师、用人单位等教育主体广泛地参与评价。而艺术设计

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敦煌传统民居气候适应性营建特征分析研究

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[摘 要] 为探索极干旱气候条件下传统民居在应对气候过程中所体现的营建特征,选取敦煌地区 132 户传统民居作为研究对象,采用了气候分析软件、调查分析及环境实测的方法进行研究。研究结果表明:敦煌传统民居在建造过程中采用了降温、遮阳、蓄热、防风的营建手段来规避恶劣的自然环境,形成了独特的气候适应性营建特征。1)采用庭院外遮阳构件是直接夏季遮阳和降温的有效营建特征,有无加建玻璃顶棚,太阳辐射强度平均差值达 384.22 W/m^2;有无设置传统木构架单向遮阳棚,温度平均差值达 0.1 ℃,温度波幅差值达 3.1 ℃;有无加建玻璃顶棚,温度平均差值达 0.5 ℃,温度波幅差值达 13.8 ℃;2)采用种植绿植能有效调节夏季室内微气候,有无种植绿植,温度波幅差值达 1.5 ℃;3)采用封闭的围护构件是民居防风和保温的营建特征,有无加建封闭的玻璃顶棚,温度平均差值和波幅差值均达 9 ℃,风速平均差值达 0.3 m/s,波幅差值达 3.37 m/s;4)采用合院形制能维持室内温度的稳定,其中三合院室内温度比“L”形院落室内温度波幅差值达 2.8 ℃,四合院室内温度比“L”形室内温度波幅差值达 1.6 ℃。研究结果以期为敦煌传统民居的营建优化和居住环境提升提供依据和效果评价机制。

[关键词] 气候适应性;传统民居;光环境与热环境;营建特征;敦煌地区
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Analytical Study on the Features of Climate Adaptability Construction of Traditional Residences in Dunhuang

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Abstract: To explore the construction features of traditional residences in adapting to the climate under extremely arid climate conditions, 132 traditional residences in Dunhuang area were selected as the research objects. Climate analysis software, survey analysis, and field measurement of the environment were used during the research. The research results show that the construction methods of cooling, shading, heat storage, and wind proofing were adopted by the traditional residents in Dunhuang in the construction process in response to the harsh natural environment and creating unique climate adaptability construction features. 1) An effective construction feature for direct shading and cooling in summer is reflected in the application of external shading components in the courtyard. The addition of a glass roof will lead to an average difference in solar radiation intensity of 384.22 W/m^2. The setting of the traditional wooden frame one-way sunshade will lead to an average temperature difference of 0.1 ℃, and a temperature fluctuation difference of 3.1 ℃. The setting of an additional glass roof will lead to an average temperature difference of 0.5 ℃, and a temperature fluctuation difference of 13.8 ℃. 2) The planting of green plants can effectively adjust the indoor microclimate in summer. The planting of green plants will lead to a temperature fluctuation difference of 1.5 ℃. 3) The adoption of the closed enclosure components embodies the

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工业遗产再利用满意度评价方法
——基于利益相关者理论

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摘要 工业遗产再利用是城市存量更新的重要方式,综合各利益相关者的评价方法能更科学地反映其实际使用效果。基于再利用项目与使用者的互动机制,将政府部门、开发商、设计师、经营者、游客及周边居民作为利益相关者,构建多维度、多指标的满意度评价指标体系,运用模糊综合评价法对原兰州石化机械厂研究所进行评价。研究表明:政府、开发商、游客的满意度高于综合评价值3.817 5;而设计师、经营者、周边居民的满意度则低于3.817 5,其原因是租金管理费用、原风貌保留程度、对周边环境的影响等因素对评价造成负面影响,并基于此提出了相应的优化建议。该评价方法能科学、合理地反映各利益相关主体关注问题的满意度,为优化措施及决策提供重要依据。

关键词 工业遗产;利益相关者;满意度
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工业遗产作为城市工业文化的重要载体具有丰富的历史、艺术、文化和经济等价值。合理地再利用工业遗产,在延续城市文脉、推进存量更新和资源集约化利用等方面具有重要作用[1]。近年来,国家逐步健全、完善了保护和利用工业遗产的法律法规,从方法措施、开发管理、监督检查等方面给出规定与引导[2-3]。随着各地再利用项目的落地,其实际使用效果也成为学界关注的热点。

既有工业遗产再利用满意度研究多从游客视角展开。王凯等[4]认为应从期望、体验、评价和反馈4个阶段分别考量游客满意度。淳伟德等[5]在此基础上从期望和感知体验两个方面出发,剖析了影响游客满意度的根本原因。在后续研究中,学者们也对评价方法做出了有益的拓展与创新。文献[6-9]中分别用语义分析法、顾客满意度指数模型、Logistic模型对游客的再利用满意度进行了测评,分析了满意度的影响因素并提出了改善措施。此外,也有学者从居民、工作管理人员、创业者等视角出发探索了工业遗产再利用满意度。郭洋等[10]、刘歆等[11]用相关性系数甄别出影响创业者、设计师、游客和居民等群体满意度的负面因素并提出优化策略;贺海芳等[12]运用模糊综合评价法对专业人士、游客、艺术家和管理人员在园区布局、功能、环境品质方面的满意度做了量化研究;武乾等[13]运用重要性—满意度分析模型(IPA,importance performance analysis)将居民、游客、入驻商家的满意度指标划分为4个维度,为今后优化完善及合理配置资源提供了有力依据。既有满意度评价研究从使用者视角出发,取得了较显著的进展。

由于工业遗产使用者涉及面较广,不同使用者的满意度影响因素存在差异、界定较为模糊,并且现有研究对不同参与群体的综合考量不足。因此,基于不同群体构建一套科学的评价方法,用于探索社

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工艺相济理念下的建筑学人才培养模式探索
The Architectural Training Model based in Combination of Engineering and Art

摘　要：人才培养模式是建筑专业建设的出发点和落脚点。学生成长需求、学科特点和社会发展成为影响当前建筑学专业建设的突出问题。通过梳理建筑学教育中的“工”“艺”分歧，提出了“工艺相融”的人才培养模式理念。以兰州理工大学实践为例，从培养目标、教学内容、教学实施、实习实践、师资建设和教学评价六个维度构建了建筑学本科人才培养模式。分析了探索践的优势和不足，为同类院校人才培养提供思路。
关键词：培养模式；建筑学专业；工艺相济
Abstract:: An architectural training model for undergraduate under the concept of *Combination of engineering and art* is constructed based on the needs of students' personal growth，characteristics of architecture，social development，and the analysis of the differences between *technology* and *art* in the concept of Architectural Education. Taking the practice of the school of design and art，Lanzhou University of technology as an example，this paper analyzes the advantages and disadvantages of its practical exploration，and puts forward some suggestions，which are expected to be used in the Architectural Education of other local engineering universities，and to provide inspiration for the talent training.
Keywords：Training Model；Architectural Major；Combination of Engineering and Art

1　引言

高等教育的任务之一是培养具有创新精神和实践能力的高级专门人才。2018年《教育部关于加快建设高水平本科教育全面提高人才培养能力的意见》（教高〔2018〕2号）中明确指出高校应主动对接经济社会发展需求，不断优化专业人才培养模式，持续改进人才培养质量机制。建筑业作为我国国民经济的五大支柱产业之一，与时俱进地培养“工艺兼修”的人才在其专业教育中的意义不言而喻。在新经济、新时代背景下，高校的建筑学本科需秉承“新工科”或者说“创意工科”的理念转型升级。[1] 顺应科技升级与创新探索建筑教育新范式，为国家和社会培育科技与人文相济、工科与艺术相融的专业人才成为建筑学教育工作者亟须探讨的议题。

2　工艺相济人才培养的必要性

2.1　个人成长需要

20世纪以来，教育的本体功能发展经历了知识、智力和人三个阶段。与传统高等教育中注重于某一门类的专业知识传授不同，具备良好的科学、人文素养和健康的审美情趣是新时代大学生全面发展的内在要求。就个人就业层面而言，不仅需要接受全面扎实的建筑学专业教育，获得具有充分竞争力的就业能力，为未来的人生和事业储备能量，实现社会价值；更需要广博深厚的博雅教育，在个人成长的关键阶段，塑造健全人格，培

黄河名镇 古韵新颜——青城镇地域性色彩保护

Preserving the regional features of Qingcheng, a charming ancient town on the Yellow River

文图 | 刘奔腾（兰州理工大学设计艺术学院）张洁茹（兰州理工大学设计艺术学院）张杰（兰州理工大学设计艺术学院）
Liu Benteng, Zhang Jieru, Zhang Jie

古镇色彩是指其公共空间中所有物体外部被感知的色彩总和，它积淀着古镇的历史并与古镇一样悠久。色彩是人们对古镇风貌体验的直接途径，也是彰显古镇地域文化的重要载体，色彩逐渐成为历史古镇保护的重要内容之一。因此，探索历史古镇地域性色彩保护方法，不仅有利于彰显古镇色彩特征的价值，还有利于指导历史空间色彩体系的重构，对活化遗产和营造氛围均有积极的意义。

青城古镇概况

青城古镇位于兰州市榆中县最北端的黄河南岸，2007年被国家评为“中国历史文化名镇”。据史书记载，该镇最早为狄青在宋仁宗年间任秦州刺史时巡边所筑，所以叫青城。青城自明代始大面积种植兰州水烟，到清中期逐渐成为兰州水烟的主要产地之一。又得益于黄河的运输之便，青城由水烟运输码头发展成为兰州地区最大的商贸集散地。青城镇至今保留

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基于 CiteSpace 的场所感研究进展分析

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摘要: 场所感是建筑学科研究的重要主题,在国家城市更新背景下进一步备受关注。基于 CNKI 数据库检索文献,利用 CiteSpace 绘制知识图谱,系统地总结了场所感研究的特征,进而从概念辨析、维度划分、影响因素、研究方法和研究主体五个方面分析了研究进展。结果表明: 1) 发文量经历了初始期、爆发期和成熟期三个阶段,并呈指数型增长; 2) 场所感概念随研究发展不断明晰,但现有研究对场所感的维度、影响因素尚未形成共识; 3) 研究对象受时代背景和政策引导的影响显著,不同时期的研究主体有所差异; 4) 研究方法多以定性分析与案例分析相结合为主,近年来定量分析逐渐成为主要手段。今后研究可在影响因素、实践类型等方面进一步探索。

关键词: 场所感; 知识图谱; CiteSpace
中图分类号: TU-02 **文献标志码:** A

Analysis on the Research Progress of Sense of Place Based on CiteSpace

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Abstract: Sense of place is an important topic of research in the discipline of architecture, and has further attracted attention in the context of national urban renewal. Based on the literature search in the CNKI database and the knowledge map drawn using CiteSpace, the characteristics of researches about sense of place are systematically summarized, then the research progress is analyzed in five aspects: concept identification, dimensional division, influencing factors, research methods and research subjects. The results show that: 1) the number of articles published has gone through three stages: the initial period, the explosive period and the mature period, with exponential growth; 2) the concept of sense of place has been clarified with the development of research, but the existing research has not yet formed a consensus on the dimensions and influencing factors of sense of place; 3) the research subjects are significantly influenced by the background of the times and policy guidance, and the research subjects differ in different periods; 4) the research methods are mostly based on a combination of qualitative analysis and case studies, with quantitative analysis gradually becoming the main tool in recent years. Future research can be further explored in the aspects of influencing factors and practice types.

Key words: sense of place; knowledge mapping; CiteSpace

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基于 PSR 模型的历史文化名镇风貌保护质量评价

——以兰州青城为例

The Evaluation on the Feature Protection Quality of the Historic Towns Based on PSR Model: A Case of Qingcheng in Lanzhou

刘奔腾[1] 解晓羽[1] 王立新[2]
Liu Benteng[1], Xie Xiaoyu[1], Wang Lixin[2]

摘要 历史文化名镇风貌保护的质量对于名镇进一步保护与开发具有至关重要的意义。为了更好地衡量风貌保护工作的水平，引入生态学中的 PSR 评价模型，从风貌压力、风貌状态、风貌响应三个维度建立历史文化名镇风貌保护质量评价指标体系，最后运用模糊综合评价法对兰州青城的风貌保护质量进行评价。研究发现：基于 PSR 模型构建的历史文化名镇风貌保护评价指标体系在实践中能够准确反映其保护状态和现状问题，具有较高的科学性和可操作性，能够为历史文化名镇风貌保护工作提供指导和参考。

关键词 历史名镇保护；风貌质量评价；PSR 模型；兰州青城
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Abstract The protection quality of the features of historic towns is of vital significance for the further protection and development of historic towns. In order to better measure the feature protection work, the PSR evaluation model in ecology is introduced to establish the feature protection quality evaluation index system of historic towns from three dimensions of feature pressure, feature status and feature response. Finally, the fuzzy comprehensive evaluation method is used to evaluate the feature protection quality of Lanzhou Qingcheng. It is found that the feature protection quality evaluation index system for historic towns constructed based on PSR model can accurately reflect the protection status and current problems in practice, and is highly scientific and operable, and can provide guidance and reference for the feature protection work of historic towns.

Key words historic town protection; feature quality evaluation; PSR model; Lanzhou Qingcheng

0 引言

历史文化名镇作为历史建筑、传统民居、民风民俗、传统技艺等众多历史文化遗产的集合，蕴含着城乡发展的时代精神、观念价值和思维方式，是人民群众想象力和生命力的体现。2021 年，中共中央办公厅和国务院办公厅在《关于在城乡建设中加强历史文化保护传承的意见》中明确提出，“在城乡建设中系统保护、利用、传承好历史文化遗产”，历史文化保护传承工作全面融入城乡建设和经济社会发展大局，为建设社会主义文化强国提供有力保障[1]。当前，我国城镇建设已经由快速建设阶段逐渐转向高水平发展阶段，但由于过度商业开发、保护观念落后以及原住人口流失等原因，历史文化名镇面临自然风貌污染、人工风貌破坏及人文风貌流失等问题，严重影响和限制了历史文化名镇保护与发展的效果和水平。因此，构建历史文化名镇风貌保护质量评价指标和评价方法，对现有保护效果进行测度，梳理风貌保护过程中的问题和原因，对于提高历史文化名镇风貌保护的水平以及实现风貌保护的可持续发展具有重要意义。

我国对于历史文化村镇保护和风貌保护评价的研究成果较为丰富，随着研究的不断深入，研究成果涵盖了不同的研究尺度，研究日趋呈现多样化。学者们从风貌现状评价[2]、风貌价值评价[3]以及风貌特色评价[4]等不同角度，采用层次分析法、熵值法[5]、SWOT 分析法[6]、VRM 和 SEB[7]等对历史文化名镇的风貌进行评价研究，研究的对象多为江南地区[8]、岭南地区[9]、西南地区[10]等，研究主体从不同视角和不同人群出发，以客观感受和主观感受两方面为基础，从历史研究、基础评价和居

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基于空间句法的甘南传统村落空间形态研究

——以尼巴村与东哇村为例

Research on Spatial Morphology of Gannan Traditional Villages Based on Spatial Syntax: Cases of Niba Village and Dongwa Village

刘奔腾　朱永雪
Liu Benteng, Zhu Yongxue

摘要　甘南传统村落在地域环境、历史文化、社会经济的综合作用下，形成了独特的空间形态特征。文章选取甘南传统村落中的尼巴村与东哇村为研究对象，运用空间句法结合整合度、选择度、连接值、可理解度等参数对上述两村空间形态进行解析，探究村落整体空间结构特征及内部空间的联系性。研究发现，村落整体空间结构不够完善，核心空间难以识别，内部空间联系性较弱。最终，文章从村落现存的问题出发提出相关的优化建议，旨在为甘南传统村落空间形态的研究与发展提供一定的参考。

关键词　空间句法；甘南传统村落；空间形态
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Abstract　Gannan traditional villages have formed unique spatial characteristics under the comprehensive effects of regional environment, historical culture and social economy. In this paper, Niba village and Dongwa village in Gannan traditional villages are selected as the research objects, and spatial syntax is used to analyze the spatial forms of the above two villages from the parameters of integration, selectivity, connectivity and intelligibility, so as to explore the characteristics of the overall spatial structure of the village and the connection of the internal space. It is found that the overall spatial structure of the village was not perfect, the core space was difficult to identify, and the internal spatial connection was weak. Finally, the papers put forward relevant optimization suggestions according to the existing problems of the village in order to provide a reference for the research and development of the spatial form of Gannan traditional villages.

Key words　spatial syntax; Gannan traditional village; spatial form

传统村落拥有丰富的文化内涵和独特的空间系统，在地域历史、传统文化和营建科学方面具有重要价值[1]。自2012年住房和城乡建设部、文化部（现文化和旅游部）、国家文物局、财政部发出《关于开展传统村落调查的通知》以来，传统村落逐渐得到全国学界的重视，其空间形态研究更是成为研究热点[2]。随着国家乡村振兴战略的推进和旅游建设的快速发展，甘南传统村落面临着空间同质化的挑战，探究甘南传统村落的空间特征已成为保护和发展的关键问题。空间句法作为空间形态研究的一种量化方法，逐渐被应用于乡村聚落、传统村落的研究中。基于此，本文运用空间句法对甘南传统村落的空间形态特征进行剖析，以期为甘南地区传统村落空间形态的研究提供一定的参考。

1 研究对象

甘南历史文化悠久，传统村落数目较多，根据传统村落风貌、历史文化底蕴、生活生产方式、民俗信仰等综合条件，选取尼巴村与扎尕那东哇村作为本次主要研究对象，因其处于城市边缘，受到外界干扰较少，所以村落仍保留着完整的风貌特征，在甘南地区具有一定的典型性与代表性。

1.1 尼巴村

尼巴村位于甘南藏族自治州卓尼县的西南部，车巴河横穿村域内部，将村落分为南北两岸，整个村落沿着车巴河呈线形延伸（见图1）。村落旧寨位于车巴河南岸陡峭的阳坡，传统建筑顺应地势依坡而建，在空间上错落有致。

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基于模糊综合评判的兰州屋顶绿化现状评价方法

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摘要：结合自然地域条件探索科学有效的屋顶绿化评价方法.以兰州城市屋顶绿化为研究对象，从设计合理性、成本投入、绿色效益和维护质量四个方面构建评价指标体系.运用模糊综合评判法对兰州屋顶绿化现状进行评价.结果表明：兰州市屋顶绿化的综合评价多处于“中”和“差”等级，存在基质理化特性不高、基础构造不完整、配套设施不健全、养护管理不到位等问题，依据评价结果提出了具体的改善途径.本文基于地区特征构建和设置的屋顶绿化评价体系指标及其权重，具有一定的科学性和有效性，可以为干旱半干旱地区城市生态环境资源管理和规划提供参考依据.

关键词：屋顶绿化；现状评价；模糊综合评判法；兰州市

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Assessment method of roof greening in Lanzhou icth based on fuzzy comprehensive evaluation

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Abstract: The purpose of this paper is to explore a scientific and effective evaluation method of roof greening in combination with natural geographical conditions. The roof greening of Lanzhou city was selected as the research object. In this study, the evaluation index system is constructed from the aspects of design rationality, cost input, green benefit, and maintenance quality. The fuzzy comprehensive evaluation method is used to evaluate the roof greening status in Lanzhou. The results demonstrate that Lanzhou City's comprehensive evaluation of roof greening is mostly in the middle and poor level, which has a large space to be improved. The physical and chemical characteristic index of roof greening substrate is lower and the lack of attention to the construction of drainage and aquifer layer is the binding factor affecting the green benefits of roof greening. The insufficient investment in managed funds and general maintenance personnel with low professional ability are the restrictive factors affecting the green benefits of roof greening. In this paper, the evaluation index system and its weight about roof greening based on geographical characteristic are scientific and effective to some extent. These results can provide a reference for urban eco-environmental resource management and planning in arid and semi-arid areas.

Key words: roof greening; status assessment; fuzzy comprehensive evaluation; Lanzhou city

建设生态宜居城市是我国“新常态”经济、社会发展的基本理念，也是贯彻落实“建设生态文明、推进绿色发展”这一国家基本方略的必然要求[1].在城市高密度发展的趋势下，屋顶绿化是增加绿化覆盖率的有效措施，也是改善城市生态环境、建设海绵城市的重要途径.因此，越来越多的学者开始关注屋顶绿化及相关问题.目前，屋顶绿化评价研究实践较为丰富，主要集中在针对屋顶绿化自身的绿化类型、植

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A landslide susceptibility assessment method considering the similarity of geographic environments based on graph neural network

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ABSTRACT

Landslide susceptibility assessment (LSA) is vital for landslide mitigation and management. Existing LSA methods only consider local environmental characteristics associated with landslides, while neglecting the characteristics of remote yet interconnected geographic environments. In addition, the datasets for landslide samples do not consider the equilibrium among various geographic environmental characteristics. Ultimately, the landslide susceptibility mapping (LSM) generated is unreliable. We propose an LSA method based on the similarity of geographic environments and the equilibrium of landslide samples. We selected the Bailong River Basin (BRB) as the study area. Our proposed LSA method has four steps: (1) We constructed slope units using the curvature watershed method (CWM) based on the digital elevation model (DEM) to generate geographic nodes and selected 12 landslide influencing factors (LIFs) through multicollinearity analysis to extract geographic node features. (2) We constructed an association graph of geographic environment similarity constraints based on geographic node features using the cosine similarity method to correlate landslide and geographical environments. (3) We constructed sample datasets for an equal number of landslide and non-landslides based on various geographic environments. (4) We constructed a graph neural network (GNN) model based on the association graph to predict the susceptibility of unknown geographic nodes, obtaining a reliable LSM. Compared with random forest (RF), support vector machine (SVM), and multi-layer perceptron (MLP) models, our proposed model framework outperforms in the LSA. The area under the receiver operating characteristic curve (AUC) values improved by 6.2%, 5.7%, and 1.8%, respectively. Specifically, our model can predict landslides across space in areas with few samples. Our proposed model offers an effective approach and essential technical support for landslide disaster investigation and prevention.

1. Introduction

Landslides are one of the most prevalent geological hazards in China, causing considerable damage to the personal and property safety of residents (He et al., 2023; Niu et al., 2021). The landslide susceptibility assessment (LSA) is an effective way to predict the spatial location of potential landslides (He et al., 2024b; Reichenbach et al., 2018; Zhao et al., 2022). It can accurately predict the spatial probability of potential landslides and is critical for landslide prevention and management (He et al., 2024a; Mandal et al., 2021; Wei et al., 2022). In recent years, many LSA methods have been developed, predominantly quantitative methods based on mathematical statistics and machine learning (ML) methods. ML exhibits robust capabilities in processing nonlinear relational data and autonomous learning and uncovers implicit relationships between landslides and landslide influencing factors (LIFs). Therefore, ML methods are widely used in LSA (Chang et al., 2023a; Chen et al., 2022; Yuan and Chen, 2023), such as random forest (RF), support vector machine (SVM), multi-layer perceptron (MLP), and convolution neural network (CNN) (Gao et al., 2023; He et al., 2022; Rosi et al., 2023).

However, existing LSA methods based on ML are primarily data-driven, and data quality significantly affects the reliability of the

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Research papers

Increased sensitivity of ecosystem to meteorological drought reduces carbon uptake in the Yellow River Basin☆

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ABSTRACT

Drought sensitivity, defined as ecosystem susceptibility to meteorological drought, is a key indicator of terrestrial ecosystem response to water stress and thereby critically regulates carbon sink function. However, little is known about the spatiotemporal evolution of drought sensitivity and its effects on carbon uptake changes. Here, we integrated multi-source remote sensing gross primary productivity data and meteorological drought indices in the Yellow River Basin from 1982 to 2018. Using interpretable machine learning methods, we revealed post-drought shifts in sensitivity, identified key drivers of the spatial changes in drought sensitivity, and quantified its influence on ecosystem carbon uptake. Our results showed that drought sensitivity of 57.12 % of the basin increased significantly ($P < 0.05$), particularly in arid regions and grassland ecosystems. Climate change was the main driving factor of drought sensitivity change, contributing 75.55 %, with rising solar radiation, intensifying drought, and increasing temperature as the primary factors. Increased drought sensitivity prolonged ecosystem recovery, reducing annual carbon uptake by 0.11 ± 0.05 Tg C during the 3-year recovery period, further weakening the ecosystem carbon sink capacity. Our findings highlight that increasing drought could further amplify the potential risk of carbon sinks in terrestrial ecosystems.

1. Introduction

Terrestrial ecosystem serves as the main carbon sink, absorbing about 0.19–0.26 Pg C yr^{-1} and offsetting about 20 % of global fossil fuel carbon emissions (Piao et al., 2009; Friedlingstein et al., 2022). Gross primary productivity (GPP) is the total amount of carbon dioxide uptake by vegetation and acts as a critical indicator of the carbon sink capacity in terrestrial ecosystems (Wang et al., 2020). However, climate change-driven droughts increasingly threaten the carbon sink function of terrestrial ecosystems productivity (Dai, 2011; Zhou et al., 2024). Drought directly reduces GPP through physiological constraints, including stomatal closure and suppressed photosynthetic efficiency (Cao et al., 2023; Zhang et al., 2016). For example, severe drought occurred in the Yangtze River Basin during July-October 2022 resulted in a total carbon loss of 26.12 Tg C (approximately −6.08 % relative to the 2001–2021 average) in ecosystem GPP (Li et al., 2024). Beyond immediate physiological effects, long-term drought induces structural and functional adaptive changes in vegetation, manifesting as altered biomass allocation and xylem embolism resistance (Anderegg et al., 2013; Doughty et al., 2015; Jin et al., 2023). These modifications indirectly amplify the drought sensitivity of GPP. Although drought events can exacerbate its negative response, such exacerbation may be partially mitigated by vegetation acclimation and adaptive traits under certain conditions (Xu et al., 2018). Increased drought sensitivity not only amplifies carbon flux variability but also increases vegetation mortality risks under recurrent drought changes (Anderegg et al., 2020; Keen et al., 2022). As global warming escalates and droughts become more frequent and intense, drought sensitivity may substantially elevate, potentially challenging the global carbon cycle (Liu et al., 2025). Therefore, elucidating drought-GPP interaction mechanisms is increasingly crucial for refining carbon cycle projections under climate change and formulating effective mitigation strategies.

Previous extensive studies have confirmed distinct variations in GPP sensitivity to water stress across ecosystems during drought periods. At

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Unwrap-Net: A deep neural network-based InSAR phase unwrapping method assisted by airborne LiDAR data

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ABSTRACT

In Interferometric Synthetic Aperture Radar (InSAR) data processing, accurately unwrapping the phase is crucial for measuring elevation or deformation. DCNN models such as PhaseNet and PGNet have improved the efficiency and accuracy of phase unwrapping, but they still face challenges such as incomplete multiscale feature learning, high feature redundancy, and reliance on unrealistic datasets. These limitations compromise their effectiveness in areas with low coherence and high gradient deformation. This study proposed Unwrap-Net, a novel network model featuring an encoder-decoder structure and enhanced multiscale feature learning via ASPP (Atrous Spatial Pyramid Pooling). Unwrap-Net minimizes feature redundancy and boosts learning efficiency using SERB (Residual Convolutional with SE-block). For dataset construction, airborne LiDAR terrain data combined with land cover data from optical images, using the SGS (Sequential Gaussian Simulation) method, are used to synthesize phase data and simulate decorrelation noise. This approach creates a dataset that closely approximates real-world conditions. Additionally, the introduction of a new high-fidelity optimization loss function significantly enhances the model's resistance to noise. Experimental results show that compared to the SNAPHU and PhaseNet models, the SSIM of the Unwrap-Net model improves by over 13%, and the RMSE is reduced by more than 34% in simulated data experiments. In real data experiments, SSIM improves by over 6%, and RMSE is reduced by more than 49%. This indicates that the unwrapping results of the Unwrap-Net model are more reliable and have stronger generalization capabilities. The related experimental code and dataset will be made available at https://github.com/yangwangyangzi48/UNWRAPNETV1.git.

1. Introduction

Phase unwrapping is a crucial process in InSAR technology, designed to recover the absolute phase from interferometric observations (Gao et al., 2024; Yu et al., 2019a; Zhou et al., 2021a). Achieving accurate phase unwrapping is essential for applications such as three-dimensional terrain reconstruction and surface deformation monitoring (Ferretti et al., 2001; Esch et al., 2019; Jiang et al., 2021). However, practical challenges—such as decorrelation noise, terrain variability, and algorithmic limitations—can significantly reduce unwrapping accuracy (Luo et al., 2020; Yu and Hu, 2021). These challenges are especially pronounced in areas with low coherence and steep gradients, where traditional methods frequently fail, limiting the reliability of InSAR-derived measurements. For instance, as shown in Fig. 1, Goldstein's branch-cut method exhibits errors in the phase unwrapping for a mining area (He et al., 2024b).

Recently, deep convolutional neural networks (DCNNs) have demonstrated significant advantages over conventional methods, primarily due to their ability to autonomously learn complex data representations (Wang et al., 2022; Zhou et al., 2021b). Unlike traditional methods, which rely on handcrafted features and specific assumptions, DCNNs can capture intricate relationships within the interferometric phase through multiple layers of nonlinear transformations. This capability allows DCNNs to handle diverse and complex scenarios effectively, reducing dependency on specific conditions and enhancing model adaptability (Yang et al., 2022).

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A Deep Neural Network Framework for Landslide Susceptibility Mapping by Considering Time-Series Rainfall

Binghai Gao, Yi He, Xueye Chen, Hesheng Chen, Wang Yang, and Lifeng Zhang

***Abstract*—Landslide susceptibility mapping (LSM) is of great significance in geohazard early warning and prevention. The existing LSM methods mostly used traditional static landslide conditioning factors (LCFs), which only considered the spatial features of single-pixel neighborhoods and could not extract the time-series dynamic features of developing landslides, resulting in low accuracy and insufficient reliability of LSM. To solve this problem, this study proposes to introduce time-series rainfall factors based on the traditional static factors and construct an integrated time-series dynamic neural network (TSDNN) model for LSM. A convolutional neural network (CNN) adding time-distributed convolution and a bidirectional long and short-term memory neural network is utilized to extract time-series rainfall features, and a multiscale convolutional neural network (MSCNN) is utilized to extract static features of the static LCFs. In this study, multicollinearity analysis and geodetector are utilized to analyze the LCFs. Multiple evaluation metrics are utilized to analyze the proposed model performance. The results indicate that the overall accuracy has improved by introducing time-series rainfall factors, and the susceptibility area of actual predicted is more refined. The study indicates that significant advantages of the proposed TSDNN model are over models [CNN, MSCNN, random forest (RF)] when processing combined static and rainfall data. This is notably evident that the accuracy is enhanced by 12.9%, 10.7%, and 11.4% compared to CNN, MSCNN, and RF models in the receiver operating characteristic curve analysis, respectively. Moreover, two typical areas containing three recent landslide events validate the reliability of the proposed TSDNN model. The proposed network model framework for LSM considering time-series rainfall factors can provide new ideas and key technical support for landslide disaster prevention.**

***Index Terms*—Deep learning (DL), dynamic factors, interferometry synthetic aperture radar (InSAR), landslide susceptibility.**

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I. Introduction

As ONE of the major disasters, landslides are commonly found in mountainous regions around the world posing a grave danger to human life, property, and ecological security [1]. Landslide susceptibility entails the nonlinear amalgamation of a specific geographical location and various environmental factors to assess the likelihood of landslides occurring in that particular area [2]. In the field of landslide research, Landslide susceptibility mapping (LSM) is an important subject [1], [3]. LSM can effectively reveal the potential probability of landslides occurring in a region and provide a scientific basis for planning disaster control and management in the region [4] [5], [6].

Traditional machine learning (ML) techniques can effectively capture the nonlinear relationships [7] between landslides and geographic environments that are frequently employed in LSM, such as random forest (RF) [8], [9], [10] and logistic regression [9], [10]. However, these methods classify the samples directly [11], [12], and hard to fully exploit the underlying and complex characteristics of landslides, resulting in poor reliability for LSM. In past studies, deep learning (DL) models have been employed in landslide identification and the LSM, which can effectively extract not only the deep, inner features of each factor by multilayer neural networks but also the nonlinear relationships between factors. In particular, the convolutional neural network (CNN) has shown very strong capabilities in local feature extraction by using its parameter sharing and local connectivity characteristics [1], [13], [14] and obtained an LSM for Yanshan County, China, with CNN in the region, and demonstrated that the LSM obtained utilizing CNN is more suitable for landslide prevention and management.

Most of the existing LSM studies used a variety of static environmental factors as basic geographic data [14], such as topographic factors (elevation, aspect, slope, relief degree of the land surface (RDLS), terrain ruggedness index (TRI), curvature, etc.), geological factors (distance from faults (DFFA), lithology, etc.), and human engineering activities (distance from roads (DFRO), land use, etc.), among others [15], [16], showed that rainfall intensity and rainfall dynamic process were the key dynamic factors that determined the stability of landslides. It

A Dual-Stream Coding Fusion Network for Landslide Mapping Based on Multisource Remote Sensing Images

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***Abstract*—The accurate acquisition of fine-scale landslide information is critical for disaster early warning and prevention. However, existing landslide detection methods mainly focus on the spatial characteristics of multisource remote sensing data, while often overlooking the cross-channel semantic dependencies inherent in their fusion. This limitation hinders the comprehensive characterization of landslides in complex environments, leading to insufficient recognition accuracy across different shapes and scales, and resulting in missed detections and false alarms. To address this challenge, we propose a dual-stream coding fusion landslide detection network (DSCF-LDNet), which simultaneously models spatial features and cross-channel semantic dependencies in multisource landslide remote sensing data, thereby enabling the high-precision automatic landslide detection. Specifically, the spatial branch employs a multiscale residual network (MSRNet) to extract fine-grained spatial features, whereas the sequential branch integrates an MSRNet with a long short-term memory module (MSRNet-LSTM) to model cross-channel correlations among multisource features. Subsequently, a feature fusion module is designed to integrate both representations, generating more discriminative landslide features. In the decoding stage, an attention-gated decoder module (AGDM) is designed to enhance multiscale feature interactions, thereby improving the model's sensitivity to landslide targets. Experiments on the self-constructed Bailong River Basin dataset demonstrate that DSCF-LDNet achieves a precision of 80.84%, a recall of 77.89%, an *F*1-score of 79.35%, and a mean intersection over union (mIoU) of 81.74%, surpassing benchmark models such as SCDUNet++, STUNet, and Attention-UNet. Tests on Landslide4Sense and Lanzhou Urban Area datasets further confirm the model's robustness across diverse geological settings. Overall, DSCF-LDNet effectively learns both spatial features and interchannel semantic dependencies from multisource remote sensing data, enabling accurate landslide mapping for diverse shapes and scales, and provides a practical framework for large-scale landslide monitoring.**

***Index Terms*—Attention-gated decoder module (AGDM), landslide mapping, long short-term memory (LSTM), multiscale residual network (MSRNet), multisource remote sensing data.**

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I. Introduction

With the intensification of global climate change, extreme weather events such as heavy rainfall have become frequent, significantly increasing the risk of landslides and the associated loss of life and property [1], [2]. Landslides exhibit diverse morphological characteristics and are commonly classified from two perspectives. Based on the geometric shape, landslides can be classified into elongated, equidistant, and wide-spreading types [3]. In terms of scale, they are categorized as large, medium, and small events [4]. A summary of these classification criteria is provided in Table I. High-precision historical landslide cataloging is essential not only for issuing early warnings and minimizing casualties during disaster events but also for providing critical information on landslide locations and spatial extent [5]. This information can support governmental agencies and relevant departments in guiding the construction of protective infrastructure and the development of emergency response strategies. Consequently, one of the primary objectives of current landslide research is to develop high-precision identification methods that can rapidly and accurately acquire landslide. These advancements enhance landslide identification efficiency and response capabilities, thereby mitigating potential social and economic losses [6], [7].

Landslide identification methods are generally categorized into three types: traditional manual field surveys, semiautomatic recognition based on machine learning (ML), and automatic recognition based on deep learning (DL) [8]. Traditional methods rely on manual field investigations to update landslide inventory maps. While this approach yields

A Graph–Transformer Method for Landslide Susceptibility Mapping

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***Abstract*—Landslide susceptibility mapping (LSM) is of great significance for regional land resource planning and disaster prevention and reduction. The machine learning (ML) method has been widely used in the field of LSM. However, the existing LSM model fails to consider the correlation between landslide and disaster-prone environment (DPE) and lacks global information, resulting in a high false alarm rate of LSM. Therefore, we propose an LSM method with graph–transformer that considers the DPE characteristics and global information. First, correlation analysis and importance analysis are employed on nine landslide contributing factors, and the landslide dataset is generated by combining remote sensing image interpretation and field verification. Second, a graph constrained by environment similarity relationship is constructed to realize the correlation between landslide and DPE. Then, the transformer module is introduced to construct a graph–transformer model that considers the global information. Finally, the LSM is generated and analyzed, and the accuracy of the proposed model is compared and evaluated. The experimental results show that the environment similarity relationship graph effectively improves the accuracy of the models and weakens the influence of environmental differences on the models. Compared with graph convolutional network, graph sample and aggregate, and graph attention network models, the area under the curve (AUC) value of the proposed model is more than 2.05% higher under the environment similarity relationship. In addition, the AUC value of the proposed model is more than 8.8% higher than that of traditional ML models. In conclusion, our proposed model framework can get better evaluation results than most existing methods, and its results can provide effective ways and key technical support for landslide disaster investigation and control.**

***Index Terms*—Environment similarity relationship, graph, landslide susceptibility mapping (LSM), transformer.**

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I. Introduction

LANDSLIDE disasters often appear in people's production and life, their strong destructive power will not only change the topography but also cause people's lives and property losses [1], [2]. Therefore, it is very important to evaluate the susceptibility of landslides scientifically and prevent landslide disasters in time. Landslide susceptibility mapping (LSM) refers to predicting the spatial distribution of the probability of landslide occurrence according to the characteristics of topography and geomorphology in the study area [3], [4], which is of great significance to the prevention of landslide disasters and the planning and siting of cities.

With the rapid development of artificial intelligence and Big Data, scholars [5], [6], [7] in LSM fields have begun to use machine learning (ML) methods to evaluate landslide susceptibility, such as multilayer perceptron (MLP) [8], convolutional neural network (CNN) [9], and gate recurrent unit (GRU) [10]. Compared with traditional landslide susceptibility assessment methods, ML has a more powerful feature analysis ability, which can further improve the reliability of LSM [11], [12], [13]. In recent years, as an important branch of ML, deep learning (DL) has inherited and developed the advantages of ML algorithms [14]. For landslide disaster, its formation conditions are relatively complex, and the amount of data involved is also relatively large. Theoretically, DL can better extract the formation characteristics of landslide disasters, efficiently and quickly process various landslide-related data, and more accurately assess the probability of landslides. For example, Zhao et al. [15] proposed a local and global feature extraction network, which combines the advantages of CNN and transformer models. Chen et al. [16] proposed a new hybrid framework combining landslide conditioning factors with swin transformer for landslide analysis. However, although these DL methods can obtain reliable LSM in simple small scenes, for complex environment scenes, there are still limitations that cannot consider the correlation between landslide and disaster-prone environment (DPE), and lack of feature extraction ability, resulting in a high false alarm rate of LSM.

The graph is generally represented as $G = (V, E)$, where V is the set of nodes in the graph, and E is the set of edges between nodes [17], [18]. Each edge represents the relationship between nodes [19]. Considering the complexity between landslide and DPE, compared with a single feature sequence or image, the graph structure has a high degree of data abstraction and

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An identification method of potential landslide zones using InSAR data and landslide susceptibility

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ABSTRACT

Landslides are destructive to property, infrastructure and people in potential landslide zones. Identifying potential landslides is an important step in landslide preparedness and will help develop sustainable landslide risk management. Interferometric synthetic aperture radar (InSAR) and landslide susceptibility assessment (LSA) have poor reliability in individually identifying potential landslide zones. This study proposes a threshold model for identifying potential landslide zones that fuses the InSAR two-dimensional (vertical direction and east-west direction) deformation rates and LSA results. The deformation rate threshold for this threshold model is $|D_U|$ or $|D_E|>10$ mm/year (D_U and D_E are the vertical and the east-west deformation rates, respectively), with threshold levels of LSA set to high and very high susceptibility. The criterion of potential landslide zones is (($|D_U|$ or $|D_E|>10$ mm/year) $\cap$ (high or very high susceptibility of LSA)), and points with similar deformation and susceptibility are clustered by the K-means algorithm, and the potential landslide zones are obtained by elimination, smooth and speckle removal operations. The results showed that the InSAR two-dimensional deformation rates D_U and D_E were $-32.71 - 12.72$ mm/year and $-14.88 - 24.81$ mm/year, respectively, during 2015–2020 in Lanzhou city. The LSA showed that very low, low, medium, high, and very high susceptibility accounted for 55.36%, 10.54%, 21.37%, 9.63%, 3.1% of the total area, respectively. Using the proposed threshold model, 117 potential landslide zones were identified in Lanzhou. The overlap rate between potential landslide zones and the landslide inventory was 40.17%, indicating that about 40% of the potential landslide zones overlapped with the landslide inventory and that about 60% were new potential landslide zones in Lanzhou. The feasibility of the threshold model in identifying potential landslides was confirmed by field research and time-series InSAR analysis on typical areas (L1, L2, L3, and L4), which had large deformation variables and landslide features. The proposed method can quickly determine the

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Potential landslide zones; SBAS-InSAR; landslide susceptibility assessment; threshold model

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Time-Series Analysis and Prediction of Surface Deformation in the Jinchuan Mining Area, Gansu Province, by Using InSAR and CNN–PhLSTM Network

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***Abstract*—Surface deformation poses a great threat to the safety of Jinchuan mining area production activities. At present, the spatio-temporal evolution law and mechanism of surface deformation in the Jinchuan mining area are unclear, and it is difficult to obtain reliable prediction results using the existing spatio-temporal prediction methods due to the lack of model parameters or relevant data. To solve these problems, this study proposes a new unified convolutional neural network with peephole long short-term memory (CNN-PhLSTM). Small baseline subset interferometric synthetic aperture radar (SBAS-InSAR) technology was used to obtain the spatio-temporal evolution characteristics of surface deformation in the period of 2014–2021. Time series InSAR deformation data are merged into a unified network model in series with a time-distributed CNN segmentation and stacked PhLSTM. The InSAR measurement results are shown to be reliable by comparison and verification with the benchmark and InSAR results of different orbits. The proposed CNN-PhLSTM model was evaluated by mean absolute error and structural similarity (SSIM) evaluation indexes, and was compared with support vector regression (SVR), multilayer perceptron (MLP) and CNN-LSTM models. The results show three continuous subsidence areas, namely the Longshou, second western and third eastern mining areas. The cumulative surface deformation continued to increase from 2014 to 2021. Faults and lithology control the spatial distribution of surface deformation in the Jinchuan mining area. The prediction results demonstrate that the surface deformation range will continue to expand and that time-series surface deformation will show a slow deceleration trend in the next two years.**

***Index Terms*—Interferometric synthetic aperture radar (InSAR), mining area, peephole long short-term memory (PhLSTM), predictive simulation, surface deformation.**

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I. Introduction

MINERAL resources have played a significant role in promoting China's economic development, with the mining economy accounting for 5.5% of China's GDP. However, the large-scale exploitation of mineral resources inevitably leads to surface deformation, surface collapse, and other potential disasters [1]. According to the survey results of the China Institute of Geological Environment Monitoring, at the end of 2015, the volume of mined-out sites formed by underground mining in China reached 12.8×10^6 m^3, causing a variety of geological disasters, such as mine collapse and collapse, resulting in a large number of property losses, and casualties [2]. A typical example of this phenomenon is the surface subsidence of a mined-out area in the Zhaoyuan gold mine in Shandong Province, which led to the destruction of a large area of highway and major economic losses, according to the results of a national mine geological environment survey. In the face of such a serious surface deformation problem, it is necessary to monitor and predict the spatiotemporal characteristics of surface deformation in mining areas in real time [3], [4].

Many scholars have used global position system (GPS) and leveling methods for the real-time monitoring of surface deformation in mining areas [5], [6], [7], but these methods have the disadvantages of small monitoring range, low monitoring efficiency, high cost, and low monitoring site density [8]. Interferometric synthetic aperture radar (InSAR) is a high-precision measurement technology that uses phase differences to obtain information about surface deformation [9], [10], [11]. Compared with traditional methods, InSAR has a higher density of monitoring points, a larger monitoring range, and a higher monitoring efficiency [12], [13]. The research results of many scholars prove that InSAR technology is an effective method for monitoring surface deformation in mining areas [14], [15], [16], [17], [18]. For example, Li et al. [19] evaluated the stability of residential buildings in the Huainan mining area by combining a time-series InSAR analysis method with an empirical model of building damage levels. Ma et al. [20] investigated

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A unified network of information considering superimposed landslide factors sequence and pixel spatial neighbourhood for landslide susceptibility mapping

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ABSTRACT

Landslide susceptibility mapping (LSM) is very important for hazard risk identification and prevention. Most of existing neural network models extract a pixel neighborhood feature or a pixel sequence feature of landslide factors on one side, which leads to the generalization ability of the network models difficultly, and had a low prediction accuracy in complex scenes. In this paper, a new unified network of information considering superimposed landslide factors sequence and pixel spatial neighbourhood is proposed for LSM. Different from the traditional prediction model framework, the landslide conditioning factors are merged into a unified network model in parallel with the pixel sequence features and pixel neighbourhood features. In the experiment, we take the proportion of landslide binary pixels as label data, which represents the landslide possibility in the neighbourhood. We propose a pixel sequence feature extraction algorithm based on a gated recurrent unit (GRU) network and a pixel neighbourhood feature extraction algorithm based on a multi-scale convolution neural network (MSCNN). In this study, the landslide conditioning factors were analysed by multicollinearity analysis and the frequency ratio (FR) method. The performance of the modes was evaluated by statistical indexes and the correlation analysis. The LSM results were verified by google earth images and field investigation. Our research shows that the proposed model can greatly improve the accuracy of LSM compared with the individual GRU and MSCNN, especially, the proposed model had 6.1% more improvement than the GRU model in terms of the area under curve (AUC). Therefore, we suggest that the proposed model is a suitable technology for use in early identification and landslide prediction.

1. Introduction

Landslides are considered to be one of the most serious natural disasters in the world, with them causing considerable damage to public infrastructure and human life every year (Avalon et al., 2016; Chen et al., 2017a; Dai et al., 2020). Due to many factors affecting landslides, landslide prediction is very difficult, and landslide prediction modelling is one of the main challenges of geological disaster research. Landslide susceptibility mapping (LSM) is a comprehensive evaluation based on remote sensing image and geographic information system (GIS) spatial analysis of landslide influence factors and landslide characteristics (Pradhan, 2010). LSM is also an effective visualization technology for landslide regional positioning and sustainable land resource management (Wang et al., 2015; Chang et al., 2020). The LSM model can provide an important theoretical basis for regional land resource planning and disaster prevention and mitigation.

LSM is one of the important research topics of landslide risk prediction. A suitable LSM model is very important for improving the accuracy of LSM. Nowadays, machine learning has been introduced into the research and application of LSM (Chen et al., 2017b; Bui et al., 2019; Hong et al., 2020; Du et al., 2020). With the increasing complexity of scenes and the increasing demand for LSM accuracy, the traditional machine learning method is not deep enough to fully extract the underlying features of landslides, and the model has some problems, such

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InSAR-Based Surface Deformation Analysis and Trend Prediction in Permafrost Areas Along the Qinghai-Tibet Railway Using Sentinel-1A and Environmental Factors

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***Abstract*—Global warming is accelerating the permafrost degradation along the Qinghai-Tibet railway (QTR), causing the surface deformation (SD) of the railway subgrade. Especially in the Salt Lake to Wuli section of the QTR, the permafrost is widely distributed, and the SD has been the most serious. However, the spatiotemporal characteristics and mechanism of SD are still unclear. In addition, it is very important to predict the future trend of SD. Therefore, we acquired time series SD results from 2019 to 2022 based on small baseline subset interferometric synthetic aperture radar (SBAS-InSAR) and analyzed the spatiotemporal characteristics and mechanism of SD in the Salt Lake to Wuli section. Subsequently, the EnvCA-GRU model for SD prediction was developed, integrating the multihead cross-attention mechanism and gated recurrent unit (GRU) to account for changes in environmental factors. The model was then employed to forecast SD trends over the next two years. Our results showed that the SD was uneven in the Salt Lake to Wuli section of the QTR from 2019 to 2022, there were six typical deformation areas, and the maximum cumulative ground subsidence reached 126.79 mm. The SD velocity of the sunny slope was higher than that of the shady slope, and the closer to the QTR, the greater the ground subsidence. Land surface temperature (LST), normalized difference vegetation index (NDVI), and precipitation are the main factors affecting SD. Our proposed EnvCA-GRU prediction model fusing NDVI, LST, and precipitation showed a root mean square error of 0.153 and an R^2 of 0.991, the proposed model was reliable. The maximum cumulative ground subsidence of six typical areas by July 2024 reached 177.52, 268.08, 287.73, 270.99, 190.70, and 211.89 mm, respectively. The results of this study can play a guiding role in the early warning and mitigation of ground subsidence disasters along the QTR.**

***Index Terms*—Deformation prediction, EnvCA-gated recurrent unit (GRU), Qinghai-Tibet railway (QTR), small baseline subset interferometric synthetic aperture radar (SBAS-InSAR), thawing subsidence.**

I. Introduction

THE Qinghai-Tibet Plateau (QTP) encompasses an area of approximately 1.06×10^6 km^2, with 40% of it underlain by permafrost [1], [2]. In the background of global warming, the permafrost areas of the QTP have decreased by 2.4×10^5 km^2 from 1960 to 2020 [3], and it is projected to shrink by nearly half by the end of the century [4]. The permafrost degradation not only induces hazards such as seasonal thaw settlement and thaw slumping [5], [6] but also contributes to the formation of thermokarst lakes [7]. These hazards pose a threat [8] to Qinghai-Tibet railway (QTR) subgrade traversing 630 km of permafrost [9], [10], affecting infrastructure safety, operation [11], and stability [12], [13]. Accurate time-series monitoring of surface deformation (SD) in permafrost areas and reliable time-series prediction of future trends are necessary for the safe operation of the QTR and early warning of thawing subsidence.

Traditional geodetic methods make it difficult to effectively perform large-scale deformation monitoring tasks due to the harsh natural environment of the QTP. The small baseline subset interferometric synthetic aperture radar (SBAS-InSAR) technology [14] can effectively reduce atmospheric delay and related noise error [15] caused by too long space-time baseline. At the same time, SBAS-InSAR is not affected by weather and has a wide monitoring range, it has been widely used in the fields of SD monitoring [16], infrastructure deformation monitoring [17], subgrade deformation monitoring [18], and SD monitoring in permafrost areas under complex engineering environment [19]. However, few studies have explored the spatiotemporal elationships between time-series InSAR SD and environmental factors (EFs) in permafrost areas. Meanwhile, the mechanism of

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RESEARCH ARTICLE

Spatiotemporal dynamics of the vegetation in Ningxia, China using MODIS imagery

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Abstract The vegetation in the Ningxia Hui Autonomous Region (henceforth, Ningxia) of north-western China plays an important role in guarding regional ecological safety and sustainable development. However, it is unclear how climate affects vegetation growth in terms of seasonality and various vegetation types in Ningxia. Based on remote sensing vegetation index from 2001 to 2016, climatic parameters, and the Chinese vegetation type data, this article examines the spatiotemporal effects of climate parameters on vegetation. The relative importance to variability in the normalized difference vegetation index (NDVI) for different seasons and various vegetated types is also determined. The results demonstrate that the vegetation increased from 2001 to 2016 in Ningxia. The rate of NDVI increase was fastest in summer and slowest in spring. Areas with significant increases in vegetation occurred primarily in the southern mountain, Liupan Mountain, and central arid areas. Degraded vegetation occurred in the Yellow River irrigation area with intense human activity influence. The vegetation in most areas of Ningxia will continue to increase in the future. The sensitivity of vegetation to temperature, precipitation, sunshine duration, and wind velocity showed significantly seasonal variability. Sunshine duration and wind velocity were important climatic factors affecting vegetation growth in Ningxia. However, the impact of summer precipitation variation on summer NDVI (SMN) demonstrated a time lag effect. The impact of climate variation on vegetation was distinct among various vegetation types. Moreover, the spatial pattern of vegetation in Ningxia was also impacted by human activities.

Keywords spatiotemporal patterns, vegetation NDVI, climatic parameter, Hurst exponent, Ningxia

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1 Introduction

Global climate has undergone substantial changes that significantly affect human lives, natural environments, and socio-economic development. Vegetation can reflect climate change and has been used to detect changes in the water, soil and atmosphere (Gerten et al., 2004; Guo et al., 2014; Lei et al., 2014; Mao et al., 2015; Nair et al., 2017). Previous research has shown the relations between vegetation and climate exhibiting specific characteristics in different regions, e.g., the correlation of vegetation to climate parameters was very strong in one place with one certain time, but weak in other locations at different times (Zhao et al., 2011; Wang et al., 2015; Zhang and Wang, 2015). Therefore, it is clear that the effect of climate variation on vegetation is spatiotemporally correlated in different geographic regions. Furthermore, it needs to be further explored. Vegetation is an important part of the ecosystem and responds to climate variation in north-western China and Central Eurasia. These regions are characterized by slight precipitation and thin vegetation, and have a high risk of desertification (Jamali et al., 2014). Ningxia Hui Autonomous Region (henceforth, Ningxia) in north-western China is a typical arid region characterized by a fragile ecological environment. Vegetation change in Ningxia can guard the regional ecological security of the north-western China. Therefore, considerable research focused on vegetation change in Ningxia (e.g., Jin et al., 2007; Du and Tian, 2012; Zong and Wang, 2014).

The NDVI is largely applied for vegetation dynamic monitoring that is affected by climatic changes (Mao et al., 2012). Using NDVI, researchers have achieved significant advancements in the field (Hu et al., 2011; Zhang et al., 2013a; Xu et al., 2016). Research in the field included following: Chen et al. (2007) used GIMMS NDVI data to analyze the average vegetation coverage in each geographical unit from 1982 to 2004 and establish statistical

基于 R2AU-Net 的 InSAR 相位解缠方法

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摘　要:InSAR 相位解缠的质量直接影响地形高程或地表形变的反演精度。传统的基于非机器学习模型的相位解缠方法(如基于路径跟踪或最小范数)在低相干性或相位梯度较大(干涉条纹密集)的区域难以获得正确解缠结果。深度神经网络算法在非线性表示和特征表达能力方面具有独特优势,被广泛应用于数字图像处理研究中,InSAR 相位解缠可视为图像回归。本文提出基于 R2AU-Net 深度神经网络的 InSAR 相位解缠方法。首先,基于数学分形法模拟成对的缠绕和解缠相位,避免了外部 DEM 合成相位时引入的固有误差和残缺问题,保持了地貌特征的多样性及复杂性,得到模型训练所需的数据集。然后,基于传统的 U-Net 模型构建 R2AU-Net 相位解缠模型,该模型结合注意力机制增强了模型对于卷积特征筛选能力,提高了在低相干或条纹密集区域的解缠性能;使用循环残差卷积结构,避免了梯度消失问题,增强了模型特征表示能力。最后,利用模拟和真实数据进行试验分析,结果表明本文提出的 R2AU-Net 相位解缠模型能够更有效地保留地形高程或真实地表形变信息,提高了解缠结果的可靠性,在性能表现上优于 Goldstein 枝切法、SNAPHU 方法及 CNN 和 U-Net 相位解缠模型。

关键词:InSAR;相位解缠;深度神经网络;U-Net;地表形变

合成孔径雷达干涉测量技术(interferometric synthetic aperture radar,InSAR)可以实现高精度、大范围、全天候的地形或形变监测,被广泛应用于地质灾害监测、水资源管理、建筑物变形监测、矿产资源勘探、地形三维重建等领域[1-3]。近些年,我国在经济、军事、科技等领域飞速发展,相关部门对形变监测或者地形重建的精度要求越来越高。在数据源固定的条件下,对 InSAR 反演精度的要求本质上就是对 InSAR 数据处理算法的要求,特别是相位解缠算法的性能和效率对 InSAR 地表形变监测精度或者地形三维重建精度具有关键的影响[4],因此,设计和实现高效高精度的相位解缠算法对于提高时序 InSAR 形变监测或地表三维重建精度具有重要意义。

SAR 影像经过配准,干涉处理之后会得到 InSAR 干涉相位,干涉相位具有周期性或混叠性,

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A landslide extraction method of channel attention mechanism U-Net network based on Sentinel-2A remote sensing images

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ABSTRACT

Accurate landslide extraction is significant for landslide disaster prevention and control. Remote sensing images have been widely used in landslide investigation, and landslide extraction methods based on deep learning combined with remote sensing images (such as U-Net) have received a lot of attention. However, because of the variable shape and texture features of landslides in remote sensing images, the rich spectral features, and the complexity of their surrounding features, landslide extraction using U-Net can lead to problems such as false detection and missed detection. Therefore, this study introduces the channel attention mechanism called the squeeze-and-excitation network (SENet) in the feature fusion part of U-Net; the study also constructs an attention U-Net landside extraction model combining SENet and U-Net, and uses Sentinel-2A remote sensing images for model training and validation. The extraction results are evaluated through different evaluation metrics and compared with those of two models: U-Net and U-Net Backbone (U-Net Without Skip Connection). The results show that proposed the model can effectively extract landslides based on Sentinel-2A remote sensing images with an F1 value of 87.94%, which is about 2% and 3% higher than U-Net and U-Net Backbone, respectively, with less false detection and more accurate extraction results.

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KEYWORDS
Sentinel-2A remote sensing image; landslide extraction; U-Net; attention mechanism; deep learning

1. Introduction

Landslides are a common geological disaster, in which a large amount of rocks, debris, or soil is loosened by rivers, rain, earthquakes, and other factors before moving, downward along a slope under the effect of gravity (Prakash, Manconi, and Loew 2020). Landslides are characterized by high hazard and destruction, susceptibility, and suddenness, posing a serious threat to the safety of human life and property worldwide while, causing damage to the surface environment (Cheng et al. 2021; Thomas et al. 2021; Wandong et al. 2021). Therefore, rapid and accurate landslide extraction of landslide areas is essential for carrying out emergency relief work and postdisaster recovery. In addition, accurate landslide extraction to obtain spatial information on landslides,

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RESEARCH ARTICLE

A scalable graph transformer for large-scale landslide susceptibility mapping: a case study in the Upper Yellow River Basin

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ABSTRACT

Landslide susceptibility mapping (LSM) is crucial for disaster prevention and regional planning; however, existing approaches face challenges in large-scale and heterogeneous environments owing to high computational costs and limited capacity for modeling long-range dependencies. To overcome these limitations, we proposed a scalable Graph Transformer with a dual-branch design. It integrates a linear attention-based Transformer, which reduces the computational complexity for global dependency modeling, and a Scalable Inception Graph Neural Network (SIGN), which emphasizes local feature extraction and multiscale feature integration. Additionally, consistency regularization loss was incorporated to enhance the robustness and generalizability. Experiments in the Upper Yellow River Basin, which is characterized by complex and diverse geomorphology, show that the proposed model achieves 81.7% accuracy and 88.8% recall, outperforming traditional machine learning methods and mainstream Graph Neural Networks (GNNs) with improvements of 5% and 3.7%, respectively. Furthermore, we introduced the Mean Average Distance (MAD) and the gap of MAD values (MADGap) to quantify the over-smoothing problem in a GNN-based LSM. The proposed model exhibited consistently higher MADGap values across multiple subgraphs than mainstream GNNs, indicating its superior capacity in mitigating over-smoothing and confirming its overall accuracy and effectiveness for large-scale LSM.

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KEYWORDS
Landslide susceptibility mapping; graph neural network; graph-transformer; Upper Yellow River Basin

1. Introduction

As highly destructive geological hazards, landslides pose severe threats to human life, property, and regional economic development (Ghanbari *et al.* 2025). Landslide susceptibility mapping (LSM) predicts the probability of landslide occurrence by integrating multi-source environmental factors, thereby providing critical information for

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RESEARCH ARTICLE

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A spatiotemporal displacement prediction method for InSAR-detected landslides using a graph neural network coupling spatial and temporal features

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ABSTRACT

Accurate spatiotemporal prediction of landslide displacement is crucial for early disaster warning and risk mitigation. However, existing deep learning-based models typically focus on either temporal or spatial features independently, without adequately capturing the interactions and dependencies between them, leading to reduced prediction accuracy. In this study, we propose a novel InSAR-based landslide displacement prediction method that integrates spatial and temporal features through a graph neural network (GNN) framework. Taking the Heifangtai landslide area in the Chinese Loess Plateau as a case study, we first utilize SBAS-InSAR techniques on multi-orbit Sentinel-1A data to derive surface deformation time series, and apply a three-dimensional decomposition method to extract east-west, vertical, and north-south displacement components. Four typical landslide regions in the Heifangtai area are selected as experimental scenarios, and their corresponding spatial nodes are defined through a grid-based approach to construct an adjacency matrix, forming a spatial graph. We then develop a hybrid model, GCN-MHSA-TCN (GMTC), which combines Graph Convolutional Networks (GCN), Multi-Head Self-Attention (MHSA), and Temporal Convolutional Networks (TCN) to jointly learn spatiotemporal dependencies for accurate landslide displacement forecasting. Experimental results demonstrate that the proposed method effectively captures both local and long-range spatiotemporal correlations, achieving improved prediction accuracy and robustness compared to existing approaches. Moreover, across the four typical landslide regions, the GMTC model achieves an average root mean square error (RMSE) of 0.13 mm, representing the best performance among all evaluated prediction models. The predicted displacement time series exhibit high consistency with observed values and demonstrate greater temporal stability. This model offers a promising tool for supporting landslide monitoring, hazard assessment, and emergency evacuation planning based on InSAR time-series data.

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KEYWORDS
Landslide displacement prediction; InSAR; three-dimensional decomposition; GNN

1 Introduction

Landslide disasters occur frequently in China, posing serious threats to people's lives and property (Zhang et al. 2024). Landslide displacement, as a direct indicator of landslide activity status, serves as a critical metric in early landslide warning systems (Yang et al. 2024; Meng et al. 2024; Jiangang Lu et al. 2024). Therefore, conducting landslide displacement monitoring, multidimensional analysis, and prediction research to achieve high-precision displacement forecasting holds significant scientific importance and practical value for enhancing early warning capabilities and reducing disaster risks (Liu, Zhao, Zhang, Yin, et al. 2021; Wang et al. 2022; Chang et al. 2025).

In recent years, some researchers have employed GPS and leveling surveys to monitor landslide deformation; however, these methods suffer from high costs, limited monitoring coverage, and sparse

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A Heterogeneous Ensemble Learning Method Combining Spectral, Terrain, and Texture Features for Landslide Mapping

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***Abstract*—The existing landslide recognition methods mainly focus on the use of spectral bands of optical remote sensing and machine learning base classifiers, which are insufficient in landslide characterization in complex scenes, resulting in a high missed and false detection of landslides. In this article, we develop a landslide recognition framework, which combines the multidimensional feature advantages of spectral, terrain, and texture of optical satellite images, and constructs a heterogeneous ensemble learning method for landslide mapping. First, we construct a landslide multidimensional feature dataset using Sentinel-2A and Advanced Land Observing Satellite digital elevation model data. Then, we construct a heterogeneous ensemble learning landslide recognition method, which combines the advantages of fully convolutional network, U-Net, and attention U-Net base classifiers to fully learn the multidimensional features of landslides. Finally, we evaluate the performance of the landslide recognition framework in the Bailongjiang River Basin complex scenes. The experimental results show that integrating the multidimensional features of spectral, terrain, and texture and using the heterogeneous ensemble learning method can reduce the missed and false detection of landslides in complex scenes. Specifically, compared with using only spectral bands, integrating spectral bands, spectral indexes, terrain factors, and texture indexes achieves the highest Recall, Kappa, F1-score, and MIoU in testing areas, and missed alarm (MA) is reduced by 15.56%. Compared with deep learning base classifiers, the constructed heterogeneous ensemble learning demonstrates improvements in Recall ranging from 41.67% to 69.89%, and MA is reduced from 52.17% to 30.11%. This study provides a new idea for high-precision landslide recognition in complex environments.**

***Index Terms*—Ensemble learning, landslide detection, spectral index, texture index, U-Net.**

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I. Introduction

A landslide is a frequent geological disaster in nature. Landslides have caused huge losses to the ecological environment, communication systems, transport services, and human life and property [1], [2]. China is a country with frequent geological disasters, among which the landslide disaster occurs most frequently [3]. A total of 3 668 geological disasters occurred in China in 2023, of which 925 were landslides, accounting for 25.21% of the total annual geological disasters. Therefore, it is very important to obtain landslide information quickly and accurately for formulating disaster relief plans and emergency measures [4]. Using geological data and information technology to quickly detect and warn landslides in a large area is of great significance for speeding up disaster reduction and prevention and winning the battle of disaster prevention and control [5], [6].

Landslide recognition methods mainly include visual interpretation, object-oriented [7], traditional machine learning [8], [9], and deep learning [10], [11]. Among them, the deep learning method can obtain the optimal parameters of the construction model [12], [13]. Deep learning has been widely used in landslide recognition; for example, fully convolutional network (FCN) [14], [15], U-Net [16], [17], region-based convolutional neural network (R-CNN) [18], and YOLO [19], [20]. FCN and U-Net models are simple and have a strong ability to learn features, so they are widely applied for landslide recognition [15], [17]. However, most of the existing studies mainly use the spectral bands of optical remote sensing. In the face of complex geographical and geological environments, landslide colors in remote sensing images of different regions are diverse spectral and textural characteristics of different background environments [21], such as soil type, water content, solar incidence angle, and vegetation. For example, in some areas with sparse vegetation, landslide colors in remote sensing images are very similar to those of bare lands. The existing landslide recognition methods based on deep learning using spectral bands have high missed and false detection rates in complex environments [11].

Some studies have tried to increase spectral index [22], terrain factor [16], [23], [24], and texture index [25] to extract information, respectively, and these studies have achieved excellent results. However, the existing studies do not integrate the multidimensional features of spectral band, spectral index, terrain index, and texture index for landslide detection, which leads to

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An integrated neural network method for landslide susceptibility assessment based on time-series InSAR deformation dynamic features

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ABSTRACT

We develop an integrated neural network landslide susceptibility assessment (LSA) method that integrates temporal dynamic features of interferometry synthetic aperture radar (InSAR) deformation data and the spatial features of landslide influencing factors. We construct a time-distributed convolutional neural network (TD-CNN) and bidirectional gated recurrent unit (Bi-GRU) to better understand the temporal dynamic features of InSAR cumulative deformation, and construct a multi-scale convolutional neural network (MSCNN) to determine the spatial features of landslide influencing factors, and construct a parallel unified deep learning network model to fuse these temporal and spatial features for LSA. Compared with the traditional MSCNN method, the accuracy of the proposed model is improved by 1.20%. The performance of the proposed model is preferable to MSCNN. The area under the receiver operating characteristic curve (AUC) of the testing set reaches 0.91. Our LSA results show that the proposed model clearly depicts areas with very high susceptibility landslides. Further, only 10.18% of the study area accurately covers 84.79% of historical landslide areas. Subjective consequences and objective indicators show that the proposed model that is integrated time-series InSAR deformation dynamic features can make full use of landslide characteristics and effectively improve the reliability of LSA.

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KEYWORDS
Landslide susceptibility assessment; InSAR; time distributed convolutional neural network; bidirectional gated recurrent unit; remote sensing

1. Introduction

Landslides damage or destroy houses, roads, bridges and other infrastructure, often resulting in casualties and property losses (Dai et al. 2020; He et al. 2023a). In addition, landslides destroy land ecosystem, causing environmental problems, such as soil erosion, water and soil loss and water pollution (Keefer and Larsen 2007). Early landslide positioning and prevention are the best measures available for reducing and avoiding disaster losses (Chawla et al. 2002; Mantovani et al. 2023). Landslide susceptibility assessment (LSA) explores the complex relationship between landslides and disaster-prone environments (He et al. 2021a). LSA determines the occurrence probability of unknown landslides in similar environments through comprehensive evaluation (Cantarino et al. 2019; Fan et al. 2021; Thomas et al. 2021). LSA can provide strong support to landslide

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DBPFNet: a double branch parallel fusion neural network method for land subsidence susceptibility mapping with InSAR observation data

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ABSTRACT

Current machine learning methods for land subsidence susceptibility mapping (LSSM) predominantly focus on the spatial features of land subsidence conditioning factors (LSCFs), overlooking the sequence relationships that merger after the superposition of these factors. This often leads to unreliable LSSM results. To address this limitation, this paper proposes a novel double-branch parallel fusion neural network, termed DBPFNet, which integrates multi-factor sequence and spatial features to improve LSSM accuracy. The Beijing Plain is selected as the study area. InSAR-derived land subsidence data are used as positive samples, and 12 LSCFs are chosen for analysis. Convolutional neural network (CNN) is employed to learn multi-factor spatial features, while long short-term memory (LSTM) is used to learn multi-factor sequence features. The spatial and sequence features are fuzed by two full connections to generate the LSSM. Experimental results demonstrate that the proposed DBPFNet model significantly outperforms CNN, LSTM and transformer models in terms of performance, yielding highly accurate LSSM result. The high susceptibility areas are predominantly located in the central region of Beijing Plain. Key factors influencing land subsidence in the study area include groundwater, altitude, build density, precipitation and river density.

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KEYWORDS
Land subsidence susceptibility; InSAR; CNN; LSTM; GIS and RS

1. Introduction

Land subsidence is a geological disaster resulting from both natural and anthropogenic factors (Qin et al. 2018). It is characterized by regional, long-term and varying characteristics. In the early stage, land subsidence is often imperceptible, yet it predominantly occurs in medium and large cities, posing significant threats to local urban safety and hindering sustainable economic and social development (Lei et al. 2022). Since the beginning of the twenty-first century, approximately 150 cities worldwide have experienced land subsidence, with over 50 of these cities located in China (Cao et al. 2019; He et al. 2023a). The urban areas exhibiting a cumulative subsidence greater than

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RESEARCH ARTICLE

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Assessing spatiotemporal consistency of vegetation productivity indicators (SIF, GPP, NPP) in northwest China: climate and vegetation perspectives

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ABSTRACT

Accurate assessment of vegetation productivity dynamics is critical for understanding ecosystem responses to environmental change. However, the spatiotemporal consistency among key remote sensing indicators, such as solar-induced chlorophyll fluorescence (SIF), gross primary productivity (GPP), and net primary productivity (NPP), remains poorly quantified, especially in ecologically fragile drylands of Northwest China (NWC). In this study, we developed a dual-factor framework integrating climate and vegetation perspectives to evaluate the consistency and inconsistency among SIF, GPP, and NPP across diverse climatic gradients and vegetation types from 2000 to 2020. We found that all three indicators increased significantly across most of NWC ($p < 0.05$), with higher values in the southeast and lower values in the northwest. Only 61.41% of the pixels presented fully consistent trends, which were concentrated in humid eastern regions. In contrast, 38.59% of the pixels presented inconsistent trends among SIF, GPP, and NPP, which were predominantly located in arid and subarid transition zones and central grasslands. Notably, SIF and GPP demonstrated strong consistency in humid zones ($R > 0.95$) and grasslands ($R = 0.91$), making them suitable for tracking dynamic photosynthesis, whereas NPP was more reliable in arid zones because of its lower sensitivity to atmospheric interference. The proposed framework provides a reference approach for selecting appropriate vegetation productivity indicators based on local climatic and ecosystem contexts. Our findings lay a solid foundation for more reliably assessing the carbon cycle in global drylands.

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KEYWORDS
Vegetation productivity; spatiotemporal dynamics; consistency; climate and ecosystem feedback; northwest China

1. Introduction

Vegetation productivity, quantified rate of photosynthetic carbon assimilation into organic matter, serves as the foundational process driving terrestrial ecosystem function. It regulates global carbon cycles, energy budgets, and the provisioning of vital ecosystem services (Yue, Zhang, and Shao 2021; Zhang et al. 2022; Wang et al. 2020; Xia et al. 2020; Wei et al. 2022; Wang et al. 2025). Satellite observations have documented widespread vegetation greening and significant increases in terrestrial vegetation productivity globally in recent decades (Fensholt and Proud 2012; Shen et al. 2022; Zhang et al. 2025), highlighting the need for quantifying spatiotemporal vegetation dynamics at regional to global scales (Beck et al. 2011; Chen et al. 2014).

Remote sensing technologies have enabled large-scale monitoring of vegetation productivity through proxies, including solar-induced chlorophyll fluorescence (SIF), gross primary productivity (GPP), and net primary productivity (NPP) (Wang et al. 2020; Xia et al. 2020; Wei et al. 2022). SIF, an emerging optical signal emitted during photosynthesis, provides near-real-time insights into photosynthetic activity and strongly correlates with GPP (Li and Xiao, 2019a). GPP—representing total photosynthetic carbon assimilation—is

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Thaw Slump Susceptibility Mapping Based on Sample Optimization and Ensemble Learning Techniques in Qinghai-Tibet Railway Corridor

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***Abstract*—Thaw slump susceptibility mapping (TSSM) of Qinghai–Tibet railway corridor (QTRC) is the prerequisite and basis for disaster assessment and prevention of permafrost projects. The objective of this article is to construct ensemble learning models based on single classifier models to generate the TSSM of the QTRC, compare and verify the performance of the models, and further explore the relationship between the high susceptibility area and environmental factors of the QTRC. The collinearity analysis was carried out by selecting 14 thaw slump conditioning factors (TSCFs). We used the balance bagging method for sample optimization, and the dataset was divided into 70% training set and 30% verification set. Convolutional neural network, multilayer perceptron, support vector regression, random forest single classifiers were selected to construct blending and stacking ensemble learning models for the TSSM. The results showed that there was no collinearity among the 14 TSCFS. The comparison of model performance revealed that all models had good performance, but the constructed stacking and blending ensemble learning models had stable performance and high prediction accuracy for TSSM. The stacking ensemble learning model had the best effect, and the area under curve value of receiver operating characteristic curve reached 0.9607. It showed that the generated TSSM of QTRC based on stacking ensemble learning model had the highest reliability. The QTRC has local areas with high thaw slump susceptibility, mainly concentrated in the permafrost areas with high altitude, high slope, adjacent faults, sparse vegetation, ice and snow and the more cumulative precipitation.**

***Index Terms*—Ensemble learning, Qinghai–Tibet railway, sample optimization, thaw slump susceptibility mapping (TSSM).**

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I. Introduction

THAW slump is a typical thermal karst landform, which refers to the phenomenon that the underground ice is exposed by natural factors or human activities in the slope area where the underground ice is distributed, so that the melting soil above it loses its support and collapses under the action of its own weight [1], [2]. Thaw slumps that are accompanied by the melting of underground ice will have a series of disaster effects on ecological environment, water environment, climate, and infrastructure [3], [4]. Specifically, thaw slump disasters expose the surface and promote ecosystem degradation [5]; Thaw slump disasters break water balance, releasing chemical solutes and causing water environment pollution [6]; Thaw slump disasters release greenhouse gases and accelerate global warming [7]. In addition, thaw slump disasters will destroy roadbed, block bridges and culverts, and threaten the safe operation of frozen soil projects [8], [9]. In recent years, with the influence of global warming and anthropogenic activities, the number of thaw slumps development has increased rapidly [10], [11]. It is very important to identify the potential thaw slumps. The evaluation of thaw slump susceptibility can predict the probability of potential thaw slumps, which is of great significance for the prevention and control of thaw slump disasters.

The QTRC is a belt area that runs through the south and north. Due to the rapid warming of the global climate, the thaw slump geological hazards in the QTRC show a trend of obvious intensification [12]. In particular, the new thaw slump disasters in recent years not only threaten the safety and stability of existing permafrost projects such as the Qinghai–Tibet railway (QTR), but also have a great impact on the design and operation of future Qinghai–Tibet projects [13]. It is extremely important to carry out comprehensive identification of potential thaw slumps of QTRC. However, there are few reports on the evaluation of thaw slump susceptibility, and even fewer studies on the evaluation of thaw slump susceptibility of the QTRC. Therefore, this article carried out the evaluation of thaw slump susceptibility of QTRC and realized the evaluation of thaw slump susceptibility "one map."

Machine learning methods have the ability to express nonlinear relationships and have been widely explored and applied in susceptibility assessment, such as logistic regression [14], decision tree [15], RF [16], SVM [17], artificial neural

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ConvLSTM神经网络的时序InSAR地面沉降时空预测

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摘 要:现有地面沉降时空预测方法存在时序特征捕捉能力差,未顾及空间邻域特征等问题,导致地面沉降时空预测的可靠性差。采用合成孔径雷达干涉测量技术(interferometric synthetic aperture radar,InSAR),提出了一种能够捕捉时序特征和空间邻域特征的卷积长短时记忆(convolutional long short-term memory,ConvLSTM)神经网络地面沉降时空预测方法。选取北京首都国际机场作为研究区,首先基于差分干涉测量短基线集InSAR(small baseline subset InSAR,SBAS-InSAR),利用Sentinel-1A影像获取地面沉降时空InSAR数据,然后构建ConvLSTM的地面沉降时空预测模型,模拟预测该区域未来1 a的地面沉降。利用永久散射体干涉测量技术、SBAS-InSAR结果和水准点数据,交叉验证了时序InSAR结果的可靠性;时序InSAR地面沉降数据采用滑动窗口进行数据分割,形成多对一数据集模式;结合小波变换和评价指标确定时空预测模型的最佳时间步长,建立时序InSAR地面沉降的ConvLSTM时空预测模型。实验结果显示,所提模型的预测结果和真实结果的拟合度R^2达到0.997,基于图像评价指标结构相似性(structural similarity,SSIM)和多尺度结构相似性(multi-scale structural similarity,MS-SSIM)进一步评价了模型的性能,SSIM和MS-SSIM分别达到了0.914、0.975。此外,与支持向量回归、多层感知器、卷积神经网络和长短时记忆神经网络模型进行了对比分析,各项指标均显示所提模型最优。所提模型预测到2022年11月北京首都国际机场最大累积沉降量将达到157 mm,研究成果可为城市地面沉降早期预防提供关键技术支撑。

关键词:地面沉降;时序InSAR;时空预测;卷积长短时记忆神经网络

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Spatio-Temporal Prediction of Time-Series InSAR Land Subsidence Based on ConvLSTM Neural Network

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Abstract: **Objective**: The existing spatio-temporal prediction methods of land subsidence have some problems, such as poor ability to capture time-series features and ignoring spatial neighborhood features, which lead to poor reliability of spatio-temporal prediction of land subsidence. **Method**: This paper proposes a spatio-temporal prediction of land subsidence based on convolutional long short-term memory (ConvLSTM)

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RESEARCH ARTICLE

Mapping the dynamics of urban land creation from hilltop removing and gully filling Projects in the river-valley city of Lanzhou, China

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Abstract

Lanzhou is located in the long, narrow valley of the Yellow River Basin, China. With the development of urbanization, the contradiction between its economic development and limited spatial expansion was very acute. To expand urban space, improve the efficiency of land use and protect farmland effectively, Hilltop Removing and Gully Filling Projects (HRGFP) around Lanzhou have been carried out over the last decades by local government. To better manage and evaluate the effectiveness of HRGFP implementation, it is necessary to map the urban newly land creation, monitor its dynamics change and access the environmental impact, which is of great significance to understand and master the past, present and future development trend of HRGFP. Based on multi-source remote sensing data and field investigation, here we use multiple monitoring indicators and spatial statistical analysis to analyze the change dynamic characteristics of newly plots from HRGFP and its impact on the local ecological environment. The main conclusions are as follows: From 1989 to 2016, the total area of the newly land creation around Lanzhou was about 203.18 km^2. The center of newly land plots generally showed a trend of continuous transfer from south to north, from the main urban region to the low hills, gentle slopes, and gullies and shifted 15.5 km northwest. And the maximum annual average expansion rate was about 36.003 km^2/a, which occurred in the third stage (i.e., 2012–2016). During the study period, it was found from land use and land cover change (LULCC) statistics that more new land plots from HRGFP were converted to forest land and grassland, except for construction land, which was consistent with the results of remote sensing environmental index (RSEI). Statistics showed that the area of environmental quality improvement in the study region is about 3984 km^2, accounting for 55.73% of the total area. Our results indicated that HRGFP in Lanzhou have enlarged the urban space and increased economic development and improved ecological environment under the guidance of the local government.

Keywords Hilltop removing and gully filling · City expansion · Newly land creation · Remote sensing · Indicator

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Introduction

As a scarce natural resource, land cannot be used by human beings without limitation because of its fixed location and limited area (Fischer et al., 2012; Steduto et al., 2012). In China, the national land survey shows that by the end of October 2006, the total area of farmland in the country was about 121.8 M hectares and per capita farmland area is less than 0.093 hectares, which is only 40% of the world average area (Wen, 2016; Yang & Wang, 2014). It is urgent to restrict the conversion of farmland to non-agricultural land. Therefore, the Chinese government stipulated that the farmland area of 120 M hectares is "red line" and nobody can change its use. With the development of

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PS-InSAR 技术在兰州市地面形变中的监测应用

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摘　要　近年来，由于城市地表沉降带来的次生灾害后果愈加严重，给城市的发展带来了诸多隐患，因此对城市进行长时间序列的形变监测具有重要的现实意义，而传统的监测方法无法获取城市大面积的地表形变信息。合成孔径雷达遥感(interferometric synthetic aperture radar，InSAR)技术在大规模地表形变监测中具有独特的优势。兰州市地质条件特殊，地貌条件复杂，是中国地质灾害发生频率较大的区域之一。采用 63 景 Sentinel-1A 和 5 景 Sentinel-1B 数据基于永久散射体合成孔径雷达干涉(persistent scatterer interferometric synthetic aperture radar，PS-InSAR)测量技术获取了 2014 年 10 月—2020 年 4 月的兰州市城区的地面形变场。研究结果表明，兰州市城区地表形变较小，临近城区周边的几处村镇存在着不同程度的沉降，且部分区域的沉降呈现出逐渐加快的趋势。

关键词　地面沉降；Sentinel-1A；永久散射体干涉；时间序列
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Application of PS-InSAR Technology in Ground Deformation Monitoring of Lanzhou City

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[Abstract]　In recent years，the secondary disasters caused by urban surface subsidence have become more serious and have brought many hidden dangers to the development of the city. Therefore，long-term deformation monitoring of the city has important practical significance，while traditional monitoring methods unable to obtain information on the surface deformation of a large area of the city. Interferometric synthetic aperture radar (InSAR) technology has unique advantages in large-scale surface deformation monitoring. Lanzhou City has special geological conditions and complex geomorphic conditions. It is one of the areas where geological disasters occur frequently in my country. 63 scenes of Sentinel-1A and 5 scenes of Sentinel-1B were used to obtain the ground surface deformation field of Lanzhou City from October 2014 to April 2020 based on persistent scatterer interferometric synthetic aperture radar (PS-InSAR). The research results show that the surface deformation in the urban area of Lanzhou is relatively small，and several villages and towns adjacent to the urban area have different degrees of subsidence，and the subsidence in some areas has gradually accelerated.

[Keywords]　land subsidence；Sentinel-1A；permanent scatterer interferometry；time series

地面沉降是社会经济发展中普遍存在的地质问题[1-2]，是在自然因素或人为因素作用下引起的局部下沉或区域性下沉现象，通常会引起建筑物倾斜、生产设施毁坏、地基失稳等，严重影响人们的正常生活和生产，是城市可持续发展的重要障碍之一[3]。为此，对城市地表进行长时空维度的沉降监测、掌握地表沉降监测资料具有十分重要的现实意义[4-5]。传统的地表沉降监测主要依赖重复精密水准测量、基岩标、分层标测量以及全球导航卫星定位监测网等，其特点是监测精度高，但监测成本高、范围较小、点位密度低等，难以揭示整体形变特点[6-7]。近年来发展起来的合成孔径雷达干涉测量[8]及合成孔径雷达差分干涉(differential interferometric synthetic aperture radar，D-InSAR)测量[9]，可获取大面积、全天候、高精度和高分辨率的地表三维空间微小变化，在地表形变监测方面显示出前所未有的优越性[10-11]，已成为城市地表形变监测的热点课题[12-14]。

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RESEARCH ARTICLE

WILEY

Ecological engineering projects increased vegetation cover, production, and biomass in semiarid and subhumid Northern China

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Abstract

Multiple ecological engineering projects have been implemented in semiarid and subhumid Northern China since 1978 with the purpose to combat desertification, control dust storms, and improve vegetation cover. Although a plethora of local studies exist, the effectiveness of these projects has not been studied in a systematic and comprehensive way. Here, we used multiple satellite-based time-series data as well as breakpoint analysis to assess shifts in leaf area index (a proxy for green vegetation cover), gross primary production, and aboveground biomass in Northern China. We documented increased vegetation growth in northwest and southeastern parts of the region, despite drought anomalies as documented by the standardized precipitation-evapotranspiration index during 1982–2016. Significant breakpoints in leaf area index were observed for over 72.5% of the southeastern and northwestern regions, and 70.6% of these breakpoints were detected after 1999, which correspond well to the areas with the highest ecological engineering efforts. Areas with negative trends were mainly located in the Inner Mongolian Plateau, Hulun Biur, Horqin Sand Land, and urban areas. The Loess Plateau had the largest increase in vegetation growth, followed by the north parts of Northern China where biomass increased more in the provinces of Shanxi, Liaoning, Shannxi, Hebei, and Beijing than Xinjiang, Inner Mongolia, Tianjin, and Qinghai. Our results show that multiple ecological engineering projects in the region have increased vegetation cover, production, and aboveground biomass that have led to improved environmental conditions in the study area.

KEYWORDS

breakpoint, effectiveness, remote sensing, trend, vegetation regrowth

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Selection and prediction of metro station sites based on spatial data and random forest: a study of Lanzhou, China

Quanfu Niu[1,2,3]✉, Gang Wang[1], Bo Liu[1], Ruizhen Zhang[1], Jiaojiao Lei[1], Hao Wang[1] & Mingzhi Liu[1]

Urban economic development, congestion relief, and traffic efficiency are all greatly impacted by the thoughtful planning of urban metro station layout. with the urban area of Lanzhou as an example, the suitability of the station locations of the built metro stations of the rail transit lines 1 and 2 in the study area have been evaluated using multi-source heterogeneous spatial data through data collection, feature matrix construction, the use of random forest and K-fold cross-validation, among other methods. The average Gini reduction value was used to examine the contribution rate of each feature indicator based on the examination of model truthfulness. According to the study's findings: (1) K-fold cross-validation was applied to test the random forest model that was built using the built metro stations and particular factors. The average accuracy of the tests and out-of-bag data (OOB) of tenfold cross-validation were 89.62% and 91.285%, respectively. Additionally, the AUC area under the ROC curve was 0.9823, indicating that this time, from the perspective of the natural environment, traffic location, and social factors The 19 elements selected from the views of the urban function structure, social economics, and natural environment are closely associated to the locations of the metro station in the research region, and the prediction the findings are more reliable; (2) It becomes apparent that more than half of the built station sites display excellent agreement with the predicted sites in terms of geographical location by superimposing the built metro station sites with the prediction results and tally up their cumulative prediction probability values within the 300 m buffering zone; (3) Based on the contribution rate of each indicator to the model, transport facilities, companies, population density, night lighting, science, education and culture, residential communities, and road network density are identified as the primary influential factors, each accounting for over 6.6%. Subsequently, land use, elevation, and slope are found to have relatively lower contributions. The results of the research provided important information for the local metro's best location selection and planning.

Given the explosive growth of the Chinese economy, urban rail transit has been instrumental in improving the effectiveness of urban public transportation, reducing congestion, optimizing the use of readily available space, and improving the living environment[1]. To date, approximately 53 cities in China have opened and operated urban rail transit, of which the selection of urban metro station sites needed to be done in conjunction with the spatial layout of the city, work commuting and the layout of tourist attractions[2]. The reasonable design of metro stations contributes significantly to the economic growth of cities, the reduction of commute times, the growth of tourism, and the name-card impact of the city.

There are often the following categories for the site selection issue. One is the traditional site selection methods, which is based on the development of various industries within the proposed site selection area, combined with the proposed site and surrounding environment to determine the site selection. This method is easily influenced by subjective factors of the executors[3]. The second is to use mathematical modeling methods, which primarily rely on specific algorithms and multivariate analysis to establish a location model and are more popular due to their better siting accuracy[3]. The third is to use the geo-information system (GIS) technique, which is

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Sentinel-1/2 影像在兰州北山削山造地范围识别中的应用

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摘要: 城市空间发展易受地形所限,削山造地能克服土地资源稀缺,成为解决城市空间拓展最为直接的途径。该方法利用遥感技术快速准确获取削山造地范围信息,对区域生态环境科学评估和新城发展规划具有十分重要的意义。本文基于 GEE 遥感云计算平台,利用 Sentinel-1 合成孔径雷达(synthetic aperture Rader,SAR)数据,采用组合升、降轨影像,在噪声滤除和多时相影像合成的基础上,计算削山造地前后后向散射强度的差值,并采用百分位阈值法结合样本数据确定阈值,提取研究区 2017—2022 年削山造地开挖区时空分布;然后联合 SAR 和光学数据的光谱特征、纹理特征和地形特征,在特征优化的基础上结合随机森林算法获取了 2017—2022 年逐年削山造地范围时空分布。研究结果表明:①提取的开挖区范围总体分类精度和 Kappa 系数分别达 85%和 0.83。②研究期间,发现 2019 年前开挖区主要集中在九州开发区、碧桂园和保利领秀山,2020 年以后新增加了刘家沟、水源站等开挖区,开挖范围和强度逐渐增大。③2018 年前造地规模较小,面积为 2.655 km^2;2019 年以后造地规模逐年增大,特别是 2021 年,其造地面积达 12.607 km^2,占监测期间总造地面积的 34.56%,2022 年在原造地基础上开挖,因坡度和开挖量逐渐增大,造地面积仅 2.686 km^2。本文构建的削山造地开挖区监测和造地范围提取方法可有效获取削山和造地范围快速监测与提取。

关键词: 削山造地; Sentinel 影像; 多时相; 变化监测; 随机森林
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0 引言

随着我国社会经济的快速发展,城镇化进程所带来的人地关系日趋紧张。因此,一些空间拓展受地形所限的城市不断将城市扩张的建设用地转移到荒山、荒沟等未利用地上,特别是地处典型河谷盆地的兰州市,黄河穿城而过,其“两山夹一沟”的地形地貌特点,使其可供城市拓展的建设用地十分有限[1]。为破解城市拓展与用地短缺的矛盾,对兰州北山的低丘缓坡荒沟等大量未利用地进行削山造地[2-3]。20 世纪 90 年代,九州开发区实施削山造地建设; 2008 年,沙井驿、安宁堡、西果园镇实施削山造地工程; 2012 年启动的兰州新城建设中预计要推平 700 多座荒山,开发整理青白石区域低丘缓坡等未利用土地[4]。削山造地是将山丘的一部分或整体进行切割、削平,然后利用削平后的土地进行填筑,创造出新的平坦地面,通常用于城市建设、基础设施建设、土地开发或其他大型建设项目。削山造地区主要为黄土沟壑,生态环境极为脆弱,削山造地对生态环境的负面影响不容低估。因此,利用遥感技术对削山造地区进行动态监测,有效获取削山造地的开挖区和范围,是该区域生态环境影响评价和新城发展规划的基础工作。

自 1989 年起,针对削山造地城市空间拓展,国内外学者基于遥感技术从不同方面开展了研究工作。白建荣等[5-6]采用无人机遥感影像和人工矢量化等方法,按时间顺序依次提取兰州周边地区削山造地信息,获取了削山造地的规模和发展趋势; 何永刚等[7]利用多源数据和计算机技术构建 Skyline 系统,实现削山造地的三维监测; 赵元等[8]利用无人机倾斜摄影和土地利用等数据实现了削山造地精细化监测; 赵大卫等[9]利用多时相 Landsat TM 影像

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Spatial-temporal variability of snow cover over the Amur River Basin inferred from MODIS daily snow products in recent decades

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ABSTRACT

MODIS snow products MOD10A1\MYD10A1 provided us a unique chance to investigate snow cover as well as its spatial-temporal variability in response to global changes from regional and global perspectives. By means of MODIS snow products MOD10A1\MYD10A1 derived from an extensive area of the Amur River Basin, mainly located in the Northeast part of China, some part in far east area of the former USSR and a minor part in Republic of Mongolia, the reproduced snow datasets after removal of cloud effects covering the whole watershed of the Amur River Basin were generated by using 6 different cloud-effect-removing algorithms. The accuracy of the reproduced snow products was evaluated with the time series of snow depth data observed from 2002 to 2010 within the Chinese part of the basin, and the results suggested that the accuracies for the reproduced monthly mean snow depth datasets derived from 6 different cloud-effect-removing algorithms varied from 82% to 96%, the snow classification accuracies (the harmonic mean of *Recall* and *Precision*) was higher than 80%, close to the accuracy of the original snow product under clear sky conditions when snow cover was stably accumulated. By using the reproduced snow product dataset with the best validated cloud-effect-removing algorithm newly proposed, spatial-temporal variability of snow coverage fraction (SCF), the date when snow cover started to accumulate (SCS) as well as the date when being melted off (SCM) in the Amur River Basin from 2002 to 2016 were investigated. The results indicated that the SCF characterized the significant spatial heterogeneity tended to be higher towards East and North but lower toward West and South over the Amur River Basin. The inter-annual variations of SCF showed an insignificant increase in general with slight fluctuations in majority part of the basin. Both SCS and SCM tended to be slightly linear varied and the inter-annual differences were obvious. In addition, a clear decreasing trend in snow cover is observed in the region. Trend analysis (at 10% significance level) showed that 71% of areas between 2,000 and 2,380 m a.s.l. experienced a reduction in duration and coverage of annual snow cover. Moreover, a severe snow cover reduction during recent years with sharp fluctuations was investigated. Overall spatial-temporal variability of Both SCS and SCM tended to coincide with that of SCF over the basin in general.

Keywords: MODIS; SCF; SCS; SCM; Amur River Basin; cloud effect removal

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周鑫蓉,牛全福,朱登峰,等.甘肃黄土高原区植被物候变化及影响因素[J].水土保持学报,2025,39(4):118-128,138.
ZHOU Xinrong, NIU Quanfu, ZHU Dengfeng, et al. Analysis of vegetation phenological changes and influencing factors in the Loess Plateau region of Gansu Province[J]. Journal of Soil and Water Conservation, 2025, 39(4):118-128,138.

甘肃黄土高原区植被物候变化及影响因素

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摘 要:[目的]为研究甘肃黄土高原地区植被物候,即植被生长和发育的季节性变化,深入了解气候变化如何影响该地区的植被生长规律。[方法]基于2002—2021年的MODIS NDVI数据集、气象数据、数字高程模型(DEM)及标准化降水蒸散指数(SPEI)数据,提取甘肃黄土高原区植被生长季始期(SOS)、植被生长季末期(EOS)、植被生长季长度(LOS),采用Theil-Sen趋势分析法和Mann-Kendall检验法探究黄土高原植被SOS、EOS和LOS的时空动态变化情况,采用偏相关分析法研究植被物候变化与气温、降水、干旱和地形的关系,基于Hurst指数和随机森林回归模型预测未来甘肃黄土高原区植被物候变化。[结果]1)甘肃黄土高原区植被SOS集中在第81~138 d,变化速率为-4.5 d/10 a;EOS集中在第266~305 d,变化速率为-0.4 d/10 a;LOS集中在131~218 d,变化速率为2.6 d/10 a。2)研究期温度与植被SOS(90%)、EOS(54%)呈正相关,与LOS呈负相关;降水与植被SOS(85%)呈正相关,与植被EOS(57%)、LOS呈负相关;陇西黄土高原西部植被SOS变化和天水南部植被EOS与干旱呈显著负相关,兰州、临夏及定西等部分地区植被LOS与干旱呈显著正相关。3)未来甘肃黄土高原植被物候南部地区SOS提前,EOS推迟,LOS延长;北部地区SOS推迟,EOS提前,LOS缩短。[结论]2002—2021年,研究区由于气象等因素的显著影响,整个甘肃黄土高原地区植被的生长周期有效延长,改善当地生态环境,促进生态系统稳定和可持续发展,未来应继续加强生态环境保护力度,推动生态修复和治理工作深入开展,为甘肃黄土高原地区的生态文明建设作出更大贡献。

关键词:甘肃黄土高原; 植被物候; 气象; 标准化降水蒸散指数; 预测
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Analysis of Vegetation Phenological Changes and Influencing Factors in the Loess Plateau Region of Gansu Province

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Abstract: [**Objective**] This study aimed to investigate the phenology of vegetation, i.e., the seasonal changes in the growth and development of vegetation in the Loess Plateau region of Gansu Province, and to gain a deeper understanding of how climate change affects the growth patterns of vegetation in this area. [**Methods**] Based on MODIS NDVI datasets, meteorological data, digital elevation models (DEM), and standardized precipitation evapotranspiration index (SPEI) data from 2002 to 2021, the start of the growing season (SOS), end of the growing season (EOS), and length of the growing season (LOS) of vegetation in the Loess Plateau region of Gansu Province were extracted. Theil-Sen trend analysis and Mann-Kendall tests were used to explore the spatiotemporal dynamics of SOS, EOS and LOS. Partial correlation analysis was employed to investigate the

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甘肃黄土高原植被动态变化监测与驱动因素分析

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摘　要：针对黄土高原区域植被动态变化的遥感监测问题，以甘肃黄土高原为研究区，基于 kNDVI 和像元二分模型构建了 2002—2022 年的核植被覆盖度(kFVC)，采用 Sen+MK 趋势分析及显著性检验、变异系数、Hurst 指数及残差分析等方法，对研究区植被动态变化、驱动因素及未来变化趋势进行分析。研究结果表明：研究期间，甘肃黄土高原植被变化稳定性呈高波动变化态势，其中，约 38.55%区域的 kFVC 等级向高等级转移，52.65%的区域呈显著提升趋势，55%区域的 hurst 指数显示持续上升；植被覆被上升的地类主要为农田与草原，主要分布于陇东和陇西中南部的广大地区；降水和气温与 kFVC 的相关系数分别为 0.37 和－0.18，降雨是甘肃黄土高原植被改善的主要驱动因素；人类活动对植被变化的影响处于主导地位，对 kFVC 的贡献率 68.39%。2002—2022 年甘肃黄土高原植被动态变化呈波动上升趋势，分布于陇东和陇西中南部的广大农田与草原地区；相较于气温，降水对 kFVC 的变化起到了积极影响；甘肃黄土高原的植被变化是气候变化和人类活动共同作用的结果，人类活动对植被变化的具有重要的影响。

关键词：Google Earth Engine；kNDVI；植被覆盖度；时空变化
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Monitoring vegetation dynamics and analyzing driving factors on the gansu loess plateau based on kernel fractional vegetation cover

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Abstract：The Loess Plateau is a fragile ecological region in China. Gansu's Loess Plateau，as an important part of it，is characterized by sparse vegetation，water scarcity，and frequent natural disasters. Remote sensing monitoring of vegetation dynamics in this area is of significant practical importance. This study focuses on Gansu's Loess Plateau. Based on kernel Normalized Difference Vegetation Index (kNDVI) and the Pixel Binary Model，we constructed kernel Vegetation Fraction Coverage(kFVC) for the years 2002 to 2022. We employed Sen's slope estimator combined with the Mann-Kendall(MK) trend analysis and significance testing，coefficient of variation，Hurst exponent，and residual analysis to analyze vegetation dynamics，driving factors，and future trends in the study area. The findings are as

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王秀琴, 牛全福, 王浩, 等. 甘肃积石山 M_s6.2 级地震区滑坡危险性评价与区划[J]. 中国地质灾害与防治学报, 2025, 36(1): 169-181.
WANG Xiuqin, NIU Quanfu, WANG Hao, et al. Risk assessment of landslides induced by the M_s6.2 earthquake in Jishishan, Gansu Province[J]. The Chinese Journal of Geological Hazard and Control, 2025, 36(1): 169-181.

甘肃积石山 M_s6.2 级地震区滑坡危险性评价与区划

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摘要：2023 年 12 月 18 日 23 时 59 分，甘肃省积石山县发生 M_s6.2 级地震，造成大量人员伤亡及崩塌和滑坡等地震次生灾害。基于震前震后高分辨率卫星影像，利用目视解译的灾害点和影响因子特征集构建 MaxEnt 模型进行地震后滑坡灾害危险性评价，研究认为：(1)地震诱发滑坡灾害点主要分布在 1 700 ~ 2 250 m 高程带、坡度 20° ~ 25°的阳坡范围内，在距道路距离 1.5 km、距断裂带距离 1.7 km、距地震中心距离 5 km 区间广布；(2)由影响因子的贡献率和置换重要性、测试效益值、*AUC* 值和正则化训练增益值综合得到地震诱发滑坡的主要影响因子为距断裂带的距离、海拔和人口分布；(3)基于构建的 MaxEnt 模型，得出极高和高危险区主要分布于地震烈度为Ⅷ度区，其面积为 5.368 km^2，占极高和高危险区总面积的 77.82%，而低和极低危险区主要分布于Ⅵ和Ⅶ度区，面积百分比分别为 75.33% 和 97.55%。文章在影响因子重要性分析基础上构建 MaxEnt 模型进行震区滑坡灾害危险性评价，研究结果将为震区灾后重建提供参考。

关键词：积石山 6.2 级地震；滑坡；因子；重要性分析；MaxEnt 模型；危险性评价
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Risk assessment of landslides induced by the M_s6.2 earthquake in Jishishan, Gansu Province

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Abstract: On December 18, 2023, at 23:59, a magnitude M_s6.2 earthquake occurred in Jishishan County, Gansu Province, resulting in significant casualties and triggering numerous secondary geological disasters such as landslides and collapses. Utilizing high-resolution satellite imagery from before and after the earthquake, this study employs a MaxEnt model, constructed with visually interpreted disaster points and a set of impact factor characteristics, to assess the post-earthquake landslide hazard post-earthquake landslide hazard. The research conclusions are as follows: 1) Earthquake-induced landslide disasters are predominantly distributed within sunny slopes at elevations of 1 800 to 2 300 m and slope gradient of 20° to 25°,

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黑龙江流域积雪的时空动态变化及其与气候因子的关系*

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Lu X L, Zhang W C, Niu Q F, et al. Spatio-temporal dynamics of snow over in Amur River basin and its relationship with climate factors [J]. Journal of University of Chinese Academy of Sciences, 2021,38(5):601-610.

摘 要 积雪覆盖作为重要的地表覆盖类型,其变化对当地的水文环境、物候变化都有重要的反馈和调节作用。基于去云后的 MOD10A1/MYD10A1 逐日积雪覆盖数据,探讨黑龙江流域 2002—2016 年间的积雪时空变化,并结合同期气象数据,分析积雪面积与温度、降水等气象因子之间的相关性。研究结果表明: 1) 研究期间黑龙江流域积雪日数增加的地表面积稍大于减少的面积; 流域整体年积雪覆盖面积呈微弱的增加趋势,季节上表现为冬夏季略微增加、秋季轻微减少及春季无明显增减的趋势。2) 不同时段的积雪面积与同期气候因子的相关性不同。其中春季 3、4 月份与温度有明显的负相关关系($P<0.01$),夏季 6 月、冬季 12 月以及 2 月与降水呈明显正相关关系($P<0.01$),秋季与最高温度有较好的负相关关系($P<0.05$)。综上所述,黑龙江流域 14 年来的积雪年际变化及其与气温、降水之间相关性表现出明显的季节性差异,将为研究气候变化、灾害防治以及人类活动提供有效参考。

关键词 气候变化; 遥感; 积雪面积; 温度; 降水

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Spatio-temporal dynamics of snow cover in Amur River basin and its relationship with climate factors

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Abstract As one of the important types of land cover, snow cover has important feedback and adjustment effects on the local hydrological environment and phenological change of vegetation. Based on MOD10A1/MYD10A1 daily snow cover dataset after removing cloud, the spatio-temporal variation of snow cover and the correlation between snow cover area and meteorological factors (temperature and precipitation) was analyzed in the Amur River Basin from 2002 to 2016. The

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黄土高原综合干旱指数的构建与时空特征分析

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摘 要:黄土高原是我国干旱频发区域之一,干旱对生态环境及日常生活的负面影响尤为显著。基于 CRITIC 赋权法,综合考虑气象和农业干旱指标,构建一个综合性的干旱指数 *TVSS*,并在此基础上结合趋势分析和游程理论对黄土高原地区的干旱变化趋势及干旱事件进行研究与分析。结果表明:基于 CRITIC 赋权法构建的不同时间尺度 *TVSS*,通过相关性分析证实具有可靠性,且在过去的 23 年间共记录到 28 次综合干旱事件。分析干旱特征发现,干旱历时、烈度峰值以及总烈度均展现出下降趋势;黄土高原干旱频率整体呈现出西部高于东部、北部高于南部的分布趋势,遭遇全区域性干旱和局部性干旱占比分别为 19.6%和 18.5%,而区域性干旱和部分区域性干旱的发生频率则相对较低,分别为 7.6%和 8.7%;在 2000—2022 年,黄土高原 *TVSS* 指数变化趋势均表现出上升趋势,其中月尺度变化速率为 $0.0004 \cdot 10a^{-1}$,季节尺度除冬季外其他季节变化速率都在 $0.3 \cdot 10a^{-1}$ 以上,年尺度变化速率为 $0.447 \cdot 10a^{-1}$,揭示出了该区域干旱状况正逐步向湿润化的趋势发展。

关键词:干旱指数;CRITIC 赋权法;趋势分析;游程理论;干旱频率;黄土高原

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Construction of comprehensive drought index on the Loess Plateau and analysis of spatiotemporal characteristics

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Abstract: As one of the key regions in China with frequent and highly influential droughts, the Loess Plateau has a particularly significant negative impact on the ecological environment and people's lives. This study was based on the CRITIC weighting method, which comprehensively considers meteorological and agricultural drought indicators, aiming to construct a comprehensive drought index (*TVSS*). Based on this, trend analysis and trip theory were combined to study and analyze the drought change trend and drought events in the Loess Plateau region. The results showed that *TVSS* constructed based on the CRITIC weighting method at different time scales have been confirmed to be reliable through correlation analysis, and a total of 28 comprehensive drought events have been recorded in the past 23 years. Through analyzing the characteristics of drought, it was found that the duration, peak intensity, and total intensity of drought all showed a decreasing trend. The frequency of drought in the western part of the Loess Plateau was higher than that in the eastern part, and that in the northern part was higher than that in the southern part. The proportion of regional drought and local drought was 19.6% and 18.5%, respectively, while the frequency of regional drought and partial regional drought was relatively low, at 7.6% and 8.7%, respectively. From 2000 to 2022, the *TVSS* index of the Loess Plateau showed an upward trend, with the monthly change rate of

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黄土区滑坡研究中地形因子的选取与适宜性分析

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Suitability Analysis of Topographic Factors in Loess Landslide Research

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Abstract: The region of loess plateau is one of the ecologically fragile areas in China. It is one of the slippery strata of which landslides often developed. The development of the loess landslides is the result of the combined effect of many factors such as the disaster environment, the disaster factor and the disaster bearing body. The selection of topographic factors which are important environmental elements of the disasters is the basis of the study of loess landslide risk. We take Gangu county as the study area, which is one of the frequent occurrence of loess landslide hazards in Gansu province. According to the basic conditions of landform, suitability analysis of topographic factors in the study area was carried out with models of sensitivity index (SI), certainty factor (CF) and correlation coefficient (CC). The following conclusions were obtained: Based on the models of SI, CF and CC, the topographic factors suitable for the loess landslide hazard research of this area are: slope, slope of slope (SS), slope shape and surface roughness (SR). The selection of disaster-inducing factors with the methods of SI and CF is merely based on the analysis of the relationship between the single factor and the landslides. We ignore the correlation between the topographic factors. The experimental results indicated that the area with poor stability in the study area has a good correspondence with the number of landslide hazard distributions. After deeply analyzing the relationship between the landslides and the grade range of the topographic factors, it is found that the grade range of the topographic factors has an important influence on the landslide risk assessment of the study area. This is one of the main reasons of the differences in some areas. Based on field investigation, the river-cutting depth, drainage density and human engineering activities are also important topographic factors and have key control effect on the landslides of this study area.

Key words: landslide hazard; loess; topographic factors; model; suitability analysis

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摘要:黄土高原是中国生态较为脆弱的地区,也是滑坡发育的地层之一。黄土滑坡发育是孕灾环境、致灾因子和承灾体等多种因素联合作用的结果,其中作为重要孕灾环境因素的地形因子的选取是黄土滑坡风险研究的基础。本文选取黄土滑坡灾害多发的甘谷县作为研究区,综合利用敏感性指数、确定性系数和相关系数方法进行地形因子在滑坡灾害研究中的适宜性分析,得出以下结论:基于确定性系数法、敏感性分析模型和相关系数法,最终筛选出适宜于本区域滑坡灾害评价的地形因子

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基于 FFPI 模型的甘肃陇南山区山洪灾害风险评价

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摘 要:山洪是山区小流域由强降雨引发的突发性、破坏性强的自然灾害,对当地人民的生命和财产安全形成极大威胁。以往的研究多基于单沟或小流域尺度、采用成熟的评估体系和模型。如何在地形多样、地质结构复杂的山区评估山洪灾害仍需进一步探索。以山洪灾害频发的甘肃陇南山区为例,引入山洪潜在指数(flash flood potential index, FFPI)构建评价体系和框架。首先选取坡度、土地利用、土壤质地和植被覆盖度,结合层次分析法与信息熵综合定权构建了研究区山洪潜在指数FFPI的空间分布;其次引入0~24 h 累计最大降雨量、雨季日均降雨量和汇流累积量作为驱动因子,国内生产总值 GDP、人口密度和道路密度为承灾体,分别获取研究区山洪灾害的危险性和风险空间分布,并与该区历史山洪灾害数据进行验证。研究结果表明:采用耦合 FFPI 模型对甘肃陇南山洪灾害风险评价的准确率较高,有 95.77%的历史山洪灾害数据分布于中、高和极高风险分区。从行政区划分析,研究区山洪灾害高风险和极高风险区主要分布在武都区的汉王镇、成县、康县部分地区,占比分别为 31.5%、28.3%和 18.1%;低风险区位于礼县、舟曲县和文县部分区域,占其县区比例分别为 18.9%、18.4%和 13.6%。从流域范围分析,研究区山洪灾害高风险区主要集中在山区地势平缓、人口密度较大、经济较为发达的河流下游地区,低风险区主要集中于地势较高的西部和北部,评价结果与研究区调查的山洪灾害实际情况一致。研究结果可为甘肃省陇南山区山洪灾害防治及相关研究提供参考和理论依据。

关键词:山洪灾害;潜在指数 FFPI;风险;综合定权;陇南山区
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Risk assessment of flash flood disasters in Longnan mountain area of Gansu Province based on FFPI model

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Abstract: Flash floods are often sudden and destructive natural disasters triggered by heavy rainfall in small mountainous watersheds, which cause a great threat to the lives and property safety of local people. Previous flash flood studies are mostly based on single ditch and small watershed scales with mature assess system and models. How to assess flash flood hazards in the large-area mountain with diverse landforms and complex geological structures still need further exploration. Taking Longnan mountain area in Gansu Province, which is prone to flash floods, as an example, this paper introduces the flash flood potential index (FFPI) to build an evaluation system

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牛全福，冯尊斌，张映雪，等. 基于 GIS 的兰州地区滑坡灾害孕灾环境敏感性评价[J]. 灾害学，2017，32(3)：29－35. [NIU Quanfu，FENG Zunbin，ZHANG Yingxue，et al. Susceptibility Assessment of Disaster Environment for Landslide Hazard based on GIS in Lanzhou Area[J]. Journal of Catastrophology，2017，32(3)：29－35. doi：10.3969/j.issn.1000－811X.2017.03.006.]

基于 GIS 的兰州地区滑坡灾害孕灾环境敏感性评价*

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摘 要：选取坡度、坡向等八个孕灾环境因子，利用概率指数法、信息量法和 Logistic 回归模型对兰州地区地质灾害进行了危险性研究，对比三种模型的评价结果可以看出，地质灾害的敏感性强弱分布趋势基本一致，信息量模型对应的 ROC 曲线下面积较大，Logistic 回归模型次之，概率指数模型略低。模型精度评价表明，信息量模型略高于 Logistic 回归模型，概率指数模型评价精度最低。评价结果表明，位于地质灾害极高易发区的县(区)为：城关区、西固区、永登县；位于高易发区的县(区)有：七里河区、安宁区；位于易发区的县(区)为皋兰县；相对较稳定(不易发区)的县(区)为榆中县。

关键词：滑坡灾害；孕灾环境；敏感性；模型；兰州

中图分类号：X43；P642.22 **文献标志码**：A **文章编号**：1000－811X(2017)03－0029－07

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黄土滑坡与崩塌是黄土地区很重要的地质灾害。前者是斜坡或边坡地带的岩土体，在重力或其他附加力的作用下，整体顺坡下滑的现象；后者是较陡斜坡上的岩土体，在重力作用下，突然发生崩落现象。由于我国黄土高原地质构造复杂、断裂发育、新构造运动强烈，黄土及下伏中新生界泥岩、沙质泥岩等岩土体疏松、欠压密的岩性性质，以及区内地形起伏、沟壑纵横的地貌特征，加之降雨集中、局地性暴雨多，植被稀疏，土体裸露等因素，因此黄土滑坡和崩塌异常发育。黄土高原地区滑坡是我国滑坡灾害最严重的地区，据统计，我国滑坡约有 1/3 发生于黄土高原地区，仅甘肃省就有各类大小滑坡 4 万处，其中，体积大于 50 万 m^3 的滑坡约 5 580 处[1]。滑坡灾害是山区常见的突发性地质灾害，经常压埋村庄城市、毁坏道路渠道、摧毁工程矿山、堵塞江河水库、破毁农田，还可引发泥石流等次生灾害。因此，滑坡已成为制约我国黄土山区经济发展和人民生命财产安全的最严重自然灾害之一，故对黄土区滑坡灾害研究和危险性评价具有重要现实意义[2]。

黄土区域滑坡灾害的危险性是指在一定区域内滑坡灾害发生的可能性[3]，自 1980 年后期始，世界各地广泛开展了滑坡危险性研究。Cross[4] 于 1996 年利用滑坡敏感性指数(LSI)在英国 Derbyshire 地区进行滑坡危险性区划实践研究。Finlay P J 等[5] 采用统计学原理，对香港 1984－1993 年间的 3 000 多个滑坡灾害记录数据库进行了统计分析研究，建立了基于滑坡灾害几何条件预测滑坡灾害水平运动距离的多元回归模型。随着遥感与地理信息系统的发展，为滑坡灾害危险性评价研究提供了更加便利的数据来源与空间分析工具，使滑坡灾害危险性评价研究的精度与效率都得到了很大提高[6-7]。

中国滑坡灾害危险性评价研究发展也较快。仵惠宁[8] 分析了兰州市区地质环境特征及其对崩滑流灾害的控制作用，并分析了人类工程经济活动对地质环境的重大影响。李家存等[9] 以马来西亚金马仑高原作为研究区，利用概率指数评价模型进行了滑坡危险性评价，表明此模型具有较好的评价精度。牛全福[10] 等基于信息量模型，研究了玉树地震重灾区结古镇的滑坡危险性，得出的危险性评价等级与实际滑坡发生情况吻合度较好。许冲等[11] 基于 GIS 和 RS 技术，应用逻辑回归模型开展玉树地震滑坡危险性评价，并对结果合理性进行检验，正确率达 83.21%[10]。唐川[12] 以栅格单元与地貌单元作为单位评价单元，以信息量法

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基于 Kalman 滤波的 ARIMA-NAR 神经网络模型在深基坑沉降监测中的应用

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摘要：深基坑变形监测在城市建设安全施工中显得越来越重要.鉴于监测数据不可避免地存在噪声及单个预测模型存在的预测残差问题，为提高基坑监测预测精度，以兰州市某深基坑监测中具有明显沉降的 ZJ52 为例，采取一种基于 Kalman 去噪的 ARIMA-NAR 神经网络组合模型进行预测分析.结果发现，经 Kalman 去噪后建立的 ARIMA-NAR 组合模型的预测结果的平均绝对误差、平均相对误差和残差方差分别为 0.43、0.04、2.23 mm，预测结果均优于单一的 ARIMA 和 NAR 神经网络模型的预测结果，预测精度较好，其结果可为本项目的安全施工提供可靠指导.

关键词：深基坑；滤波；组合模型；预测

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Application of ARIMA-NAR neural network model based on Kalman filter in deformation monitoring of deep foundation

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Abstract: Deformation monitoring of deep foundation pits is becoming more and more important in the security control of urban construction. Because of the unavoidable noise in the monitoring data and the prediction residual problem from the single prediction model, it is necessary to improve the prediction accuracy of deep foundation excavation. Taking ZJ52 of a deep foundation pit in Lanzhou as an example, and based on Kalman filtering, the paper used a combined model of ARIMA-NAR neural network to predict and analyze the change trend of the observation point. The results show that the average absolute error, average relative error and residual variance from the established model are 0.43 mm, 0.04 mm and 2.23 mm, respectively. The prediction results are better than those of single ARIMA and NAR neural network models. The prediction results from ARIMA-NAR neural network with Kalman filtering can provide reliable guidance for the security construction of this project.

Key words: deep foundation pit; filtering; combination model; prediction

近年来，随着我国社会经济的快速发展，城镇化建设深入推进，建设用地日趋紧张，建设趋向高层、超高层的纵深发展，深基坑工程在城建中的安全施工显得越来越重要.近年来与基坑相关的工程事故频发[1-2]，尤其在以湿陷性黄土为主的西北地区，深基坑工程在雨水较多的季节易发生变形甚至失稳现象.因此，进行基坑变形监测，掌握其变形状态，进而对未来的变形趋势做出预测对基坑工程安全开挖施工具有重要意义.

深基坑变形监测通常为长期的形变观测，并依据适宜的模型建模预测其变形趋势来指导安全施工.常用的数学模型有：回归分析模型[3]、灰色理论

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基于MaxEnt结合粒子群优化的陇南市山洪灾害空间分布预测研究

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摘 要:山洪是山区河道水位突然上涨所引发的自然灾害,具有瞬时性、破坏性大等特点。近年来,甘肃省陇南市山洪灾害频发,严重威胁到当地人民的生命财产安全,对该区域进行山洪灾害风险评价刻不容缓。运用MaxEnt结合粒子群优化算法,基于调查的834个山洪灾害点和与灾害相关的32个致灾因子,在探讨主要致灾因子的基础上进行研究区山洪灾害易发性评价,并结合当前(2021—2040年)和未来(2041—2060年、2061—2080年、2081—2100年)4期气候数据的不同情景模式,预测了该区研究期间山洪灾害潜在易发区空间分布格局。结果表明,各期研究结果的受试者工作特征曲线的曲线下面积均大于0.85,表明所提方法的研究结果精度较高;研究区的主要致灾因子为最干月降水量、昼夜温差月均值、降水量变异系数、最暖月最高温、土地利用、距河流的距离、土壤质地、剖面曲率、海拔、地形起伏度;研究区不同时期山洪灾害中高易发区集中分布于武都区、文县和宕昌县部分地区,与当前时期相比,未来3个时期的模拟结果均体现为减少趋势。

关键词:粒子群优化算法;MaxEnt;陇南市;山洪灾害;易发区;致灾因子

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Spatial Distribution Prediction of Flash Flood Disaster in Longnan City Based on Particle Swarm Algorithm Combined with MaxEnt Model

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Abstract: **Objectives**: Flash floods are natural disasters caused by sudden rise in water levels in mountainous rivers, which are characterized by instantaneity and great destructiveness. In recent years, the frequent occurrence of flash floods in Longnan city, Gansu province, has posed a serious threat to the safety of local people's lives and property, thus it is urgent to carry out a risk assessment of flash floods in this region. **Methods**: This study takes Longnan city as the study area, and utilizes the MaxEnt model combining with the particle swarm algorithm to evaluate the vulnerability of study area based on 834 flash flood hazard points investigated and 32 disaster-causing factors. It also predicts the spatial pattern changes and potential mass migration trends of the future flash flood vulnerability areas based on three periods of climate data from the current period (2021—2040) and the future period (2041—2060, 2061—2080, 2081—2100). **Results and Conclusions**: The area under receiver operating characteristic curve of the results of the study

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基于 SE-VUNet 模型的高分辨率遥感影像耕地提取

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摘 要：为应对多样地形下耕地分割中边界模糊、细节缺失等问题，提出一种改进的 U-Net 耕地提取方法。此方法融合 VGG 网络加深主干特征提取（V-UNet），嵌入 Squeeze-and-Excitation（SE）注意力机制优化特征定位与边缘细节，利用 Batchnormalization（BN）层抑制过拟合；并通过在 V-UNet 网络 5 个关键位置嵌入 SE 模块形成 5 种 SE-VUNet 模型；基于 GID 高分二号 RGB 数据，在平整集中与复杂冗余两种耕地地形下，与 PSPNet、HrNet、Deeplabv3+、U-Net 进行对比试验。结果表明，两种地形下，5 种 SE-VUNet 均优于对比网络；SE 模块置于下采样之前的 SE-VUNet 对平整集中耕地分割最优，平均交并比（mIoU）为 96.66%，F_1 分数（$F_{1\text{-score}}$）为 97.57%；SE 模块置于特征学习部分的 SE-VUNet 对复杂冗余耕地分割效果最佳（mIoU=94.40%，$F_{1\text{-score}}$=97.11%）。此模型可为应对多样地形下，耕地分割中边界模糊、细节缺失等问题提供技术参考。

关键词：耕地；遥感；注意力机制；残差网络；高分影像；语义分割；U-Net

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0 引 言

民以食为天，农业经济的发展关乎国计民生，是国家经济稳步发展的重要基石。当前，环境污染加剧、人口持续增长及城镇化快速扩张导致耕地资源日益紧张[1]。在此背景下，精准提取耕地资源成为构建精准农业生产系统的关键环节。遥感技术凭借其时空覆盖广、多维信息获取能力强等优势，在动态监测地表覆盖变化、更新耕地信息方面发挥着关键作用，为精准农业提供了重要的数据支撑与决策依据[2]。随着遥感科学、计算机科学与人工智能技术的进步，深度学习与遥感技术的交叉融合已成为耕地信息提取领域的研究热点。深度学习技术的引入显著提升了耕地信息提取的精度与效率，推动了该领域研究的深入发展[3]。

传统耕地提取方法，主要包括基于像素的分类[4-7]和面向对象的分类[8-11]，在处理高分辨率遥感影像时面临诸多挑战。基于像素的方法原理简单[12-14]，但易受“椒盐噪声”影响，且对光谱相似地物（如植被/作物与裸土/建设用地）的区分能力有限，常导致提取结果边界模糊、内部破碎。面向对象的方法通过像素聚合提升了精度，但其固定尺度的分割方法难以同时适应大小差异显著的地块，在种植结构复杂或地块破碎（如丘陵山区、城乡过渡带）的场景下，易出现小地块遗漏或大地块内部错误分割[15-18]。这些方法在捕捉高分辨率影像中细微的多维特征和复杂空间关系方面存在局限，泛化能力不足。

近年来，深度学习技术在图像处理等多个领域取得显著成果[19-25]，其强大的数据表征能力使其被广泛应用于图像分类任务。在耕地分割领域，基于深度学习的语义分割已成为主流方法。杨瑞等[26]采用 U-Net 模型提取耕地、草地等 5 种地物，分类总体精度和 Kappa 系数分别达 85.02% 和 0.79，相比 SVM 和面向对象方法，能更有效地提取地物本质特征，满足精度要求。YUAN 等[27]利用改进的 U-Net 模型进行耕地提取，并与 DeeplabV3+、PSPNet 等模型对比，结果显示改进 U-Net 在精确率（90.36%）、召回率（90.78%）、交并比（82.57%）和 $F_{1\text{-Score}}$（90.57%）上表现最优。CHEN 等[28]应用训练好的 U-Net 模型进行土地利用分类，仅需 55.7 s 即可达到 90.95% 的分类准确率和 0.86 的 Kappa 系数。这些研究验证了 U-Net 模型在快速、精确提取遥感影像耕地特征方面的有效性与应用潜力。

为提升经典语义分割模型的耕地分类精度，现有研究主要聚焦于三个方向：网络架构优化、多尺度特征融合及注意力机制设计。在网络架构优化方面，董张玉等[29]提出结合 EfficientNet 骨干网络和 U 型框架的 BECU-Net 模型，相比 DeeplabV3+，其提取精度和 F1-Score 分别提升 2.24% 和 1.77%，有效缓解了边界模糊问题。在多尺

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基于灰色关联与粗糙依赖度的甘肃兰州市区泥石流危险性评价

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摘要： 危险性评价是泥石流灾害研究的主要问题之一，多因子综合评价是泥石流危险性评估的主要模式。由于泥石流灾害的不确定性和灾害系统的复杂性，因而非确定性分析方法成为其评估首选的研究方法。本研究以泥石流频发的兰州市为例，针对常规研究中选取的坡度等 10 个地形影响因子，首先应用复相关系数法去除地形因子间相关性，获得综合主要地形影响因子的地形易发性因子；然后，从地形易发性、地质岩性、地貌类型、降雨、植被覆盖度 5 个影响因子出发，应用灰色关联度、粗糙依赖度以及融合灰色关联度与粗糙依赖度的模糊综合方法获取泥石流危险性评价图。评价结果可知：（1）地形起伏度、坡向变率、地表粗糙度、坡长、坡度变率、植被覆盖度和降雨对该地区泥石流的发生具有一定的控制作用，与现场调查结果相吻合；（2）将三种评估结果与泥石流灾害进行叠加分析发现，研究区大多数泥石流点分布在 0. 4 ~ 0. 6 和 0. 6 ~ 0. 8 区间，且三种方法获得结果的趋势一致，均较客观地反映研究区泥石流危险性的空间分布；（3）由 ROC 曲线分析，灰色关联度和粗糙依赖度的评估结果精度比较接近，其 ROC 曲线下面积均接近 0. 7；融合灰色关联和粗糙依赖法的模糊综合方法所得的 ROC 曲线下面积大于 0. 7，其说明该模型评估的结果较好地反映泥石流危险性分布，具有较高的可信度。

关键词： 泥石流；危险性；不确定性分析；因子；精度
中图分类号： P642. 23　　**文献标识码：** A　　**文章编号：** 1003-8035（2019）05-0048-09

Hazard assessment of debris flow in Lanzhou City of Gansu Province based on methods of grey relation and rough dependence

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Abstract: Hazard assessment is one of the key issues in disaster studies of debris flow. And comprehensive assessment with multiple factors is the main mode of them. Because of uncertainty and complexity, non-deterministic analysis has already become the preferred approach. This study take Lanzhou, a provincial capital with frequent debris flows, as an example. Firstly, the relationship among 10 topographic factors, such as slope, et al., was taken away with the method of complex correlation coefficient and the topographic susceptibility factor was gained from them. Then, using five factors, for example, the topographic susceptibility, the geological lithology, landform, the precipitation and vegetation coverage and the hazard assessment maps were obtained with three methods of grey relational degree, rough dependence degree and fuzzy comprehensive method with grey relational degree and rough dependence degree. The conclusions are as follows: (1) These debris flows in the study area are controlled by seven factors, including the relief, slope

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基于随机森林的GF-6 WFV和Landsat8 OLI遥感影像分类比较

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摘　要：高分六号卫星具有宽覆宽、多种分辨率、波段多的优势，能为遥感土地覆盖提供更丰富的信息。为了明确GF-6 WFV在土地覆盖分类中的重要性，以山西省浑源县为研究对象，选取同期Landsat8 OLI影像为对比数据集，采用随机森林分类方法进行土地覆盖分类对比研究，结果表明：GF-6 WFV和Landsat8 OLI总体分类精度分别为91.11%和87.87%，Kappa系数分别为0.89和0.85，说明GF-6 WFV的分类效果优于Landsat8 OLI。对比GF-6 WFV和Landsat8 OLI影像的地物光谱特征分析可知，各地物在两幅影像的近红外波段区分较明显，但是GF-6 WFV在红边波段对耕地、林地、草地和灌木的可分性更好，尤其是在红边2波段差异最明显；GF-6 WFV提取的地类面积占比更接近真实值，此外，GF-6 WFV具有更高分辨率的优势，在复杂地物类型分布的地区，GF-6 WFV的分类精度更高。

关键词：GF-6 WFV；Landsat8 OLI；随机森林法；分类精度；浑源县
中图分类号：P237　　**文献标志码：**B　　**文章编号：**1672-4623（2022）08-0049-06

Comparison of GF-6 WFV and Landsat8 OLI Remote Sensing Image Classification Based on Random Forest

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Abstract: GF-6 satellite has the advantages of wide coverage, multi-resolution and multi band, which can provide more information for remote sensing land use. In order to make clear the importance of GF-6 WFV in land use classification, taking Hunyuan County, Shanxi Province as the research object, taking Landsat8 OLI images of the same period as the comparative data set, we used random forest classification method to compare land cover classification. The results show that the overall classification accuracy of GF-6 WFV and Landsat8 OLI are 91.11% and 87.87%, respectively, and Kappa coefficient are 0.89 and 0.85, indicating that the classification effect of GF-6 WFV is better than that of Landsat8 OLI. Combined with the spectral characteristics of ground features of GF-6 WFV and Landsat8 OLI images, it can be seen that the near-infrared band of the two images are more distinct, but the red band of GF-6 WFV has better separability for arable land, forest land, grassland and shrub, especially in the red band 2. In addition, GF-6 WFV has higher resolution. The classification accuracy of GF-6 WFV is higher in the complex terrain type distribution area.

Key words: GF-6 WFV, Landsat8 OLI, random forest method, classification accuracy, Hunyuan County

土地覆盖是人们依据土地的特性，对土地进行间段性的管理和经营。同时土地覆盖也是全球变化的热点问题之一[1]。遥感数据则因其具有大范围、时效性强和成本低的优势成为土地覆盖获取的主要数据源。如何精确地获知土地覆盖的情况，这就应该在中高分辨率遥感影像的支持下，对土地覆盖的变化情况进行高效、准确、及时的管理[2-10]。本研究以山西省浑源县为研究对象，运用随机森林分类方法对GF-6 WFV与Landsat8 OLI影像数据进行土地覆盖分类，并对分类结果进行对比分析。

1　研究区概况及数据预处理

1.1　研究区概况

浑源县隶属于山西省大同市，地理坐标为113.72°~113.92°E，39.67°~39.83°N，气候类型为中温带大陆性季风气候，距离大同市中心约82 km。研究区域内主要土地覆盖类型包括耕地、林地、草地和灌木、裸地、水域、矿区、城镇与农村用地7种土地类型。由

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（*为通信作者）

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基于异质注意力循环神经网络的文本推荐

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摘 要: 针对当前大数据环境下文本推荐不精确的问题,对文本数据和关系网络2种异质数据进行融合,并引入编码器-解码器框架,提出基于异质注意力的循环神经网络模型用于短期文本推荐。使用句子级的分布记忆模型和实体关系表示方法TransR,分别将文本数据和关系网络嵌入到高维向量中作为模型的输入。在编码器阶段,使用双向GRU将用户的短期兴趣引入到推荐模型中,并将注意力机制与解码器相连接,使解码器能动态地选择并线性组合编码器输入序列的不同部分,以建模用户在短期内的偏好。在解码器阶段,将编码器的注意力输出、候选项和当前用户的表示作为输入。通过双向GRU和前馈网络层,计算每个候选项的得分得到推荐结果。实验结果表明,与TF-IDF和ItemKNN等模型相比,该模型在召回率和均值平均精度指标上均有明显提升。

关键词: 短期文本推荐; 数据嵌入; 异质数据; 双向GRU; 注意力机制

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Text Recommendation Based on Heterogeneous Attention Recurrent Neural Network

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【Abstract】 To improve the inaccurate text recommendation in the big data environment, this paper merges two kinds of heterogeneous data, text data and relational network, and introduces the encoder-decoder framework. On this basis, a Recurrent Neural Network (RNN) model based on heterogeneous attention is proposed for short-term text recommendation. The sentence-level Distributed Memory Model of Paragraph Vectors (PV-DM) and the representation method for entity relations, TransR, are used to embed text data and relational network into high-dimensional vectors as the input of the model. In the encoding stage, the short-term interests of users are introduced into the recommendation model by using bidirectional GRU, and the attention mechanism is used to connect with the decoder, so that the decoder can dynamically select and linearly combine different parts of the input sequence of the encoder in order to build short-term interests of users. In the decoder stage, the attention output of the encoder, the candidate items, and the representation of current users are taken as inputs. The score of each candidate item is calculated with the bidirectional GRU and the feedforward network layer to obtain the recommendation result. Experimental results show that compared with TF-IDF, ItemKNN and other models, the proposed model significantly improves the recall rate and the average precision of the mean.

【Key words】 short-term text recommendation; data embedding; heterogeneous data; bidirectional GRU; attention mechanism

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近20年来新疆阿勒泰地区植被动态变化及其对气候与地形的响应

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摘 要:植被在生态环境监测中有着极其重要的意义,探讨植被覆盖变化可为区域生态环境保护工作提供重要参考。利用多源遥感长时间序列数据、分离趋势和季节项的突变点方法像元突变监测、地形位分析及地统计等方法,对新疆阿勒泰地区2000—2019年间植被覆盖动态进行遥感变化监测。实验结果表明:(1)研究期间,2003—2009年植被突变像元数逐年增多,2009年以后突变像元数逐渐减少,同时在监测出的7类植被像元突变趋势类型中,由退化后转变为增长类的像元突变数最多,干扰退化和持续退化类较少;(2)多源数据植被覆被年际变化曲线显示,植被覆盖动态变化出现先减少后增加的趋势,其中,2000—2008年时段总体呈现退化趋势,2008—2019年时段呈现明显改善趋势,且退化大于改善;(3)高程大于900 m、坡度大于15°的东坡(北转东和南转东)为植被覆盖变化退化类型的优势地形位,约占62.4%,研究区植被覆盖改善并不明显,需继续加大研究区生态环境保护。

关键词:植被覆盖;叶面积指数;标准化降水-蒸散发指数;时空动态;地形位

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Vegetation Dynamic Change and Its Response to Climate and Topography in Altay Region of Xinjiang in Recent 20 Years

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Abstract: **Objectives**: Vegetation plays an important role in ecological environment monitoring. Studying vegetation cover change can provide reference for regional ecological environment protection. The region of Altay in Xinjiang belongs to the ecological function zone of water conservation mountain grassland, with rich natural resources and beautiful scenery. However, the ecological environmental problems were gradually emerging under the national development strategies. Therefore, monitoring the dynamics of vegetation change in the area with multi-source remote sensing data is necessary to explore the relationship between the economic development and ecological environment protection. **Methods**: This paper uses multi-source remote sensing long time series data with breaks for additive seasonal and trend, topographical posi-

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兰州南北两山植被覆盖变化动态监测

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摘要： 以2000年、2008年和2013年3期Landsat TM/TM+遥感影像计算获得的植被覆盖度分级图为基础，通过统计分析各时相、各级别的植被覆盖面积及计算得到的转移矩阵，定量分析兰州南北两山植被覆盖度的变化. 结果表明：2000—2013年间，劣等植被覆盖面积从2000年的393.07 km^2减少到2013年的0.12 km^2；中等植被覆盖面积，在前8 a的变化相对较小，而后5 a变化较大；良、优等植被覆盖面积均有明显的扩大. 劣等级的植被覆盖一直在向优等转移，而优等的植被覆盖转移到劣等的相对较少. 兰州南北两山植被覆盖总体呈明显的增长趋势，至2013年，南北两山植被已经进入良好的生长期，生态建设成效显著.

关键词： 南北两山；遥感；植被覆盖度；动态监测

中图分类号： TU19；TP79 **文献标志码：** A

Dynamic monitoring of vegetation coverage variation on southern and northern two mountains in Lanzhou

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Abstract: Based on fractional vegetation coverage classification graphs obtained by means of analysis of remote sensing images in three issues (2000, 2008 and 2013) of Landsat TM/TM+, the variation of the fractional vegetation coverage (FVC) on southern and northern two mountains in Lanzhou was quantitatively analyzed by means of statistics and analysis of vegetation coverage areas, in every periods for every classes and the transition matrixes calculated on the basis of the former. The result showed that from 2000 to 2013, the inferior vegetation coverage area decreased from 393.07 km^2 in 2000 to 0.12 km^2 in 2013. The moderate vegetation coverage area changed relatively less in the first eight years and then changed greater in the late five years. The both good and excellent vegetation coverage areas expanded obviously. During these years, the FVC of the inferior vegetation was continuously transferred to that of excellent one, but the FVC of the excellent one was less transferred to that of inferior one comparatively. Vegetation coverage on southern and northern two mountains in Lanzhou exhibited all in an obvious growth trend. By 2013, the vegetation has entered into a good growth period, and the effect of ecological construction was remarkable.

Key words: northern and southern two mountains; remote sensing; vegetation cover age fraction; dynamic monitoring

兰州位于黄河上游的黄土高原西部，是中国唯一的黄河干流穿城而过的城市. 兰州市城区坐落黄河两岸河流阶地上，其南北两侧为绵延起伏的高山和纵横沟壑的黄土峁梁，地形陡峭. 由于半干旱的气候环境，地表植被稀少，降水相对集中，小范围短时暴雨往往强度大，因此，滑坡泥石流等地质灾害频发，灾害的预防难度也较大. 建国以来，兰州地区发生灾害性滑坡100多起，造成严重的经济损失，其危害程度居全国各省会城市之首. 随着西部大开发和城市化的步伐加快，大量人类工程活动对周围环境

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Liu Bo, Niu Quanfu, Wang Gang, et al. Analysis of forest cover changes and driving forces in the Loess Plateau (Gansu region) based on multisensor remote sensing images[J]. Science Technology and Engineering, 2025, 25(1): 54-66.

联合多源遥感数据的黄土高原(甘肃区)森林覆盖变化及驱动力分析

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摘 要 黄土高原作为中国西部地区的自然生态屏障,为国家可持续发展做出了积极贡献。黄土高原(甘肃区)生态环境的治理与修复对中国生态文明建设战略的实施具有关键作用,为监测 2008—2018 年黄土高原(甘肃区)森林资源变化情况,基于云平台,联合 Landsat、PALSAR 及地形数据,探究光谱指数、后向散射、纹理及地形特征在森林资源信息获取方面的优势,运用随机森林特征优选算法获取研究区 10 年间森林覆盖时空分布并基于地理探测器进行因子探测。结果表明:随机森林特征优选算法可以有效筛选特征重要信息,总体精度可达 91.88%,Kappa 系数为 0.91。联合 Landsat、PALSAR 及地形数据的实验方案精度明显高于使用单一数据源的森林分类结果,四期分类结果总体精度分别为 86.65%、88.23%、90.15%、89.86%。10 年间研究区森林面积净增加 0.60×10^4 km^2;森林增加的区域主要分布于庆阳市中东部、平凉市东部、天水市中部和临夏回族自治州西部地区,而森林退化主要出现在定西市西南部和临夏回族自治州中东部地区。单因子探测中土地利用类型是森林覆盖变化的主导因子,适宜性的土壤类型的空间分布和降雨量的辅助作用,为植树造林成活率和森林健康生长提供了良好的自然条件。

关键词 黄土高原(甘肃区); 特征优选; 遥感监测; 地理探测器
中图法分类号 P237; **文献标志码** A

Analysis of Forest Cover Changes and Driving Forces in the Loess Plateau (Gansu Region) Based on Multisensor Remote Sensing Images

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[**Abstract**] The Loess Plateau, as a natural ecological barrier in the western region of China, has made positive contributions to the sustainable development of the nation. The governance and restoration of the ecological environment on the Loess Plateau (Gansu region) plays a critical role in the implementation of China's ecological civilization construction strategy. To monitor the changes in forest resources on the Loess Plateau (Gansu region) from 2008 to 2018, based on cloud platform, Landsat, PALSAR, and terrain data were integrated to explore the advantages of spectral index, backscatter, texture, and terrain features in obtaining forest resource information. The random forest feature selection algorithm was utilized to obtain the spatiotemporal distribution of forest cover in the study area for 10 years, and factor detection was conducted using geographic detectors. The results indicate that the random forest feature selection algorithm can effectively screen important feature information, with an overall accuracy of 91.88% and a Kappa coefficient of 0.91. The experimental scheme that integrates Landsat, PALSAR, and terrain data presents significantly higher accuracy compared to the forest classification results using a single data source. The overall accuracy of the four classification results is 86.65%, 88.23%, 90.15%, and 89.86% respectively. Over the past 10 years, the net increase in forest area in the study area is 0.60×10^4 km^2. The areas with increased forests are primarily distributed in the central and eastern parts of Qingyang City, Pingliang City, Tianshui City, and the western region of Linxia Hui Autonomous Prefecture, while forest degradation

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Mapping the forests and their spatiotemporal changes in the Yellow River Basin (Gansu section) in China from 2008 to 2018

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ABSTRACT

Efficient and precise extraction of forest information is crucial for assessing the effectiveness of ecological projects and informing ecological policy adjustments in the Gansu section of the Yellow River Basin, China. Utilizing PALSAR (Phased Array L-band Synthetic Aperture Radar) and Landsat data, this study gathered forest/non-forest samples and formulated classification rules using the backscatter coefficients from PALSAR's HH, HV, HH-HV, and HH/HV polarizations to generate monthly 30-meter forest data. These results were further refined using Landsat's NDVImax and B7max indices. Our findings are as follows: The forest/non-forest data extracted from PALSAR and Landsat aligns more closely with publicly available forest data, achieving an overall accuracy of 95.4% and a Kappa coefficient of 0.87, which demonstrates the reliability and accuracy of our extraction method. Driven by ecological engineering projects and climate factors, the forest area has expanded significantly, from 13,200 square kilometers in 2008 to 19,800 square kilometers in 2018, with an average annual growth rate of 5%. Approximately 94.09% of the forest area is located at elevations up to 3,500 meters, with stable and increasing forest types predominantly found on the northern and western slopes, spanning elevations between 3,000 and 3,500 meters and slopes ranging from 20° to 35°. Our study provides valuable insights into regions characterized by rugged terrain and low forest density.

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KEYWORDS
The Yellow River Basin (Gansu section); forest/non-forest; PALSAR; Landsat; reliability

Introduction

As an essential component of terrestrial ecosystems, forests play a crucial role in providing regional and global ecological services (Seddon et al., 2016). Forests not only serve as an important material foundation for national sustainable development, but also represent an essential renewable resource in economic and ecological construction (Fang & Li, 2021). They possess multiple ecological functions, including soil and water conservation (Li et al., 2020), biodiversity protection (Cao et al., 2017), air purification, wind and sand prevention, and climate regulation (Zhang et al., 2018). Therefore, forest protection and afforestation are crucial in establishing a favorable ecological environment. The Yellow River Basin spans the three major regions of China: the Qinghai Plateau, the Loess Plateau, and the North China Plain. This region not only serves as a significant ecological barrier in China, but is also a typical area characterized by a fragile ecological background and severe soil erosion (Kang et al., 2022). Among them, the Gansu section of the Yellow River Basin is an important area for water source conservation and supply, responsible for the ecological restoration of the upper reaches of the Yellow River. In history, the region had a beautiful ecological environment, a pleasant climate, and abundant mineral resources. Before the 1980s, with the acceleration of development and construction in the central and western regions of China, the contradiction between economic development and environmental protection in the Yellow River Basin became increasingly acute. In order to protect the ecological environment, a series of ecological engineering projects such as the Grain for Green (GfG) program were launched (Niu et al., 2019), which is a major ecological project with the widest coverage and has had the highest rate of public participation in history, involving 124 million people and 32 million households across a total of 1,897 counties and 25 provinces (Delang & Wang, 2013; Niu et al., 2019; Zhou et al., 2019). After more than 30 years of ecological construction, evaluating the ecological effectiveness of the region has become a research focus (Qu et al., 2021; Yang et al., 2022; Zhu et al., 2022). Quantitative forest information extraction through remote sensing is a crucial

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Quantifying spatial-temporal changes of tea plantations in complex landscapes through integrative analyses of optical and microwave imagery

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Abstract: High demand for tea has driven the expansion of tea plantations in the tropical and subtropical regions over the past few decades. Tea plant cultivation promotes economic development and creates job opportunities, but tea plantation expansion has significant impacts on biodiversity, carbon and water cycles, and ecosystem services. Mapping the spatial distribution and extent of tea plantations in a timely fashion is crucial for land use management and policy making. In this study, we mapped tea plantation expansion in Menghai County, Yunnan Province, China. We analyzed the structure and features of major land cover types in this tropical and subtropical region using (1) the HH and HV gamma-naught imagery from the Advanced Land Observation Satellite (ALOS) Phased Array L-band Synthetic Aperture Radar (PALSAR) and (2) time series Landsat TM/ETM+/OLI imagery. Tea plantation maps for 2010 and 2015 were generated using the pixel-based support vector machine (SVM) approach at 30 m resolution, which had high user/producer accuracies of 83.58%/91.67% and 87.50%/90.83%, respectively. The resultant maps show that tea plantation area increased by 33.56% (~9335 ha), from ~27,817 ha in 2010 to ~37,152 ha in 2015. The additional tea plantation area was mainly converted from forest (32.50%) and cropland (67.50%). The results showed that the combination of PALSAR and optical data performed better in tea plantation mapping than using optical data only. This study provides a promising new approach to identify and map tea plantations in complex tropical landscapes at high spatial resolution.

Keywords: Tea plantation; Support vector machine; Landsat; PALSAR; Tropical zone

1. Introduction

The tea plant (*Camellia sinensis* (L.) O. Kuntze), an evergreen broad-leaved perennial shrub, is widely cultivated in the mountains of tropical and subtropical zones and is important commercial crop (Duncan et al., 2016; Wang et al., 2016). As one of the three most popular manufactured beverages (tea, coffee, and cocoa) consumed in the world (Kumar et al., 2013), tea is a major economic crop in many developing countries, including China, India, Kenya, and Sri Lanka. Due to the rapid development of the global tea industry since the beginning of this century, tea plantation area and tea production have increased significantly. According to International Tea

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ORIGINAL ARTICLE

Suitability analysis for topographic factors in loess landslide research: a case study of Gangu County, China

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Abstract
Loess Plateau is one of the ecologically fragile regions in China. It is one of the slippery strata of which landslides often developed. The formation and development of landslides are mainly affected by various natural environments, triggering factors, the vulnerability of landslide-bearing bodies, and topography has a controlling effect on landslides and determines landslide distribution. As important environmental elements, the selection and reclassification of topographic factors are the basis for loess landslide vulnerability map. In this study, our research suggests an effective workflow to select and analyze the topographic factors in the loess landslides. Nine hazard-formative environmental factors [e.g., slope, aspect, slope shape (SS), slope of slope (SOS), slope of aspect (SOA), surface amplitude (SA), surface roughness (SR), incision depth (ID) and elevation variation coefficient (EVC)] are prepared for landslide suitability analysis. The models of certainty factor, sensitivity index and correlation coefficient are combined to select and analyze the suitability of these factors. Four topographic factors (i.e., slope, SOS, SS and SR) were ultimately selected to carry out the landslide vulnerability mapping with other factors. Our results showed that most of the landslides were located in medium and high classes and accounting for 75.3%, and these places also coincided with higher economies and intense human activities. Our research also suggested that in situ measurements are necessary to determine how to reclassify these topographic factors and how many grades these topographic factors divided, which would further improve the reliability of landslide vulnerability map for the decision makers to deal with the possible future landslides in terms of safety and human activities.

Keywords Landslide · Loess · Topographic factor · Model · Suitability analysis

Introduction

Loess is a windblown under-consolidated deposit formed during the past 2.5 million years in arid and semi-arid climatic conditions (Zhang and Liu 2009) and is widely distributed in Asia, Europe, North America and South America with the color of pale yellow or brownish yellow (Liu 2009). It consists of angular grains of quartz, feldspar, mica and other minerals between 0.005 and 0.05 mm in size with the characteristic of macroporous, well-developed vertical jointing and susceptibility to collapse on wetting (Zhang and Liu 2009). The north and northwest parts of China have the most extensive, most complete and thickest loess deposits (Zhang and Liu 2009). Loess is mainly distributed in Gansu, Shaanxi, Shanxi and other places in China, and covers a total area of over 0.6 million km^2 (Duan 1993). Loess deposits record the changes of the global natural environment and climate and the occurrence of geological disasters since the late Neogene (Liu 2009). Because of its large thickness, loose structure, intersecting ravines and gulliesjavascript:void(0);, broken terrain, dry climate, short-time concentrated rainfall and serious soil erosion, loess is the most ecologically vulnerable area in China and extremely prone to landslide development. In China, approximately one-third landslides occurred in the loess area (Zhou and Zhu 2002). With the development of the economy and human engineering activities, a variety of landslides and latent unstable slope have increased apparently. In recent years, landslide risk assessment for regional scale has received more and more attention (Erener and Düzgün 2011; Xu et al. 2009). To gain the

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Research article

Dominant drivers of vegetation changes in key ecological barrier of northeastern Tibetan Plateau since 2000: Human impacts or natural forces?

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ABSTRACT

Human activities and natural forces have profoundly influenced vegetation ecosystems in the Tibetan Plateau over the recent decades. However, contributions of these two driving forces to vegetation changes remain controversial, especially in the ecological barriers like the Qilian Mountains (QM) in the northeast where many protecting measures and strategies were applied to enhance ecosystem stability and services. Our study employed a process-based model and a multi-perspective assessment method to determine dominant drivers of vegetation changes in the QM since 2000. The result indicated that human activity changes contributed 40.74% to the significant vegetation amelioration of the QM as a whole, which is comparable to natural forces. Areas dominated by human activity changes accounted for 18.42% of the entire region, which were mainly distributed in grassland restoration area, oasis agricultural area and forestry protection area. In these areas, increased human activities (including desertified grassland restoration, agricultural irrigation and fertilization, forest protections and afforestation) mainly promoted the vegetation amelioration. Yet, natural forces resulted in amelioration in partial alpine grasslands in southeastern QM, accounting for 10.53% in area. Areas dominated by both human activity changes and natural forces, mainly in grazing grasslands, accounted for 47.80%. Variations in grazing intensity and climate jointly determined fluctuations in vegetation therein. Additionally, there remained 23.25% areas lack of obvious drivers, generally with sparse vegetation. Ecological protections and agricultural measures significantly promoted the vegetation amelioration of the QM since 2000. The findings could provide essential insights for protection and construction of the ecological barriers in the Tibetan Plateau.

1. Introduction

The intensity of human activities in the Tibetan Plateau have changed markedly since the launch of the China's Western Development Strategy (WDS) in 2000 (Zeng et al., 2023; Yang et al., 2022). Extensive land development, agricultural cultivation, and grazing activities have been continuously undertaken to stimulate socioeconomic growth of local mountainous areas (Zhu et al., 2023; Yang et al., 2022; Winkler et al., 2021). Meanwhile, ecological protecting measures and strategies, such as desertified grassland restoration, afforestation and grazing restrictions, have also been performed for restoring and enhancing ecosystem stability and services within ecological barriers (Fu et al., 2023; Wang et al., 2022; Chen et al., 2019). Concurrently, the regional climate has experienced significant warming (Bao et al., 2024; Yao, 2019), and the natural resilience of the ecosystem tends to increase (Gao et al., 2019; Fang and Zhang, 2019). Natural forces (i.e., climate change and natural resilience) and human activity changes have induced significant changes in the greening and carbon sequestration capacity of the mountainous vegetation (Li et al., 2024; Wang et al., 2021, 2023). However, whether human activity changes or natural forces are the dominant drivers of these changes remains controversial. It is urgent to determine relative contributions of these two drivers to vegetation changes and then guide ecosystem protection and construction of the ecological barriers in Western China (Fu et al., 2023; Wen et al., 2023; Wester et al., 2019).

Extensive studies have assessed the contributions of human activity changes and natural forces to vegetation changes in the Tibetan Plateau using a residual-trend method (Zhang et al., 2022; Li et al., 2018; Evans and Geerken, 2004). These assessments typically quantified the contribution of human activity changes through comparing remotely sensed vegetation changes with its potential changes driven solely by climate change (Zhang et al., 2022; Chen et al., 2021; Li et al., 2018). The

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Main Article

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Human impacts on vegetation carbon sequestration capacity in the Qilian Mountains, northeastern Tibetan Plateau since 2000

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Abstract

Vegetation carbon sequestration in alpine areas of West China, such as the Qilian Mountains on the northeastern Tibetan Plateau, has been subject to long-term human intervention under a warming climate since the launch of the western development strategy (WDS) in 2000. However, the human impacts on vegetation carbon sequestration capacity during this period remain unclear. In this study, the magnitude and direction of human impacts on vegetation carbon sequestration capacity (defined as net primary production, NPP) were assessed by the deviation of remote-sensing–estimated actual NPP data from the simulated potential NPP. The potential value was derived from natural system coupling under the assumption that human activities ceased during the assessment period. The impacts of natural forces and historic human activities were then effectively exfoliated in our final assessment using a process-based $IBIS_i$ model. The results indicate that the total actual vegetation carbon sequestration capacity in the Qilian Mountains has reduced compared with its potential value since the WDS launched. This reduction was mainly attributed to grazing in the grasslands. However, deforestation, mineral resource exploitation, and the construction of hydropower facilities have also caused a reduction in vegetation carbon sequestration capacity at the local scales. In contrast, forestry protections and afforestation, and agricultural activities associated with reclamation, cultivation, irrigation, and fertilization, have resulted in local increases in the vegetation carbon sequestration capacity in the corresponding forest lands, shrublands, and croplands. These findings highlight the importance of ecological protections for vegetation carbon sequestration and were expected to provide evidence to verify the improvement of ecological management and the increasing of carbon sinks in West China.

Keywords

human impacts, vegetation carbon sequestration, net primary production, Qilian Mountains, the western development strategy in China, $IBIS_i$ model

I Introduction

Carbon sequestration by vegetation is a key contributor to the global terrestrial carbon sink (Fang et al., 2015; Lu et al., 2018; Piao et al., 2022). The

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remote sensing

MDPI

Article

Spatiotemporal Heterogeneity in Runoff Dynamics and Its Drivers in a Water Conservation Area of the Upper Yellow River Basin over the Past 35 Years

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Abstract: The upper Yellow River Basin (UYRB) is an important water source and conservation area. As well as a warming climate, the region has experienced long-term human interventions, such as grazing, farming and reservoir construction, since the mid-1980s. The runoff dynamics and its drivers in the UYRB remain poorly constrained, especially the differences between pastoral and agricultural areas, due to a lack of detailed measurements. Here, the contributions of climate change, land-use change and anthropogenic water consumption to runoff changes observed at hydrological stations were evaluated by combining the observations with scenarios simulated by a process-based hydrological model. Changes in the pastoral and agricultural areas of the UYRB were then compared at 10-year intervals during the period 1986–2020. The results indicated lower runoff in the UYRB over the past 35 years, when compared with that in the baseline period of 1965–1985, due to the negative influences of both climate change and anthropogenic water consumption. Meanwhile, land-use change had only a weak influence, due to stable land-use patterns. However, spatial differences in dominant drivers of runoff reductions were evident between the pastoral area and agricultural area. Specifically, runoff decreases were caused by the negative influences of climate change in the pastoral area and anthropogenic water consumption in the agricultural area. A shift in the dominant drivers after the period 2006–2015 was attributed to the positive influence of climate change and a weakening of agricultural water consumption and reservoir inflow during the same period. These changes initially caused a decrease in runoff, and later an increase. These findings contribute to a crucial evidence base for optimizing water resource management, ecological protection and high-quality development in the Yellow River Basin.

Keywords: runoff dynamics; dominant drivers; spatiotemporal heterogeneity; upper Yellow River Basin

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1. Introduction

The Yellow River (Huang Ho) is central to Chinese culture, where it is considered the Mother River. The upper Yellow River Basin, as an important water source area and water conservation area [1–3], is a primary resource for socioeconomic development along the Yellow River [2,4]. The basin has experienced continuous agricultural and grazing activities, as well as a warming climate, over the past decades [5–7]. Agriculture in this region depends heavily on the upper Yellow River water resource [4,8], such that water consumption for livestock grazing has a direct impact on river runoff. Meanwhile, grazing also changes the underlying surface conditions (mainly the vegetation cover and soil structure), thereby influencing the local water cycle [2,9,10]. A series of ecological conservation and restoration programs (e.g., the Grain for Green Project and Grazing withdraw program) had additional impacts on the ground surface, with corresponding impacts on the water storage capacity

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An improved IBIS model for simulating NPP dynamics in alpine mountain ecosystems: A case study in the eastern Qilian Mountains, northeastern Tibetan Plateau

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ABSTRACT

The Integrated Biosphere Simulator (IBIS) model is an effective means of simulating potential vegetation dynamics driven by climate change. However, this model neglects certain key processes and the influences of terrain and soil thickness in alpine mountain ecosystems, which leads to a poor accuracy of net primary production (NPP) simulation. Taking the eastern Qilian Mountains as a case, we revised the IBIS model by integrating terrain influences, water distribution processes, and vegetation and soil characteristics. Terrain effects on solar radiation and precipitation intensity were executed using a hill-shade value and a terrain correction factor, respectively. Then, the re-infiltration process of surface runoff within a pixel was integrated into water distribution sub-module. In the revised model ($IBIS_i$), soil hydraulic conductivity was dynamically updated based on the saturated hydraulic conductivity of soil texture and soil-pore water content, instead of a constant value. Inverse migration of soil water due to surface evaporation was also integrated to simulate its impacts on soil moisture. Considering spatial heterogeneity of soil thickness in alpine mountains, the $IBIS_i$ adopts a thickness-based soil layer structure instead of a 4-meter one. The leaf area index base in herbaceous areas was optimized by a germination coefficient. A measured CO_2 concentration series was utilized as an alternative to the calculated values by model prediction. Meanwhile, the key parameters of alpine mountain ecosystems were set based on field survey from the case study area. The NPP values simulated by the $IBIS_i$ model were compared with the ones measured by remote sensing in areas with relatively less human activities. The results indicated that the $IBIS_i$ model had a high reliability and accuracy. Thus, it is a good option for simulating NPP dynamics in alpine mountain ecosystems under climate change, and could also provide a scientific basis for assessing human activity impacts at the regional scale.

1. Introduction

Alpine mountains count for approximately 24% of the whole land area on the earth (FAO, 2000). Alpine mountain ecosystem, widely distributed in the Tibetan Plateau and inland high-altitude mountain areas in China (Wang et al., 2011), is of great significance to regional ecological quality and safety (Wang et al., 2020). In this complex ecosystem, there are commonly various components such as glacier and snow, alpine deserts, grasslands and forests, which are very sensitive to global changes. Thus, the dynamics of the alpine mountain ecosystem are extremely complicated, especially under the influence of both climate change and human activities (Yue and Fan, 2014, Huang et al., 2016, Yao, 2019). It is difficult and important to understand their dynamics and its driving mechanisms within the framework of coupling multi-element and multi-process in ecosystems.

Net Primary Production (NPP) dynamics in alpine mountains have always been the hotspot of mountain system research, and are commonly investigated by means of remote sensing, ground-based observations and model simulation (Wang et al., 2011; Li et al., 2018; Wester et al., 2019). Remote sensing is widely used to monitor NPP changes in terrestrial ecosystems due to its advantages of large-area synchronization and high-efficiency (Congalton, 2010; Wang et al., 2019). The remote-sensed results generally reflect actual NPP changes under the impacts of both human activities and climate changes (Zhang et al., 2018; Wang et al., 2020). Nevertheless, remote-sensing images have obvious distortion in alpine sparsely vegetated areas, because of

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Alpine sparsely vegetated areas in the eastern Qilian Mountains shrank with climate warming in the past 30 years

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Abstract

Alpine sparsely vegetated areas (ASVAs) in mountains are sensitive to climate change and rarely studied. In this study, we focused on the response of ASVA distribution to climate change in the eastern Qilian Mountains (EQLM) from the 1990s to the 2010s. The ASVA distribution ranges in the EQLM during the past three decades were obtained from the Thematic Mapper remote sensing digital images by using the threshold of normalized difference vegetation index (NDVI) and artificial visual interpretation. Results indicated that the ASVA shrank gradually in the EQLM and lost its area by approximately 11.4% from the 1990s to the 2010s. The shrunken ASVA with markedly more area than the expanded one was mainly located at altitudes from 3700 m to 4300 m, which were comparatively lower than the average altitude of the ASVA distribution ranges. This condition led to the low ASVA boundaries in the EQLM moving upwards at a significant velocity of 22 m/decade at the regional scale. This vertical zonal process was modulated by topography-induced differences in local hydrothermal conditions. Thus, the ASVA shrank mainly in its lower parts with mild and sunny slopes. Annual maximum NDVI in the transition zone increased significantly and showed a stronger positive correlation with significantly increasing temperature than insignificant precipitation variations during 1990–2015. The ASVA shrinkage and up-shifting of its boundary were attributed to climate warming, which facilitated the upper part of alpine meadow in the EQLM by releasing the low temperature limitation on vegetation growth.

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RESEARCH ARTICLE

WILEY

Human activities have markedly altered the pattern and trend of net primary production in the Ili River basin of Northwest China under current climate change

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Abstract

The Ili River basin (IRB), as an epitome of border areas of Northwest China and has experienced intensive human disturbance since the implementation of the Western Development Strategy in 2000. However, the ways that human activity affected the pattern and trend of net primary production (NPP) in this region under current rapid climate change remain unclear. Here, potential NPP time-series data, driven solely by climate change, were simulated using a process-based model $IBIS_i$, with an initial status that was already disturbed by human activity prior to the measurement period. The human impacts on NPP during the measurement period were derived by comparing potential NPP with remotely-sensed ones. The results indicate that human activities have markedly altered the pattern and trend of NPP in the IRB during 2000–2017. Cropland reclamation and cultivation, and afforestation, have resulted in significant increases in NPP relative to their typically low values in the basin bottom areas. Associated with those changes grazing has caused negative deviations in most grasslands with potentially high NPP. As a consequence, the spatial heterogeneity of NPP was significantly lowered. A slight decreasing trend in NPP of the IRB was revealed by remote sensing, which contrasted the increasing trend that should have occurred due to climate change. This difference between the real and simulated trends was mainly attributed to a weakening of positive human impacts on NPP in croplands and strengthening of negative impacts in grasslands. These findings provide valuable information for current land-use management and ecosystem restoration in Northwest China and Central Asia.

KEYWORDS
human activity impact, Ili River basin, land use, net primary production

1 | INTRODUCTION

Human activity and climate change play key roles in controlling the Net Primary Production (NPP) of ecosystems in Northwest China and Central Asia (Jiang et al., 2017; Qi et al., 2020; Teng et al., 2020), where land degradation and water scarcity are severe (Huang et al., 2020; Qi et al., 2020). The Ili River basin (IRB), located in the upper Ili-Balkhash basin in Central Asia, is an important transboundary area between China and Kazakhstan (Chen et al., 2018; Duan et al., 2020). NPP in the IRB has been profoundly affected by the current warming and wetting of the climate and by intense human activity due to the Western Development Strategy of China since 2000 (Chen

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A Multi-Perspective Assessment Method with a Dynamic Benchmark for Human Activity Impacts on Alpine Ecosystem under Climate Change

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Abstract: Intense human activities and rapid climate changes both have obvious impacts on alpine ecosystems. However, the magnitudes and directions of the impacts by these two drivers remain uncertain due to a lack of a reasonable assessment method to distinguish between them. The impact of natural resilience is also generally included in the dynamics of a disturbed ecosystem and is liable to be mixed into the impact of human activity. It is urgent that we quantitatively discriminate human activity impacts on the ecosystem under climate change, especially for fast-developing alpine regions. Here, we propose an assessment method to determine human activity impacts under a dynamic climate, taking the potential net primary production (NPP) of an ecosystem as a benchmark. The potential NPP (NPP_P) series under the changing climate was retrieved by an improved integrated biosphere simulator based on the initial disturbed ecosystem status of the assessment period. The actual NPP (NPP_A) series monitored by remote sensing was considered as the results derived from the joint impacts of climate change, natural resilience and human activity. Then, the impact of human activity was quantified as the difference between the NPP_P and NPP_A. The contributions of human activity and natural forces to ecosystem NPP dynamics were then calculated separately and employed to explore the dominant driver(s). This assessment method was demonstrated in a typical alpine ecosystem in Northwest China. The results indicate that this method capably revealed the positive impacts of local afforestation and land-use optimization and the negative impacts caused by grazing during the assessment period of 2001–2017. This assessment method provides a quantitative reference for assessing the performances of ecological protections or human damage to alpine ecosystems at the regional scale.

Keywords: the impact of human activity; multi-perspective assessments; improved integrated biosphere simulator model ($IBIS_i$); net primary production; alpine ecosystem

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1. Introduction

Intense human activity and rapid climate change have significantly affected natural terrestrial ecosystems [1–4], especially alpine ecosystems, which are widely distributed in high-altitude mountainous areas [5–7]. The vegetation composition of the ecosystem mainly involves alpine meadows, forests and grasslands. Vegetation expansion to higher altitudes in alpine areas has been recognized [8,9], with such changes in vegetation pattern and ecosystem services directly impacting socio-economic development downstream of alpine areas [10–12]. Concurrent greening in recent decades is evident from remotely sensed data [13–15], including within arid and semi-arid areas [12,16,17], though debate remains regarding the sustainability of afforestation with respect to water resource limits [18–21]. Land degradation and ecological destruction, such as deforestation and overgrazing, have also been detected in alpine areas [22–24].

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RESEARCH

A spatial downscaling method for multielement meteorological data: case study from a water conservation area of the upper Yellow River basin

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Abstract
Meteorological datasets with high-precision and high spatiotemporal resolution are an important base in many applications, such as climatology, ecology, and hydrology. To improve the spatial resolution and accuracy of meteorological data with different elements, this study proposes a method, whereby a machine learning (ML) algorithm is jointly applied to spatial downscaling and post-downscaling error correction (ML–ML). Taking a water conservation area of the upper Yellow River basin (UYRB) as a case study, and using the China Meteorological Forcing Dataset (CMFD), four ML algorithms (Gaussian process regression (GPR), neural network (NN), random forest (RF), and support vector machine (SVM)) were selected to verify the effectiveness of ML–ML and explore the optimal downscaling model suitable for different meteorological elements. The experimental results show the following: (1) the CMFD has good applicability in the UYRB; (2) in addition to the RF, the GRP, NN, and SVM models can successfully retain the original spatial distribution patterns of the CMFD dataset and reflect increased spatial detail; and (3) by comparing the performance of the four models in spatial downscaling and error correction of different meteorological elements, we find that the GPR model is best for precipitation, and the SVM model is best for relative humidity, 2-m air temperature, and 10-m wind speed. On the basis of the thinking behind the ML–ML method, the downscaling models applicable to different meteorological elements screened in this study can provide a reference for generating high-precision and high-resolution meteorological datasets.

1 Introduction

In recent decades, climate change has affected various aspects of ecosystems, water resources, and agriculture to varying degrees (Whitehead et al. 2009; Dhakal et al. 2016; Bakure et al. 2022), and the challenges it posed have been an important concern for many researchers (Lesk et al. 2016). As the main drivers of the water and carbon cycles, near-surface air temperature, precipitation, wind speed, and humidity are important input parameters for studying the response of surface processes to climate change (Mackay et al. 2007; Brümmer et al. 2012; Kour et al. 2016). The accuracy of the input data often affects the precision of the model simulation results (Cosgrove et al. 2003). Therefore, meteorological datasets with high precision and high spatiotemporal resolution are of fundamental importance to hydrology, meteorology, and ecology.

To quickly obtain meteorological multielement data and simultaneously meet the needs of research in terms of spatiotemporal resolution, Kriging (Chang 1991), ANUSPLIN (Price et al. 2000), and other methods have been used to directly interpolate the observations in space. Although these interpolation methods are common and simple, they are dependent on the number and spatial distribution of meteorological stations. Hence, there are still some defects

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Article

Spatial Access to Medical Services in the Underdeveloped Region of Northwestern China: A Case Study in Lanzhou City

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Abstract: Research on the spatial access to medical services has become a hot topic in recent years. The representative provincial capital in the underdeveloped region of northwestern China, Lanzhou, was selected for the research area. In this paper, methods such as the two-step floating catchment area and ArcGIS network analysis are used to analyze the geographic spatial accessibility of medical services and differences of spatial access between urban and rural areas in Lanzhou city. The results show that 1. Areas in General and below grade of accessibility account for most of Lanzhou city. Therefore, the spatial accessibility of whole Lanzhou city is comparatively unsatisfactory. It shows a tendency of the north region to be worse than south region, and areas in parts of the main districts, parts of HG, and other tiny minority show Great grade of accessibility, and most of other areas distribute in poorer grade of accessibility, especially the surrounding mountainous region. 2. There are obvious differences in accessibility between urban and rural regions, mainly reflected in that residents and areas are basically districted in the Great and Good grade in the urban region, while almost 75% of the population and 35% of the areas are distributed in the Great and Good grade, and nearly 25% of the residents and 65% of the areas are still in the unsatisfactory accessibility grade in the rural region. According to the results, the researchers put forward corresponding suggestions to improve the current situation, which are roughly as follows: The construction of hospitals and primary health care should be strengthened in the rural region, especially the construction of township health centers and health stations. High-class hospitals are needed in Honggu district, Yongdeng county, Yuzhong county, and Gaolan county, while the medical capacity and facility grade of existing hospitals should be improved to satisfy the demand of local residents. Meanwhile, rural areas should strengthen the construction of road networks.

Keywords: two-step floating catchment area; network analyst; spatial access to medical services; urban-rural disparities; undeveloped region of northwestern China

1. Introduction

It is one of the main imperatives of health care geography to study the reasonable geographical allocation of health care institutions and facilities, which involves analyzing the spatial allocation and functions of medical service institutions, including geographic locations and spatial distribution of them, and the number of medical staff and beds. Geography of health care studies the relationship between the spatial distribution of medical services and the demand of an area's residents, the reasons for destroying the balance and its spatial distribution pattern, and the condition of maintaining the balance. Meanwhile, it describes and explains the characteristic of providing services, the usage type

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Population Mapping with Multisensor Remote Sensing Images and Point-Of-Interest Data

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Abstract: Fine-resolution population distribution mapping is necessary for many purposes, which cannot be met by aggregated census data due to privacy. Many approaches utilize ancillary data that are related to population density, such as nighttime light imagery and land use, to redistribute the population from census to finer-scale units. However, most of the ancillary data used in the previous studies of population modeling are environmental data, which can only provide a limited capacity to aid population redistribution. Social sensing data with geographic information, such as point-of-interest (POI), are emerging as a new type of ancillary data for urban studies. This study, as a nascent attempt, combined POI and multisensor remote sensing data into new ancillary data to aid population redistribution from census to grid cells at a resolution of 250 m in Zhejiang, China. The accuracy of the results was assessed by comparing them with WorldPop. Results showed that our approach redistributed the population with fewer errors than WorldPop, especially at the extremes of population density. The approach developed in this study—incorporating POI with multisensor remotely sensed data in redistributing the population onto finer-scale spatial units—possessed considerable potential in the era of big data, where a substantial volume of social sensing data is increasingly being collected and becoming available.

Keywords: point-of-interest; remote sensing; nighttime light; population modeling

1. Introduction

High-resolution population distribution data are essential in addressing a wide range of critical issues, such as vulnerability assessment [1,2], urban planning [3,4], emergency management [5], and public health [6,7]. In most countries worldwide, commonly available information on population number and composition through the Census Bureau is aggregated over administrative units, such as provinces, counties, townships, census tracts, and block groups. The usefulness of these census data is limited due to the spatial heterogeneity of population distribution within administrative units [8]. Meanwhile, both the availability and quality of environmental data are increasing. Such an unmatched development of demographic and socioeconomic data and natural science data, especially at the fine

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Natural vegetation responses to warming climates in Qaidam Basin 1982–2003

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In this paper, we quantified vegetation variations in the Qaidam Basin from 1982 to 2003 by using growing-season NDVI sequences, which were defined as the summation of monthly NDVI values from May to September, and were calculated pixel-by-pixel from a successive 8-km NDVI dataset. We adopt linear regressions to examine the trends in growing-season NDVI and the trends in climate (temperature, precipitation and sunshine duration) during this period in an attempt to depict their temporal and spatial variability. Our results indicate that climate in the Qaidam Basin has homogeneously warmed at a rate of about 0.6°C/decade during the study period, with significant trends in monthly mean temperatures in April–September. However, there were no statistically significant trends observed in precipitation and sunshine duration. We found positive growing-season NDVI trends in 31.6% of the vegetated lands in 1982–2003 and in 24.1% over the first half period, 1982–1992. In addition, few areas were shown to have negative trends during these periods. In 1993–2003, however, the percentage of land with a positive trend decreased to 13.1%, and the percentage of vegetated land with a negative trend increased to 10.2%. Growing-season NDVI trends show both temporal and spatial variability. Areas with negative trends are distributed mostly at lower elevations and near oasis boundaries, and areas with positive trends at higher elevations. Using correlation analyses we estimated the relationship between growing-season NDVI and the climatic factors with the consideration of duration and lagging effects. The results suggest that growing-season NDVI trends are more correlated to temperature increases in growing-season months when compared to variations in precipitation and sunshine duration; however increased precipitation amounts within May–August can also facilitate vegetation growth in some of this arid basin. However, we found no significant correlations between growing-season NDVI and temperature in the non-trend areas, which account for the majority of the vegetated land. We suggest that the variability in vegetation responses to the observed warming climates results from the differences in background thermal condition and moisture availability, which depend on elevation and other factors, such as hydrological conditions.

1. Introduction

Climate change plays a key role in driving vegetation dynamics at both global and regional scales (Braswell 1997, Lucht *et al.* 2002, Nemani *et al.* 2003, Nezlin *et al.* 2005). Thus, the warming climates in recent decades as reported by IPCC (2001) may

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Impacts of climate warming on vegetation in Qaidam Area from 1990 to 2003

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Abstract The observed warming trend in the Qaidam area, an arid basin surrounded by high mountains, has caused land surface dynamics that are detectable using remotely sensed data. In this paper, we detected land-cover changes in the Qaidam Area between 1990 and 2003 in attempt to depict its spatial variability. The land-cover changes were categorized into two trends: degradation and amelioration, and their spatial patterns were examined. Then we estimated the correlation coefficients between growing-season NDVI and several climatic factors with the consideration of duration and lagging effects. The results show that the inter-annual NDVI variations are positively correlated with May to July precipitations, but not significantly correlated with sunshine duration. We observed no obvious trend in precipitation or sunshine duration from 1990 to 2003. Thus, the authors suggest that their slight fluctuations may not be responsible to the decade-scaled land-cover changes. However, our results indicate a good positive relationship between the NDVI trend and climate warming in the ameliorated areas, but a negative one in the degraded areas. By statistical analyses, we found that degradations mainly occurred at the oasis boundaries and at lower elevations in the non-oasis regions where effective soil moisture might have been reduced by the warming-caused increase in evapotranspiration. At higher elevations where thermal condition acts as a major limiting factor, ameliorations were unequivocally detected, which is attributable to the direct facilitation by temperature increases. We suggest that the impacts of the observed climate warming on vegetation are spatially heterogeneous, depending on the combinations of thermal condition and moisture availability.

Keywords Spatial variability · NDVI · Land-cover change · Degradation · Amelioration

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Introduction

In recent decades, land surfaces over the Northern Hemisphere experience a general warming, which was modeled to continue in the following future (IPCC 2001). This climate warming can cause and have caused detectable ecosystem changes (Hughes 2000; Walther et al. 2002), because climatic fluctuations are usually of great importance to vegetation dynamics at both global and regional scales. Detailed knowledge about the ecological impacts of increased temperatures and their spatial variability will contrib-

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黄河上游水源涵养区植被恢复合理目标及恢复策略

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摘要:科学设定植被恢复合理目标,制定适宜可行的恢复策略,充分发挥植被恢复的固碳效益,对提高生态修复效率具有重要的现实意义。本文以黄河上游水源涵养区这一关键生态功能区作为研究区,以当前实际植被状态为边界条件,利用 IBIS$_i$(Improved Integrated Biosphere Simulator)模型模拟了近十年平均气候条件下的潜在植被状态,并以该状态下植被净初级生产力为指标,设定了研究区短期植被恢复合理目标,进而估算了区域固碳提升潜力。在此基础上,通过评估植被受损程度,识别了重点恢复区域,并结合生态恢复力及实际植被变化趋势分析,分区分类对植被恢复策略进行了划分。研究结果表明:(1)黄河上游水源涵养区植被净初级生产力恢复目标值平均为 295.4 gC m^{-2} a^{-1},可在其植被现状的基础上恢复提升 7.18%;(2)在当前恢复目标下,研究区植被恢复固碳提升潜力具有明显的空间差异性,存在提升潜力的区域面积占比约为 60%,主要分布在龙羊峡以上以及洮河大夏河流域上游地区;(3)研究区植被恢复策略应以保育保护和自然恢复为主,同时应在吉迈水文站以上黄河北岸、共和盆地、龙羊峡库区、贵南沙地、河湟谷地部分区域等重点恢复区,实施必要的人工辅助修复措施。研究结果可为当地因地制宜开展植被恢复工作提供科学依据和决策支持,同时也可为其他区域生态修复规划提供思路和方法借鉴。

关键词:植被恢复;固碳提升潜力;IBIS$_i$模型;净初级生产力;黄河上游

Reasonable target and restoration strategies of vegetation restoration in a water conservation area of the upper Yellow River Basin

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Abstract: Setting scientifically reasonable target of vegetation restoration, formulating appropriate and feasible restoration strategies, and maximizing the carbon sequestration benefits of vegetation restoration are of utmost importance in improving the effectiveness of ecological restoration. In this paper, we focused on a key ecological function area of the water conservation area of the upper Yellow River Basin. The Improved Integrated Biosphere Simulator (IBIS$_i$) model was used to simulate the potential vegetation state under the average climatic condition of the last ten years by using the current actual vegetation state as the boundary condition. And the short-term reasonable target of vegetation restoration in the study area was set based on the net primary productivity in the potential vegetation state, and the potential improvement of carbon sequestration due to vegetation restoration was then estimated. On the basis of this, priority areas were identified by assessing the degree of damage to the vegetation, and the vegetation restoration strategies for different regions were classified based on the analysis of the ecological resilience and the trend of the actual vegetation change. The results showed that: (1) The average restoration target value for vegetation net primary productivity in the water conservation area of the upper Yellow River Basin was 295.4 gC m^{-2} a^{-1}, with a potential increase of 7.18% over the current vegetation status. (2) Under the current restoration target, the potential improvement of carbon sequestration in the study area had obviously spatial variability. The areas with significant carbon sequestration potential through vegetation restoration were mainly distributed in

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1982—2015年柴达木盆地不同流域植被气候响应差异

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摘 要： 基于1982—2015年生长季（5～10月）GIMMS-MODIS融合数据、气象数据，利用一元线性回归和相关分析等方法研究柴达木盆地及各流域植被*NDVI*的时空演变及其与气候要素的关系。结果表明：（1）柴达木盆地植被整体上趋于改善，*NDVI*与气温和降水呈显著正相关。（2）盆地内各流域*NDVI*呈现不同程度的增长趋势，区域气候差异明显，盆地东部*NDVI*平均值与气温和降水的关系表现为以1989年和2002年为转折点的3段式特征，而盆地西部呈现出以1994—1995年为节点的2段式特征。（3）盆地东西部植被对气候要素响应的差异性显著，这可能与高原季风、西风环流及下垫面等因素有关。

关 键 词： *NDVI*；气温；降水；柴达木盆地
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地表植被是陆地生态系统最重要的组成部分，作为联结土壤、陆地水体和大气之间物质能量交换的关键环节，在调节气候、控制CO_2、促进水分循环等方面起着重要作用[1]。归一化植被指数（Normalized Difference Vegetation Index，*NDVI*）是表征植物生长状况、植被覆盖和生物量的重要指标，是监测植被变化的有效参数[2-3]。在全球变暖的背景下，利用*NDVI*时间序列监测植被生长的时空变化规律并探讨气候因子的驱动作用已成为植被—气候相互作用研究中的重要方向之一[4]。

柴达木盆地地处青藏高原东北部，位于季风区和西风区的过渡地带，是我国内陆大型山间断陷盆地（图1）。近50 a来，柴达木盆地平均气温增幅为0.54·(10 a)$^{-1}$[5]，明显高于青藏高原腹地[6]，属于全球气候变化的敏感区。截至目前，已有一些学者对柴达木盆地的植被和气候两者之间的关系进行了研究[7-9]，这些研究大多集中在植被与降水和气温的总体关系情况，而忽略了各个时期不同水热组合条件下植被对气候的响应规律差异，而这些信息对于掌握盆地内植被与气候的关系有着重要的作用。

鉴于此，本文以1982—2015年生长季（5～10月）GIMMS-MODIS融合数据为基础，以流域为单位，结合1982—2013年生长季气温和降水数据，利用相关分析法，分析各流域在不同时段上植被对气候的响应情况的时空差异，初步探讨形成这种差异性响应机制的主要因素。

1 研究区概况

柴达木盆地（35°00′～39°20′ N，87°79′～99°16′E）位于青藏高原北部，毗邻中国西北干旱区，处于中纬西风带和东亚季风系统的交界带，属于高原大陆性气候，对全球变暖较为敏感。柴达木盆地气候以干旱为主要特点：海拔高，云量少，日照时间长，常年干旱少雨，年降水量自东南部向西北部递减[10]。

本文按照流域将研究区划分为尕斯库勒湖流域、大柴旦湖流域、小柴旦湖流域、苏干湖流域、台吉乃尔湖流域、都兰湖流域、达布逊湖流域、托素湖流域。剩余一个流域由于绝大部分区域为无植被生长区，对其研究不具备代表性，故在本文的分析中不对此区域进行讨论。

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柴达木盆地气候变化区域性特征及其影响因素

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摘　要：利用1982−2013年柴达木盆地5−10月的降水量、气温、日照时数、相对湿度和平均风速等气象资料, 结合夏季风指数、经纬向环流指数等大气环流资料及植被覆盖指数对柴达木盆地气候时空变化的区域显著性成因进行讨论. 研究表明, 除相对湿度变化不明显外, 柴达木盆地降水和气温显著上升, 日照时数和平均风速显著减小, 同时, 空间分布具有明显的经向地带性特征; 降水量、平均气温、日照时数和平均风速均有突变发生, 其中, 盆地东部降水、气温、平均风速的突变时间早于西部, 东部的日照时数突变时间晚于西部, 区域差异特征明显; 各气候要素的周期变化具有共性特征, 周期变化基本在32、16、10~12、5~6和2~3 a等时间尺度附近变动; 在全球变暖背景下, 盆地气候变化具有的区域特征可能是亚洲夏季风、经纬向环流、副热带高压等气候系统以及下垫面植被演变等因素综合作用的结果.

关键词：Morlet小波变换; 曼−肯德尔突变检验; 环流指数; 植被覆盖指数
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Regional differentiation of climate changes in Qaidam Basin and its influencing factors

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Abstract: An analysis of the spatial and temporal characteristics of the meteorological data such as precipitation, temperature, sunshine hours, relative humidity and wind velocity, and the information of summer monsoon, zonal and meridional circulation, and vegetation cover from 1982 to 2013 revealed the climate contributing factors of regional differences. The results showed that precipitation and temperature displayed a significant increasing trend, which had the distinct characteristics of longitudinal zonality. Sunshine hours and wind velocity exhibited a significantly decreasing trend, while relative humidity did not have an obvious change trend. There was significant differentiation in the period of sudden change for precipitation, temperature, sunshine hours and wind velocity in two regions. The periods of sudden change for precipitation, temperature and wind velocity in the eastern region were obviously earlier than those of the western region, while the sunshine hours were the opposite. Significant cycles were found on series of 32, 16, 10-12, 5-6 and 2-3 a for meteorological elements. In the global warming situation, summer monsoon, zonal and meridional circulation, subtropical high pressure and the underlying surface,

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山西省不同生态区 NDVI 时空变化及其影响因素

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摘 要：利用 MODIS-NDVI 数据研究了 2000—2012 年山西省生长季平均 NDVI 的时空变化特征，并分析了气候变化和人类活动对生长季平均 NDVI 变化的影响。结果表明：(1) 13 a 来山西省山地落叶阔叶林生态区、农业与草原生态区、汾河谷地农业生态区生长季平均 NDVI 均呈显著增加趋势，增长率分别为 0.052/10 a，0.079/10 a，0.049/10 a。(2) 山西省植被变化存在明显的空间差异，改善区占全省面积的 73.76%，主要分布在太行山、太岳山、吕梁山、中条山等地区；而退化区占全省面积的 3.29%，主要分布在太原盆地及临汾盆地的边缘地区。(3) NDVI 变化是气候变化和人类活动共同影响的结果。不同生态区 NDVI 对气候变化的响应不同。其中，前一年 11 月至 5 月降水增多可能是山地落叶阔叶林生态区 NDVI 增加的主要原因，前一年 12 月至 1 月气温降低和 2—5 月降水增多可能是农业与草原生态区 NDVI 增加的主要原因，5—9 月气温降低和前一年 11 月至 8 月降水增多可能是汾河谷地农业生态区 NDVI 增加的主要原因。而人类活动对 NDVI 变化的影响主要表现在退耕还林、防护林建设、采矿、城市扩张等方面。

关键词：MODIS-NDVI；时空变化；气候影响；人类活动
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Spatiotemporal Variation of NDVI and Its Influence Factors in Different Ecological Districts, Shanxi Province

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Abstract: Spatiotemporal variation of growing-season average NDVI in Shanxi Province was analyzed based on MODIS-NDVI during the period from 2000 to 2012, and the influence of climate change and human activities impacting on vegetation growth were discussed. The result showed that: (1) the growing-season average NDVI of three ecological districts in Shanxi Province which were the Mountain Deciduous Broad-leaved Forest Ecological District, the Agriculture and Grassland Ecological District and the Fen River Valley Agricultural Ecological District showed a significant increase trend; the growth rates of three ecological districts were 0.052/decade, 0.079/decade and 0.049/decade, respcectively; (2) there were obvious spatial differences about vegetation change in Shanxi Province, the greening area accounted for 73.76% of the total area that was mainly distributed in Taihang Mountain, Taiyue Mountain, Lüliang Mountain, Zhongtiao Mountain, the degraded area accounted for 3.29% of the total area that was mainly distributed in the edge of Taiyuan Basin and Linfen Basin; (3) both climate change and human activities were important factors on vegetation variation. Different districts had different responses to climate change. Increasing precipitation from November to May probably was the main reason for average NDVI increase in the Mountain Deciduous Broad-leaved Forest District. Decreasing temperature from December to January and increasing precipitation from February to May probably were the main reasons for average NDVI increase in the Agriculture and Grassland District. Decreasing temperature from May to September and increasing precipitation from November to August probably were the main reasons for average NDVI increase in the Fen River Valley Agricultural District. In addition, the impacts of human activities on the NDVI changes mainly were observed in forestland shifted from the cropland, shelter forest construction, mining, urban expansion.

Keywords: MODIS-NDVI; spatiotemporal variation; climate influence; human activities

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近 23 年来青藏高原东北部香日德地区高寒草甸上界变化及其与气候变化关系研究

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摘 要:利用 1990 年、1999 年、2013 年的 Landsat 卫星遥感影像数据,通过遥感和 GIS 技术,运用非监督分类和目视解译相结合的方法,提取香日德地区的高寒草甸上界,分析其变化特征及其与该地区气候变化的关系。结果显示:(1) 1990—1999 年升温趋势显著,降水量基本保持不变;1999—2013 年气温基本不变而降水呈显著增加的趋势。(2) 香日德地区高寒草甸上界呈现向更高海拔即原高寒荒漠的范围扩张的趋势,其上界的扩张受气温和降水变化的共同作用。其中以气温变化为主导的 1990—1999 年期间,高寒草甸面积扩张迅速;以降水变化为主导的 1999—2013 年期间,高寒草甸上界扩张减慢。并且海拔越高的地区高寒草甸面积增加越迅速。(3) 高寒草甸上界在不同坡向上均有扩张。其中,以升温为主导的 1990—1999 年主要集中在北坡与西坡;以降水量增加为主导的 1999—2013 年期间则主要集中在南向坡。(4) 从坡度分布来看,1990—1999 年高寒草甸上界的扩张主要发生在 15°～25°,而 1999—2013 年为 20°～35°。

关键词:Landsat; 高寒草甸上界; 非监督分类; 目视解译; 气候变化

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Research on the Upper Boundary Change of Alpine Meadow and Its Relationship with Climate Change During the Past 23 Years in Xiangride, in Northeast Tibetan Plateau

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Abstract: We adopted the unsupervised classification and visual interpretation to extract upper boundary of alpine meadow in Xiangride by using remote sensing images of 1990, 1999 and 2013 to summarize the change characteristics and analyze its relationship with climate change. The results showed that: (1) the temperature had a significant increasing trend and the precipitation remained unchanged from 1990 to 1999; the temperature remained unchanged and the precipitation increased significantly from 1999 to 2013. (2) the upper boundary change of alpine meadow was controlled by both temperature and precipitation, the alpine meadow expanded in higher region in the past 23 years, the area increased fast from 1990 to 1999 which was controlled by temperature change, the area increased slowly from 1999 to 2013 which was controlled by precipitation change. (3) the upper boundary of alpine meadow increased in all slope aspects, alpine meadow increased mainly in north and west from 1990 to 1999 which was controlled by temperature, and it increased in southern slope aspect from 1999 to 2013 which was controlled by precipitation. (4) according to the distribution of slope gradient changes, the expansion of the upper boundary of the alpine meadow in 1990 to 1999 mainly occurred in steepness of 15°～25°, and the expansion in 1999—2013 mainly occurred in gradients of 20°～35°.

Keywords: Landsat; the upper boundary of alpine meadow; unsupervised classification; visual interpretation; climate change;

草地生态系统是陆地生态系统的重要组成部分。高寒草甸作为分布在高山、高原寒冷环境下的一种草地类型,广泛分布在青藏高原中东部地区,是青藏高原主要的植被类型之一,对维持青藏高原生态平衡

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近半个世纪以来中国季风区气温与降水变化及其时空差异

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摘 要: 利用中国东部季风区20个测站1960−2012年气温和降水量的月值数据，采用线性趋势分析、Mann-Kendall突变检验、Morlet小波分析等方法，分析了季风区各区域年平均气温和年降水量的变化趋势、突变现象和周期特征. 结果表明1960−2012年季风区各区域均有增温趋势，在20世纪90年代发生突变，东北地区发生突变要早于其他地区，北方地区的增温幅度大于南方，存在4年左右周期，8∼16年的准周期，气温的高频变化周期在内陆地区表现更为明显；年降水量在53年里处于波动状态，四川盆地、华北地区和季风区西北部地区降水有减少趋势，长江流域下游降水有增加趋势，其他地区没有明显变化趋势，存在2∼4年周期、8∼16年左右准周期，降水的低频变化周期在近海地区表现更为明显.

关键词: 中国季风区；年平均气温；年降水量；气候周期

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Temperature and precipitation changes in the Chinese monsoon region during the recent half century and the spatio-temporal differences thereof

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Abstract: In recent years, the serious consequences of global warming have become a greater concern for the wide international community. The existing research into the eastern China monsoon region has discussed either an area or the whole region and had different emphases. Recently there have been few studies about the periods and abrupt features of different regional climate change in the eastern monsoon region. Base on the linear trend analysis, Mann-Kendall mutation test and Morlet wavelet, the regional annual average temperature and annual precipitation were analysed by using 20 sites' monthly temperature and precipitation data from 1960−2012 in eastern China monsoon region. The results show that the whole region is getting warmer. Abrupt climate changes occurred in 1990's and the northeast underwent earlier changes than other areas. The increasing of temperature in the northern area was higher than the southern area. There existed an about-4-year cycle and a 8∼12 year quasi-period. High frequency periodic variations of temperature were more obvious in the inland areas. The precipitation in the Sichuan Basin, Northern China and northwest of the monsoon region decreased. Precipitation in the lower part of the Changjiang river basin showed an increasing trend and other areas did not change significantly. There existed a 2∼4 year cycle, and an 8∼16 year quasi-period and the low frequency periodic variations of precipitation were more obvious in the offshore areas.

Key words: Chinese monsoon region; annual average temperature; annual precipitation; climate cycle

随着全球变暖日益显著[1−3]，气候变化越来越受到科学界、社会公众和各国政府的关注，对于气候变化的研究在经济社会的可持续发展、适应和减缓气候变化对政策制定、气候政策与环境外交谈判、资源保护和开发等方面都具有重大的意义. 20世纪以来，尤其是在80年代中国显著增

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重庆青华林场树轮宽度指数分析及其与 NDVI 的关系

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摘 要：利用重庆市东南酉阳土家族苗族自治县青华林场的杉木树轮样本、2000—2010 年的 MODIS-NDVI 数据以及气象资料，对原始轮宽进行标准化处理后采用一次线性拟合与相关分析的方法，分析树轮宽度指数与气候因子、NDVI的关系，探讨揭示树木主干与冠层的关系。结果表明：研究时段内，树轮宽度原始值呈减少的趋势；树轮宽度指数与前一年及当年的气候因子存在不同程度的相关关系，NDVI 与同期气候因子呈现显著的相关性；树轮的整轮宽度和早材宽度与前一年 NDVI 以及前一年 7—9 月 NDVI 均呈显著的正相关关系，而树轮的晚材宽度与当年 4—5 月 NDVI呈显著的负相关关系。

关键词：树轮宽度；NDVI；气候因子

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Analysis of Tree Ring Width Index and Its Relationship with NDVI in Qinghua Forest of Chongqing

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Abstract: This study aims at analyzing the relationships between tree ring width index, climatic factors, and NDVI, using MODIS-NDVI data from 2000 to 2010, meteorological data, and fir [*Cunninghamia lanceolata* (Lamb). Hook] tree ring samples. The tree ring samples were collected from Qinghua forest in Youyang Tujia and Miao Ethnic groups Autonomous County, southwest of Chongqing. Correlation analysis and a linear fitting were used to investigate and reveal the relationship between trunks and canopies. The findings showed that the original value of the tree ring width presented the declining trend during the study period. There are correlations of different levels between climatic factors and tree ring width index. Meanwhile, NDVI and climatic factors in the same periods show the significant correlation. The entire wheel width and earlywood width both have significantly positive correlation with the NDVI of the last year and the NDVI from July to September of the last year, while latewood width and NDVI of April and May in the same years have the significantly negative correlation.

Keywords: tree ring width; NDVI; climatic factors

植被作为生产者在陆地生态系统中占有重要的位置，而森林是陆地生态系统的主体。在陆地与大气 CO_2 的交换中，90%以上是由森林植被完成的，森林生态系统碳储量占陆地生态系统碳库总量的 56%[1-3]。森林吸收固定碳主要通过树木的叶片、主干和根。光合作用表明叶片直接吸收固定大气中的 CO_2，主干中的碳则来源于各种途径的 CO_2 的同化和转化，叶片和主干中碳的存在形式不太相同，且形成过程不同步，由此可能导致主干与林冠叶片固碳量不同[4]。同时叶片与主干具有不同的生长周期，在森林生态系统的 C 循环中，植物凋落分解后部分碳会进入土壤，其余在分解过程中释放。因此研究树木冠层与主干固定碳的不同步性与固碳量的差异对估算一定时间内森林的固碳量和森林生态系统的碳循环有重要意义。

近年来遥感卫星监测被用于研究植被的生物量、净初级生产力的变化及其与气候变化的关系[5]。对于森林来说，通过遥感图像解译计算出的 NDVI、

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柴达木盆地德令哈地区MODIS-NDVI时空变化及其与气候的关系

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摘 要: 利用遥感与GIS手段, 分析了12年来柴达木盆地德令哈地区MODIS-NDVI的时空变化及其与气温、降水量的空间相关性. 研究表明: 2000−2011年柴达木盆地德令哈地区生长季NDVI平均值年际变化趋势中, 改善区、稳定区、退化区和无植被生长区的面积分别占总面积的49.13%, 32.14%, 0.51%, 18.21%; 山地和绿洲生长季NDVI平均值的增长率分别为3.9%/10 a, 2.9%/10 a. 在山地的各海拔高度带上, 12年NDVI平均值越大的区域, 植被改善趋势越强烈, 反之改善趋势越微弱. 山地改善区在海拔较低、坡度较小的区域以及南坡所占的面积百分比较大, 绿洲植被改善显著的典型区域主要分布在农场区域和临近河流的部分区域, 退化显著的区域主要分布在城镇建设区域, 植被砍伐、铁路和公路修建区域. 12年来德令哈地区气候呈暖湿化趋势. 德令哈地区植被的生长状况与生长季降水量和生长季前期气温呈较强的正相关关系, 而与生长季气温和前期降水量的相关性并不显著. 春季较高的温度和较多的降水量、夏季较多的降水量以及前一年冬季较高的温度是植被生长的有利条件.

关键词: MODIS/NDVI; 空间差异; 气候变化; 德令哈地区

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Spatial-temporal variations of MODIS-NDVI and its correlations with climate in Delingha Region, Qaidam Basin

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Abstract: Based on RS and GIS technology, the spatial-temporal changes of NDVI in Delingha Region and its spatial correlation with temperature and precipitation were analyzed and the results showed that the greening area, stable area, degraded area and bare area accounted for 49.13%, 32.14%, 0.51% and 18.21% of the total area respectively in the variation trend of growing-season vegetation NDVI averages from 2000 to 2011. The growth rate of growing-season vegetation NDVI averages in mountain and oasis region was 3.9%/10 a and 2.9%/10 a. In all the altitude rings of the mountainous region, the bigger the NDVI value, the more intense the vegetation greening trend; the smaller the NDVI value, the weaker the vegetation greening trend. The greening area in the mountain region was larger in lower altitudes, concentrated on gentle slopes and south sides. The greening area in oasis region was mainly distributed in farming areas and riversides, the degraded area was mainly distributed in urban construction zones, and vegetation deterioration mainly occurred along railway and highway construction areas. The climate in Delingha Region became warmer and wetter in the last 12 years. Vegetation growth conditions in Delingha Region had positive correlations with growing-season precipitation and prophase temperature, but were uncorrelated with growing-season temperature and prophase precipitation. Higher temperature and more precipitation in the spring, more precipitation in the summer and higher temperature in the winter of the previous year was beneficial to vegetation growth.

Key words: MODIS/NDVI; spatial difference; climatic variation; Delingha Region

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广东高州市域产业发展及其空间优化

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摘 要：县（市）域作为区域研究的最基本单元，是解决区域发展问题的重要切入点。高州市是由茂名市代管的省辖县级市。自 20 世纪 90 年代中期以来，全市主要产业获得快速发展，“三高”农业优势日益明显，工业发展也初成体系，但第三产业发展较为滞后，产业发展整体水平较低，产业结构亟待优化调整。文中从增强创新能力、内外资源利用、中心城镇建设和周边区域合作等 4 个方面阐述了未来产业发展的总体思路，并提出“一核四区”的空间优化方略。

关键词：高州市；产业发展；空间优化
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新中国成立以来，宏观及中观区域的理论与实践研究使学科理论在国内得到进一步丰富和完善。但随着近 30 年国民经济的快速发展，人口、资源、环境三者间的矛盾在部分地区十分突出，出现了人地关系不协调、区域发展不平衡、城乡分割以及“三农”问题日益凸现等诸多问题。究其原因，与我国众多县（市）域（以下简称县域）在自然地理、资源条件、经济水平、产业结构等方面存在差异密不可分。如果忽视微观区域特别是各县域的具体情况，往往就会造成国家的一些宏观和中观的发展政策及战略措施执行效果不佳[1]。为深入探讨上述问题，国内学术界对区域的研究已逐步走向具体、特定和微观尺度，如有关县域经济、规划和可持续发展方面的研究[1-8]。县域经济作为我国国民经济的基本单元，是构造地带经济、经济区、省区、城市（城市群、大都市区、一般城市）等区域经济的基础[4]，发挥着承上启下、沟通城乡、固本强基和总揽农村全局的重要作用，并且从地理学科角度看，重视县域发展的理论与实践探索将是一项十分重要的课题。文章选择地处广东省西翼、由茂名市代管的省辖县级市高州为研究区域，通过对产业发展这一县域经济核心内容的现状分析，旨在探讨其未来发展的总体思路和空间优化方略，以期为我国县域产业的发展提供有益借鉴。

1 高州产业发展现状特征

上世纪 90 年代中期以来，高州市通过大力引进外资，发展外向型工业，社会经济发展取得了很大成就，经济实力显著增强。至 2006 年，全市生产总值已达 177.7 亿元，人均地区生产总值达 12 673 元[9]；三次产业结构调整也取得显著进展，已由 1990 年的一产主导（58∶21∶21）逐渐转变为 2006 年的“三足鼎立”（31∶30∶39）。产业发展主要呈现以下 4 个特征。

1.1 “三高”农业发达，比较优势明显

目前，高州以水果为龙头的“三高”农业（即高产、高质、高效）已实现了品种名优化、布局区域化和生产标准化的“三化”生产，并先后建成了水果、蔬菜、粮食、淡水鱼、肉蛋鸡、生猪等 10 大农业商品生产基地，有“国家级荔枝标准化生产示范区”和“国家级龙眼标准化生产示范区”。香蕉、荔枝、龙眼、北运菜已发展成为高州农业的 4 个重要品牌，储良龙眼、逭地雷香蕉、白糖罂荔枝荣获国家农业博览会金、银奖，一批名优水果被中国绿色食品开发中心认证为无公害的 A 级绿色食品；香蕉、荔枝、龙眼的种植面积和产量均位居全国县级首位，是全国最大的水果生产基地，被誉为“全国水果第一市（县）”。2006 年农业总产值达 79.48 亿元[9]，居茂名市第一位，并已连续多年名列广东省各县（市）第一，山地产值居全国之冠，农业发展比较优势明显，具有很大提升空间。

1.2 工业初成体系，发展基础较好

近年来，高州工业发展一直保持着良好势头，2006 年工业总产值已达 44.44 亿元[9]，并基本形成

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广东省中心城市发展潜力分析与省域城镇空间发展*

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摘要：运用主成分分析法（PCA），在SPSS 13.0统计软件支持下，对广东省21个中心城市的发展潜力进行了测度，并将第一、第二和综合主成分按其得分水平进行了等级划分．结果表明：各主成分所代表的经济活力、农业发展水平和城市发展潜力，在省域范围内的地域分布具有不同的特征，且三者间差异较大．据此提出了有利于广东省城镇空间合理有序发展的几点启示．

关键词：广东省；中心城市发展潜力；主成分分析；城镇空间
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Analysis on the Development Potential of Central Cities and Urban Spatial Extension in Guangdong Province

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Abstract: Applying the principal component analysis and supported by the statistical software SPSS 13.0, the development potential of the 21 central cities in Guangdong province were measured, and according to scoring level, the first, second and general principal components were compartmentalized. The calculation indicated that the economic vigor, agricultural development level and city development potential, which could be represented by different principal components, saw a big discrepancy in the scope of Guangdong province. The implications of the study to the rational urban spatial extension in the province were put forward.

Key words: Guangdong province; central city development potential; principal component analysis; urban space

城市发展潜力分析是按照一定的指标体系、采用一定的方法，对城市发展潜力的大小进行定量测算与等级划分，进而对所评价城市的发展潜力予以全面综合分析．它作为当前城市地理学、城市经济学、城市规划学研究的一个新领域，已成为区域城镇体系规划的重要基础性工作之一．通过对城市发展潜力进行综合分析，并作出相应的优劣分等，将有助于揭示区域城镇体系的结构特征，对于优化区域城镇空间结构、提高其系统效益具有重要意义．国内有关城镇发展潜力的研究始于20世纪末期，内容主要涉及城镇发展潜力评价[1~2]、城镇发展潜力与城镇体系[3]、城市特色与城市发展潜力[4]等方面．综观之，国内城镇发展潜力研究较少，深度不足，主要偏重于城镇发展潜力的定量计算与分级，对影响城镇发展潜力主要因素的分析比较欠缺；并且，在研究区域上也较少关注社会经济快速发展的东部沿海地区．文章采用主成分分析法对广东省21个中心城市发展潜力进行了测度，就城市发展潜力及其两大主要影响因素进行了分析，并提出有利于全省城镇空间发展的几点建议．

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兰州城市居民意象空间及其结构研究

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IMAGE SPACE AND ITS STRUCTURE OF URBAN RESIDENTS IN LANZHOU CITY

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Abstract: Urban image space is the cognitive space based on residents' direct or indirect experience in the surroundings, and is also the space of "subjective environment" in residents' mind. To analyze urban structure by image space is one of the research methods on the spatial structure of modern city. Well avoiding the disadvantage of neglect of residents' status and functions in traditional city planning and construction, the method is helpful to plan and design a city with the consideration of humanism, therefore the harmony between man and city can be established, accordingly it is also one of the most popular method in modern city planning and designing in western countries. This paper examines the image space and its structure of residents in the city of Lanzhou which is a typical valley-city, and has a rather unique city landscape. As a result of the grand western development program, a new urban image of Lanzhou is in the process of forming. Therefore, to study the urban image space of Lanzhou city, discuss the city image in people's mind, and provide theoretical base for urban planning and designing are quite necessary. The authors investigate the image space of urban residents in Lanzhou by questionnaire, and get 266 cognitive maps. Then the authors analyze the basic types, the constitutive factors, and the development stages of space cognition. The research shows that the basic types of Lanzhou residents' image space include not only the sequentially and spatially cognitive maps developed by western scholars, but also the individually cognitive maps. The constitutive factors do not go beyond the five factors developed by Kevin Lynch, which are road, border, district, node and sign. In the development stages of spatial cognition, the elementary and medium stages, which means the residents' space cognition level in Lanzhou city is low relatively. Based on the regional objects and the emergence frequency of regional elements recorded on the cognitive maps of urban residents, the authors generalize the general image framework of spatial structure in Lanzhou city in which parts of Kevin Lynch's urban image theory are proved in Lanzhou city.

Key words: image space; spatial cognition; urban spatial structure; Lanzhou

提 要:通过问卷的方式对兰州城市居民的意象空间进行了调查,从266份认知地图中提取和统计相关数据,据此分析了兰州城市居民空间认知的基本类型、构成要素和发展阶段。研究表明,兰州城市居民空间认知的基本类型不仅包括西方学者提出的序列型与空间型,而且还包括单体型;空间认知的构成要素并没有超出Lynch提出的5种:道路、边界、区域、节点和标志物,但各要素所占比重要相对均衡一些;就空间认知的发展阶段而言,初、中级的连接发展阶段和邻里描绘阶段所占比重高达96.61%,说明居民对兰州城市的空间认知水平普遍较低。最后,根据各种地物和要素出现的频率概括出了兰州城市的意象空间结构,发现它与现实中兰州城市空间格局及其重点十分相似。

关键词:意象空间;空间认知;城市空间结构;兰州

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兰州城市贫困住区空间分异特征及其影响因素*

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摘 要 依据空间属性和社会属性,将兰州市区 155 个贫困住区分别归类为棚户区型与城中村型、多民族型与单一汉族型,运用最邻近距离指数、核密度估计和缓冲区分析等方法,揭示兰州城市贫困住区的空间分异特征及其影响因素。结果如下。1) 棚户区型、城中村型和单一汉族型的贫困住区在市区层面均呈凝聚型分布,而多民族型贫困住区呈分散型分布。2) 4 类贫困住区都存在 1 个高密度区(带)和 1 个次高密度区;多民族型与单一汉族型还各存在 1 个较高密度区,但核密度最高值差异较大。3) 在城市基础地理要素黄河、洪道和铁路两侧,不同类型贫困住区的数量与比重不同,亲疏关系差异较大。4) 微观上的自然地理环境、历史格局和民族文化,宏观上的产业发展政策、住房供应体制和城市规划是影响贫困住区空间分异的重要因素。

关键词 贫困住区; 空间分异; 微观基础因素; 宏观影响因素; 兰州

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Spatial differentiation characteristics and impact factors of poverty settlements in Lanzhou City

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Abstract Based on the spatial and social characteristics, we classified the 155 poverty settlements in Lanzhou City into shanty-town type, urban-village type, multi-ethnic type, and single-Han-ethnic type. Then, we analyzed the spatial differentiation characteristics of poverty settlements and the impact factors using several methods such as nearest neighbor index (NNI), kernel density, buffer analysis, and overlay analysis. The results are given as follows. 1) The poverty settlements of shanty-town type, urban-village type, and single-Han-ethnic type present condensed distributions, but the multi-ethnic type presents dispersed distribution. 2) There are a high density area and a second high density area for each of the four types. There is also a third density area for each of single-Han-ethnic type and multi-ethnic type, but the central locations and the highest density values are different. 3) In terms of the spatial relations between poverty settlements and the three

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兰州市民参与城市规划的困境与出路

张新红 徐含成 王 辉

通过对兰州市民进行的问卷调查及其统计分析，对公众参与城市规划这一热点问题进行了研究，发现兰州市民在参与城市规划方面普遍表现出 :规划概念模糊、实际参与率低、参与方式偏少和参与效果欠佳等现实问题，进而提出完善的公众参与法规制度、政府主动推进、构建多元化的参与方式和提高公众的参与意识与能力是未来有效促进市民参与城市规划的可行之路。

一、问卷调查及统计方法

2008 年实施的《中华人民共和国城乡规划法》，对公众参与城市规划给予了明确规定，将听证会、论证会和其他方式听取公众和专家意见作为城市规划的必经程序，这是城市规划中公众参与民主化的重大体现，也将我国公众参与城市规划的权利通过法律形式确定下来。公众参与城市规划不仅有利于政府吸纳各方意见，有效协调不同主体间的利益冲突 ;也有利于发挥公众的集体优势与监督作用，提高城市规划的科学性和民主性，体现城市规划公共政策的重要属性。然而，公众参与城市规划在我国尚处于初期阶段，实施过程中仍存在着诸多问题。为深入分析这些问题，作者选择公民社会体系尚不成熟、经济社会发展相对滞后的的西北中心城市 —— 兰州市为案例，对市民参与城市规划情况进行了问卷调查和统计分析（实际发放问卷 500 份并及时收回，其中有效问卷 477 份，有效率为 95.4% ;从整个调查样本构成状况看，样本数量在性别、年龄、受教育程度和收入水平 4 个方面分布较为合理，对兰州城市居民总体有较好的代表性），以剖析现实背景下公众参与城市规划面临的困境，进而寻求未来的可行出路，以期为城乡规划与建设部门、公众和学术界等有效解决公众参与城市规划这一热点问题，提供有用的理论参考和实践价值。

二、市民参与城市规划的现实困境

（一）市民的规划概念模糊

调查问卷的统计结果表明，大部分兰州市民对城市规划的涵义模糊，认为“ 非常了解 ” 和“ 大概了解 ” 城市规划的样本数仅分别为 23 和 160，占总量的 4.82% 和 33.54%（表 1），表明市民总体上对现代城市规划的编制、管理、立法等方面存在很大的认知空白。在对城市规划不了解的原因调查中，29% 的居民选择了政府相关部门的宣传教育力度不够，各有 27% 的居民认为城市规划专业性太强难理解和未曾接触过专业性的学习或了解，其他 17% 的居民不了解的原因是他们对城市规划不感兴趣。诚然，城市规划是一门专业性和综合性很强的技术工作，市民要具备较好的认知就需花费一定的时间去学习，但同时城市规划作为一项公共政策，更需政府部门自上而下地主动采取多种方式进行宣传教育，让市民熟知规划涵义，能读懂规划。

表 1 公众对城市规划的了解程度

选项	非常了解	基本了解	不太了解	完全不了解
人数	23	160	219	75
比重	4.82%	33.54%	45.91%	15.72%

（二）市民的实际参与率低

问卷调查中有 414 位市民表示他们未曾参与过城市规划过程，占总样本的 86.79% ;而在 63 位表示参与过城市规划过程的市民中，大部分是城市规划相关专业人士和国家公务员，少部分为普通市民。遗憾的是，在与这些普通市民的交流过程中得知，部分市民只是凭兴趣旁听、观看了规划展览，真正参与过城市规划过程的市民较少，反映出兰州市民很低的规划参与率。在有关“ 没有参与过城市规划 ” 的原因调查中，有 40% 的市民至少选择了“ 政府宣传力度不够，对参与时间、方式等不了解 ”，这说明政府部门宣传力度较低、参与渠道或方式偏少是造成兰州市民参与率低的首要原因。

（三）参与规划的方式偏少

公众参与城市规划有多种途径，如规划座谈会、报告会、听证会，问卷调查，借助网络、报纸、电话、信件等反馈建议，规划举报或诉讼等。在参与过城市规划的兰州市民中，选择参与问卷调查和参与城市规划座谈、报告、听证会等被动参与方式的较多，而选择通过网络、报纸、电话、信件等方式

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兰州－西宁城市整合与协调发展①

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摘 要：1990年代以来，整合与协同成为城市相互关系的主流。兰州和西宁作为我国西部地区相距最近的省会城市，相对完整的地域经济单元，一脉相承的历史文化积淀和日益密切的社会经济联系，为其整合发展提供了有利条件；城市群发展的客观要求，区域经济中的相互依赖及城市空间拓展的相向延伸，为其整合发展提供了必要动力；而建立跨区协调机构、建设高效基础设施、营造良好生态环境、调整优化产业结构和完善区域城镇体系，是其实现整合发展的有效途经。

关键词：城市整合；协调发展；兰州；西宁
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1990年代以来，经济全球化和区域集团化的时代主旋律对城市及其相互作用关系产生了深刻影响，整合与协同成为城市相互关系的主流[1]。我国地理学界关于城市整合发展的研究已取得了一些成果[1－6]，但研究对象主要集中于东中部城镇密集地区，很少涉及到广大的西部地区。随着西部大开发战略的实施，西部地区的城市化道路问题被提上了议事日程，其中，如何发挥中心城市尤其是省会城市的作用更是成为人们关注的焦点。兰州和西宁是甘肃和青海两省的省会城市，还分别扮演着西北地区第二大中心城市和青藏地区最大的区域中心城市的重要角色，在各自省域及西部地区社会经济发展中均占有举足轻重的地位。同时，两市又同处两省城镇最为密集和经济较为发达的河湟谷地，为西部地区相距最近的省会城市，这在地域广袤的西部地区实属罕见，对构建合理的区域空间组织格局显得弥足珍贵。但由于地处西北内陆、生态环境脆弱、民族众多，加之长期行政分割，使河湟谷地很大程度上还处于各行其是的发展状态，社会发育程度低，难以在西部大开发中发挥应有的作用。因而，探讨兰州和西宁的整合与协调发展，不仅是对我国城市整合理论的重要补充，更为重要的是，对促进河湟城市群的崛起，带动甘青两省及西部地区社会经济的快速发展，促进民族地区的团结与稳定具有重要的现实意义。

1 整合发展的基础条件

1.1 相对完整的地域经济单元

河湟谷地位于黄土高原和青藏高原交汇地带，在地貌、气候、植被和土壤等自然条件方面具有明显的过渡性和互补性。这里地势较低，气候温和，用水便利，灌溉农业发达，能矿资源富集，经济基础良好，人口和城镇相对密集。其中，位于黄河岸边的兰州，居西北地区中心地带，是西陇海－兰新经济带上重要的一级节点城市[7]，西北地区最大的综合运输枢纽，内地通往青海、西藏、新疆等省区的交通要冲；位于湟水河畔的西宁，是青藏高原的重要门户和交通枢纽，内地联系青藏高原乃至南疆地区的“桥头堡”。两市相距仅216km，且有兰青铁路、109国道、高速公路、空中航线、输气管道构成的立体快速交通运输体系和兰西拉国家光缆主干线相连，交通便捷，通讯畅通。地域上的邻近性和良好的通达性，使河湟谷地形成了以黄河、湟水为纽带，兰州、西宁为中心，包括地区行政中心、县城和独立工矿点在内的城镇相对密集地区，成为西部地区唯一具有流域特点且相对完整的地理单元。

1.2 一脉相承的历史文化积淀

兰州具有悠久的历史文化，历来是西北地区的交通、贸易和军事要地，古丝绸之路上中国与亚、非、欧各国友好往来的交通要道和商埠重镇；西宁也曾是东西方商业往来和文化交流的重要通道，古代“丝绸辅道”和“唐蕃古道”的必经之地，汉、藏地区间的交通和贸易枢纽。自西汉起，两市同属一个行政管辖范围，区内藏、土、回、满、东乡、蒙古、撒拉等少数民族与汉族长期共同生活，繁衍生息，直到1928年，国民政府中央政治会议通过决议，新建青海省，治设西宁，从此兰州和西宁分属不同的行省管辖[8]。尽管如此，由于两地间居民相同的生活方式、相近的宗教信仰和稳定的地缘和亲缘关系，使得民间交往从未间断，历史文化一脉相承，逐渐形成了以藏传佛教文化、伊斯兰教文化和汉族儒释道文化为主体的多元文化交融区，成为西部文化多元性体现得最为集中的地区之一[9]。

1.3 日益密切的社会经济联系

从历史上的“茶马互市”集散地发展到现代的人流、物流、信息流和资金流中心，两市间在产品的生产、加工、销售和运输等环节联系紧密；兰州在资金、技术、信息等方面具有较大优势，西宁及其腹地则拥有较为充足的矿产资源和工业原料。在西陇海－兰新经济带各主要城市中，与兰州交往最密切的城市是西宁，铁路客流占其总客流的17.1%；与西宁联系最密切的城市是兰州，铁路客流占其总客流的49.3%[7]。据薛东前等人[10]研究，兰州的紧密联系区为甘肃和青海东部，强

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ZHANG X H, CHEN Y Y, LIU B T. Spatial Morphological Characteristics and Construction Wisdom of Ancient Cantonment on the Qinghai-Tibet Plateau:Taking Baoan Four Cantonments in Tongren City as an Example[J]. Journal of Human Settlements in West China, 2023, 38(5): 158-164.

青藏高原古军屯的空间形态特征及营建智慧*

——以同仁市保安四屯为例

Spatial Morphological Characteristics and Construction Wisdom of Ancient Cantonment on the Qinghai-Tibet Plateau:Taking Baoan Four Cantonments in Tongren City as an Example

张新红　陈越依　刘奔腾　ZHANG Xinhong, CHEN Yueyi, LIU Benteng

摘　要: 军屯作为典型的军事防御型传统聚落，认知其空间形态和营建智慧对其科学保护和可持续发展具有重要意义。文章以青海省同仁市的保安四屯为研究对象，借助数理方法对其空间形态特征进行了探析，结果表明：第一，军屯边界形状均为紧凑度高的指状，形态呈强结构化；第二，中心区域的全局集成度高、可达性强，但局部空间的协同度整体偏低，由连通性感知整体空间的能力较弱；第三，内部空间的相互控制程度较低，但遮蔽性好。藉此可透视出中国古人在建设军屯时的高超智慧，即构建紧凑的空间围合形态、营建通达性高的军屯中心和塑造防御性强的街巷布局，这有利于青藏高原古军屯的价值认知、合理保护和传承性发展。

关键词: 古军屯；空间形态；营建智慧；青藏高原；保安四屯

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Abstract: As a typical traditional military defensive settlement, cantonment is of great significance to recognize its spatial form and construction wisdom for its scientific protection and sustainable development. The article takes Bao'an four cantonments in Tongren City as the research object, and analyzes their spatial morphological characteristics by several mathematical methods. Bao'an four cantonments, namely Bao'an, Wutun, Nianduhu and Guomari, are located in the valley area of Longwu River, a tributary of the upper Yellow River. They not only carry rich historical and cultural heritage, but also are typical representatives of ancient cantonment in the Qinghai-Tibet Plateau.

In the early stage of the study, the formation history and current situation characteristics of Bao'an four cantonments were briefly summarized. Then, through AutoCAD software, the outer contour lines of buildings and public activity places, the street road network and the border of Tunpu are digitized, and their building bottom, public space bottom and road axis are obtained.

The boundary shape index and the fractal dimension of public space are used to determine the geometric shape of the military camp boundary, and to quantify the degree of compactness and structure of the internal space form of the cantonment. Although the boundary of Bao'an four cantonments is fingerlike, its shape tendency is different. The Nianduhu cantonment is banded, while the other three cantonments are clumpy (Tab.2). Generally speaking, the finger-shaped boundary shape means that the security four cantonments have a high spatial compactness, which is due to the need of military defense function and the influence of local natural geographical environment. There are few agricultural lands around cantonment, and the finger-shaped layout can not only reduce the occupation of cultivated land, but also facilitate the development of agricultural production activities. The fractal dimension values of public space in Bao'an four cantonments are all greater than 1.5 (Tab.3), and the cantonments are strongly structured. This shows that although they are located in different areas, the cantonments are all confined by the fortress wall, and they rely on less public space to organize more residential buildings and public buildings, which is compact.

At the same time, Cantonment is a kind of densely distributed settlement of construction groups, so it is suitable to use the axis analysis method in space syntax to analyze and calculate the degree of integration, coordination and control of Bao'an four cantonments, and analyze the spatial similarity and difference between them. The axis of the warm color system of the overall integration degree of Bao'an four cantonments (Fig.6) is mainly concentrated in the central area of the cantonments, indicating that the center of most cantonments is the most accessible and dynamic area, which is closely related to the daily life of residents. The warm color axis of local integration (Fig.7) is mainly distributed in the main entrance and exit of cantonments and its connected streets, or the main movable nodes and their connected streets. For example, Bao'an cantonment is mainly distributed in Dusi Yamen, Chenghuang Temple, Guandi Temple, etc. These spaces have the function of defending the enemy and guarding the passage. The coordination degree of Bao'an four cantonments (Fig.8) is less than the highly correlated level of 0.7, that is, the fitting level of local

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全球化背景下西北内陆城镇密集区整合发展研究
——以兰州—西宁城镇密集区为例

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【摘　要】城镇密集区整合发展已成为一个政府和学术界共同关注的话题。文章以兰州—西宁城镇密集区为例,在分析整合发展的有利条件与制约因素的前提下,从内部和外部两个层面剖析了整合发展的主要动力,并最终提出编制区域规划、共建交通网络、共治环境污染和加快产业整合是其整合发展的关键举措。

【关键词】城镇密集区;整合发展;兰州;西宁

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在经济全球化迅猛发展的今天,国家、地区之间的竞争主要表现为以中心城市为核心的城市区域或城市集团之间的竞争。城镇密集区以规模经济和设施集约优势,日益成为区域经济发展乃至全球经济体系的重要节点区域,引来政府和学术界广泛关注。改革开放以来,城镇密集区在国内不断出现并快速成长,成为国家在经济发展水平、速度、实力和活力等方面最具发展前景的空间单元,决定着国民经济发展的态势与格局。兰州—西宁城镇密集区作为西北内陆城镇密集区的典型代表,地处西部两大经济发展带西陇海—兰新经济带与包兰—兰青经济带交汇地带,行政区划上包括甘肃省的兰州市、白银市、临夏州以及定西市的安定区、通渭县、陇西县、渭源县和临洮县(可称为兰州地区),青海省的西宁市、海东地区、海南州的贵德县和黄南州的尖扎县(可称为西宁地区),共计41个县、区,是甘肃、青海两省经济社会发展的精华地带。随着青藏铁路的全线通车和黄河上游水电资源的快速开发,作为黄河上游多民族经济区(甘青宁)的核心地带,其区域中心地位将进一步提升。但由于长期的行政分割,这一地区在很大程度上还处于各行其是的发展状态,经济发展水平低,与西北中心地带的地位很不相称,难以在西部大开发中发挥应有的作用。为此,必须进行整合以提升其整体实力,获得高效、持续、健康发展,并带动甘青两省乃至西北地区经济社会的快速发展,就显得尤为重要。

一、整合发展的条件分析

1.有利条件

①相对完整的地域经济单元

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融合 OSM 路网与 POI 数据的兰州市中心城区功能区识别

杨玉欢，张新红

摘要：识别城市功能区的空间格局与特征是实现城市科学规划管理的基础，是践行国土空间规划下全要素整合的基本内涵。文章以兰州市中心城区为研究对象，基于 38464 条 POI 数据与 OSM 路网数据，采用核密度、混合度测算等方法，识别兰州市中心城区用地类型及混合度，并结合规划图与卫星影像图进行精度检验。结果表明：（1）兰州市中心城区混合用地广泛分布与各组团中心，单一/复合用地多位于各组团外围地区，展现了带型城市典型的多中心空间结构。（2）兰州市中心城区用地混合度分布呈现出从组团中心向边缘扩散和沿黄河两岸为高混合度地块两种形态，形成了典型的“核心-边缘”结构。（3）识别结果与兰州市实际情况相符，但与规划图有较大误差，体现了城市结构的复杂性与多变性。研究结果可为兰州市城市规划与管理提供参考。

关键词：城市功能区，混合度，POI，兰州市

1 引言

城市是一个动态演进、机制复杂的巨系统，在演进中渐进式的形成了公共服务、居住、工业、交通等不同的单一或复合的功能区，识别城市不同功能区空间分布特征及其混合度，不仅是认识城市复杂性的重要途径，也是国土空间规划下全要素整合的基本内涵[1-3]。然而，传统的城市功能区划分方法主要采用人工识别、调查统计等方法，存在资源上耗时费力、准确性上真假难辨、结果上静态单一等问题[4]。

随着地理信息技术的发展，大数据背景下形成了城市数据化、数据海量化等特征，丰富多源的地理大数据为研究城市功能结构提供了新的支撑[5]。各类商铺、公交站点、居住小区等于居民日常生活密切相关的各类设施已点的形式被记录在地图中，共同组成了生活兴趣点(POI)，已被广泛运用于城市空间结构的研究[6]、公共服务设施配置研究[7]、商业布局研究[8]等方面。在城市功能区识别方面，学者基于 POI 数据与公交刷卡数据、出租车轨迹数据、遥感数据等对城市功能区进行探测，但以网格形式作为城市功能地块难以反映城市真实用地现状[4]。在此基础上，丁彦文等（2020）采用(OSM)路网数据划分用地单元，进而融合 POI 数据识别城市用地功能，但并没有进一步对用地的复合性进行探讨，缺乏对城市功能区的整体性认知[1]。在用地功能混合测度研究方面，一直是学界研究的热点，学者基于元胞自动机、熵值法等对其进行了详细探讨，本文采用较为普遍使用的 Hill Numbers 的统一公式进行用地功能混合测度，该方法是 Rimoldi 在借鉴生物地理学等领域的研究成果推导得出[9]，是研究城市用地混合度的重要方法之一[10]。鉴于此，本文以兰州市中心城区为例，融合 OSM 路网与 POI 数据识别城市用地功能，进而探讨城市用地空间结构与用地功能混合度，并基于卫星影像与城市总体规划图进行精度检验。以期对城市规划、管理人

西北河谷城市贫困住区的空间分布特征

——以兰州市为例

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提　要：城市贫困空间分布一直是城市地理学和城市规划学关注的热点问题。国内已有研究集中于低收入人口空间分布特征的探讨，鲜有从“贫困住区”这一空间实体视角开展研究。运用 GIS 空间分析工具和数理统计分析方法，对兰州市区 155 个贫困住区的空间分布状态及其与基础地理要素的空间关系进行了探析。结果表明，贫困住区在市区尺度上整体呈凝聚型分布，在组团尺度上的不均衡分布也很显著。贫困住区在市区形成了两个高密度区和 4 个较高密度区，它们或为组团中心，或邻近组团中心，其中棚户区和城中村分布较多。从与城市空间基础地理要素的关系来看，贫困住区的空间分布表现出显著的规律性，即远离黄河，趋近于洪道、山体和铁路。

关键词：贫困住区；空间分布；基础地理要素；西北河谷城市；兰州
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一、引言

“贫困住区”作为城市社会空间的一部分，是城市化进程下社会空间重构和居住空间分异产生的一类特殊空间，其空间分布和演化特征一直是学术界研究的热点[1]。国外相关研究始于美国的芝加哥学派，并在同心环、扇形和多核心 3 个土地利用经典模型中深入探讨了贫困住区的分布特征[2-4]。后继学者虽不断修正这 3 个模型，结果仍指出贫困住区主要分布于中心区内部、CBD 外缘[5]。之后彼得曼(Peter-Mann)、巴德科克(Badcock)和麦吉(McGee)等学者关于英国[6]、澳大利亚[7]和东南亚港口城市[8]的研究表明，美国城市贫困住区的分布特征并不适用于所有国家和地区，受不同因素的影响，贫困住区可能分布在城市中心区，也可能分布在郊区和城市边缘区。国内学术界关于城市贫困空间分布的研究始于 20 世纪 90 年代末期，学者们主要对低收入人口的空间分布进行了研究。一方面学者们主要利用政府部门提供的低保人口统计数据，对北京、南京、广州和重庆等城市的贫困人口空间分布特征进行了研究[9-13]，另一方面学者们主要借助问卷调查中的人口经济属性数据，对北京、西安和兰州的城市贫困空间分布进行了探究[14-17]。虽然上述研究较好地揭示了城市贫困的空间分布特征和形成原因等内容，但研究局限于街道尺度上探讨贫困人口的分布，未能真正具体到“贫困人口聚居区”(以下简称“贫困住区”)这一实体空间尺度，因而一定程度上约束了城市贫困空间分布状态及其与城市空间结构关系的深入探讨。

我国西北地区是河谷城市的重要分布区域，城市经济社会发展和空间布局结构长期受制于地形地貌和河流水系的影响。兰州作为西北中心城市和典型河谷城市，是中华人民共和国建国初期兴起的综合性工业城市，转型期以城市下岗失业人员和进城务工人员为主体的贫困人口大量涌现并聚居，其贫困住区的形成具有典型性。就城市空间结构而言，兰州为河谷城市，与其互动形成的贫困住区的空间分布格局具有特殊性。有鉴于此，本文从空间结构视角出发，以更

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西北内陆城镇密集区整合发展的理论与实践

——以兰州—西宁城镇密集区为例

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摘 要:以经济、空间和制度为基点,构建了西北内陆城镇密集区整合发展的理论框架。进而,以兰州——西宁这一典型的西北内陆城镇密集区为例,在此理论框架内探讨了整合发展的基础条件、制约因素和内外动力,并最终总结出不同阶段的经济、空间和制度整合模式。其中,经济方面包括产业互补模式、雁行发展模式和经济一体化模式,空间方面包括双核整合模式、轴线整合模式和面域整合模式,制度方面包括对宏观制度和微观机制的创新变革。

关键词:城镇密集区;整合理论;西北内陆;整合模式;兰州;西宁

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The Theory and Practice on Integration Development of Northwest Interior City and Town Concentrated Areas

—— A Case Study of Lanzhou-Xining CCA

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Abstract: Choose the economy, space and institutionas three integration basic-points, and elementarily construct the theory frame on integration development of northwest interior CCAs. Then, the paper takes Lanzhou-Xining CCA as a typical case, and analyzes its basic terms, restricting factors, inner and outer dynamics under the theory frame. Lastly, the paper summarizes the economic, spatial and institutional integration models at different stages. Among them, the economic models include mutual complementary industry model, flying geese development modeland economy integration model. The spatial ones include dual-core, axes and polygon integration models. The Institution ones include innovations of macroinstitution and microcosmic mechanism.

Key words: CCA; integration theory; Northwest interior; integration model; Lanzhou; Xining

城镇密集区的存在是区域城市化和城市区域化的重要表现,它的发展深刻影响着国家的国际竞争力,经济全球化和区域经济一体化必然要求重视和加强城镇密集区的发展[1]。受制于一定的行政管理体制,我国城镇密集区发展进程中的不整合问题日益突出,造成城镇密集区整体功能与实力大打折扣。这一现象不仅出现在东部发达地区,而且在西北欠发达地区表现得更为明显。关中平原、兰州——西宁、银川平原、天山北麓等四大城镇密集区,作为西北地区在经济发展水平、速度、实力和活力等方面最具前景的空间单元,对西北和全国经济的持续稳定发展具有重大意义。但由于各城镇密集区内部过分追求局部利益,分散了其整体功能的有效发挥,从而大大滞缓了西北地区的城市化进程和经济社会的快速发展,也给区域生态环境带来很大破坏。因而,如何整合,采取何种形式整合,以获得城镇密集区高效持续发展,符合其发展趋势是重大问题。

一、西北内陆城镇密集区整合发展的理论框架

在借鉴相关研究成果的基础上,以经济、空间和制度为基点,由三个基点与西北内陆城镇密集

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英巴两国城市贫困治理实践及其对我国的启示

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摘要：城市贫困已成为我国经济社会发展中亟待解决的重要难题。文章在梳理英国和巴西这两个典型国家城市贫困治理实践的基础上，总结性提出它们对我国城市贫困治理的启示，即要综合运用贫困人口政策和贫困地域政策化解贫困，贫困人口政策要更注重“造血能力”的提升，贫困地域政策要更注重社区经济社会发展的发展。

关键词：城市贫困；贫困治理；政策启示

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城市贫困是一个世界性的突出问题和重要难题，长期困扰着世界各国的经济社会发展。联合国调查数据表明，20世纪最后10年全球贫民窟居民人数增长到了9.23亿，约占全球总人数的1/6，增幅为36%；如果以相同速度增长，2030年将达到20亿。英国作为西方发达国家，是世界上第一个开始并完成工业化的国家，也是最早出现城市贫困问题并对其进行治理的国家，城市反贫困取得了巨大成就。巴西作为发展中国家，是世界过度城市化案例的典型代表，在快速城镇化过程中产生了严重的贫困问题，经过半个世纪的积极治理，城市反贫困效果显著。虽然我国与英巴两国在政治体制、经济发展和社会文化等方面存在很大差异，但城市贫困的发生、发展和治理具有内在规律性，研究两国城市反贫困经验对于治理我国城市贫困具有重要的借鉴意义。

一、英国城市贫困治理实践

纵观英国城市反贫困实践，总体上可将其概括为贫困人口政策和贫困地域政策两类。

（一）贫困人口政策

该政策是针对贫困人口的反贫困对策，目前主要包括社会保障制度和可持续就业政策两个方面。英国已形成比较完备、健全的社会保障制度，对化解城市贫困问题，维护社会、经济、政治秩序起到了重要的作用，主要包括社会保险、社会救助和专项津贴三部分。社会保险主要由养老保险、失业保险和疾病保险三大块组成，用于退休金、失业保险金、疾病补贴和寡妇给付金的支出。社会救助主要项目有基本收入维持、住房补助和社会基金等，它是对工薪收入和其他收入无法维持生活的家庭给予的一种最低生活保障补助，目的在于保证人们的基本生活水平。可持续就业是90年代后期出现的一种新就业理念与政策，其中那些就业竞争力弱、随时需要政府救济的贫困人群的可持续就业问题成为关注焦点。英国新工党政府执政以来，定位于减少特定群体的贫困，对贫困者可持续就业政策进行了系统构建。如1995年通过《求职者法》对贫困救助与就业促进加以整合，规定对履行和违约就业义务者分别给予奖励和惩罚；通过强制性再就业培训和增加就业培训支出等措施，增强贫困者持续就业能力；通过增加公共投资和吸引外资企业等措施，为贫困者创造就业机会。

（二）贫困地域政策

该政策是针对贫困人口聚居区的反贫困对策，是英国政府化解城市贫困的主线之一，主要经历了物质环境改善（1940-1970）和社区发展复兴（1970至今）两个阶段。物质环境改善阶段主要通过拆除贫民窟、重建公共住房、向卫星城疏散贫困人口等措施，改善贫困群体的住房设施和居住环境。社区发展复兴阶段采取物质性环境改造与经济社会环境改善相结合的方式，对城市贫困社区进行改造更新，增强社区发展能力，最具代表性的政策是“社区复兴运动”。20世纪末期，面对社区衰败的严峻形势，英国政府和反社会排斥委员会发起了“社区复兴运动”，成立18个政策行动小组，在分析和总结贫困社区面临问题的基础上，提出通过社区赋权和各方合作来改善公共服务、缩小贫富差距的战略目标。“社区复兴”政策纲要包括两个要素：一是针对就业、医疗卫生及犯罪预防等政策的目标定位；二是政府的支持和基层社区的参与。在政策实践中，政府将公共和私营部门、自愿组织与社区联合起来，通过相互合作、资源共享等方式，改善贫困者就业、医疗卫生、教育及住房，最大限度避免贫困社区和贫困者的社会排斥。经过持续努力，英国“社区复兴运动”取得了显著成效，地区贫富差距明显缩小，贫困社区居民的生活质量和发展机会均有所提升。

二、巴西城市贫困治理实践

总体上看，巴西的城市贫困治理还处于努力探索中，治理对策可分为贫民窟治理和经济社会改革两个方面。

（一）贫民窟治理

巴西对城市贫困问题的治理始于70年代对贫民窟的治理，起初政府采取驱逐贫民窟居民、禁止贫困者侵占土地等措施，力图抑制贫民窟的增长。但由于城市化无序发展和国民经济增长乏力，贫困人口和贫民窟的规模日益扩大，政府难以制止侵占土地行为，不得不另寻良策。90年代中期，随着巴西经济体制改革和社会改革的开始，以及对以往治理方式的反思，巴西政府愈加重视贫穷和社会公平问题，把贫民窟治理与化解城市贫困问题紧密联系起来，改变了过去对贫民窟所采取的取缔和驱逐政策，承认贫民窟合法性，并针对贫民窟生活基础设施极度匮乏的状况，通过改善居住条件、给排水设施、垃圾回收处理设施等，将其改造成拥有一定市政工程设施和生活服务设施的城市社区。

（二）经济社会改革

90年代中期以来，卡多佐政府对城市贫困的治理发生了很大转向，不再囿于单一的贫民窟治理，更加注重通过稳定发展经济和改革社会政策的方式化解贫困。在经济发展和社会政策方面，巴西政府主要通过“雷亚尔计划”、“社会发展战略”、“零饥饿计划”和“无贫困计划”的实行。“雷亚尔计划”始于1994年巴西开始的全面性经济改革，通过实行贸易开放、国企私有化、银行系统重组等重大措施，使巴西国家经济走向了稳定发展的道路，为贫困治理打下了坚实基础。“社会发展战略”与“雷亚尔计划”基本同时展开，它包括50个左右的具体社会计划，提出了改革基础性公共服务、增加就业机会和改善就业质量、开发缓解极端贫困项目、建立并完善“收入直接转移支付”计划等基本任务，重点对教育、医

中国东部欠发达地区县域发展研究
——以广东省高州市为例

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【摘　要】快速推进县域发展是加快东部欠发达地区经济发展，缩小与发达地区差距的内在要求和必然选择。文章以广东省高州市为例，从区位条件、资源状况、产业发展、城镇发展等角度入手，分析了高州发展具有的优势与劣势，以及未来发展所面临的机遇和挑战，最后提出了促进其快速健康发展的关键举措：增强自主创新能力、充分利用内外资源、加快中心城镇建设和加强周边区域合作。

【关键词】县域发展；高州市；东部欠发达地区
【中图分类号】TU982　　【文献标志码】A　　【文章编号】1003-0166(2010)04-0097-05

中共十六届三中全会明确提出，要以科学发展观和“五个统筹”指导和促进经济社会和人的全面发展。其中，统筹区域发展的根本点在于使不同区域间的经济社会能够协调健康发展，这不仅是指大区域如东、中、西部的协调，也指大城市、城镇和乡村之间的协调，还指发达地区、中等发达地区、欠发达地区之间的协调发展。改革开放30多年来，我国东部沿海地区经济取得了长足发展，无论是发展速度还是总量均处于全国领先地位，已成为我国经济发达地区。但是，广大的东部地区内部，经济发展存在严重不平衡现象，几乎每个省市都有地域范围不等的相对落后地区（如广东的粤西、粤北，江苏的苏北，辽宁的辽西等），这些地区主要经济指标低于东部发达地区，甚至低于全国平均水平，可称为东部发达地区中的欠发达地区，究其原因就在于县域经济的欠发达。多年来，我国学术界关于欠发达地区的研究大多集中于中西部地区，而较少涉及到东部地区，尤其是从县域角度探讨东部欠发达地区的发展问题。因此，探讨东部欠发达地区的县域发展，不仅是对我国欠发达地区发展理论与实践的重要补充，更为重要的是有利于缩小东部发达地区与欠发达地区间的发展差距，率先完成全面建设小康社会的重大任务。

一、高州概况

高州市位于我国东部省份广东省西翼中部，是由茂名市代管的省辖县级市。现辖23个镇和5个街道办，总面积3 276km²。东北部为连绵的山地，中央腹地是起伏的丘陵，西部、南部则台地与小平原相互交错。山地、丘陵面积占总面积的83.4%以上，总人口167.68万人，是典型的人多田少的山区市，在粤西地区12个县（市）中极具代表性。2008年全市地区生产总值达234.81亿元，占广东省总量的0.66%，约为国土面积所占全省比重1.82%的1/3；人均地区生产总值达

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中国工业遗产的时空分布特征与空间整合保护

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摘 要:综合时空分布特征针对性地提出历史文化遗产的保护策略,既是国土空间规划背景下保护各地建成遗产的基本内涵,也是修复国家文化空间基因的必要举措。选取中国342处工业遗产为研究对象,运用核密度估计和社会网络分析方法,探究了工业遗产的时空分布特征、网络属性特征和空间整合保护策略。主要结论如下:①工业遗产发展表现出显著的阶段性特征,6个阶段的数量与门类构成差别大。②工业遗产空间分布不均,具有较强的"核心—边缘"特征,揭示出以胡焕庸线为界的宏观区域差异。③工业遗产网络的社会关联在东、中、西三大地区间差异较大,且存在着显著的分层集聚现象,遗产集群也表现出显著的"核心—边缘"特征和流域集聚特征。④工业遗产的空间整合保护应构建"井字轴、九节点、多集群"的网络化结构,并重点分级保护16个遗产集群。

关键词:工业遗产;时空分布;遗产网络;社会关联;空间整合保护;空间结构;遗产集群
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Spatial-temporal Distribution Characteristic and Spatial Integrated Protection of Chinese Industrial Heritages

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Abstract: Proposing specific strategies for the protection of historical-cultural heritages based on the characteristics of spatial and temporal distribution is not only the basic connotation of protecting the heritages under the background of the territorial space planning,but also a necessary measure to restore the national cultural space genes. Selecting 342 Chinese industrial heritages as the research objects and using the methods of kernel density estimation and social network analysis, this paper explores the spatial and temporal distribution characteristics, network attribute characteristics and spatial integration protection strategies of industrial heritages. The main conclusions are as follows: 1) The development of industrial heritage shows significant stage characteristics,and the number and category composition of the six stages are very different. 2)The spatial distribution of industrial heritages is uneven, with a strong "core-periphery" feature, this reveals the macro-regional differences bounded by the HU Huanyong Line. 3) The social connection of industrial heritage network is quite different among three regions which are eastern region,central region and western region,and there is a significant phenomenon of hierarchical agglomeration, and heritage clusters also show significant "core-periphery" characteristics and watershed agglomeration characteristics. 4)The spatial integrated protection of industrial heritage should build a networked structure of "double cross axis, nine nodes, and multiple clusters", and focus on grading protection of 16 heritage clusters.

Keywords: industrial heritage;spatio-temporal distribution;heritage network;social relation;spatial integrated protection;spatial structure;heritage cluster

工业遗产作为一种新型文化遗产,是人类历史上影响深远的工业革命的历史遗存,保护传承已成为当代后工业社会背景下的世界性问题[1]。2006年6月,鉴于工业遗产保护的重要性和紧迫性,国

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中国农文旅耦合协调发展空间分异特征及影响肌理

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摘 要： 探索农文旅长效融合机制是实现乡村可持续发展、实施乡村振兴战略的重要举措。鉴于此，选取表征农文旅发展水平的名录数据作为研究对象，综合运用耦合协调度模型（Coupling coordination degree，CCD）和地理探测器等方法，定量探究了中国农文旅空间耦合协调发展空间分异特征及影响肌理。结果表明：（1）农、文、旅3产业发展水平不同步性、空间分布不均衡性特征突出。（2）农文旅融合发展呈现“文旅先行、农业滞后”的特征，空间耦合协调性一般。（3）农文旅空间耦合协调发展的集聚特征显著，呈现以胡焕庸线为界的局部分异特征。（4）农文旅耦合协调发展空间分异的解释力强度分别为：创新水平>社会文化>自然地理>经济发展，创新能力是农文旅耦合协调发展的主导力量。（5）农文旅耦合协调发展的空间分异受多因子复杂耦合作用，创新水平与社会文化维度之间的交互作用效果明显强于其他因子间的交互作用。

关 键 词： 农文旅；融合机制；影响因素；耦合协调度模型；地理探测器

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乡村城镇化、发展同质化、产业低端化等带来的乡村发展不可持续问题已成为制约实施乡村振兴的核心挑战[1]。进入高质量发展阶段，乡村发展范式转变为一二三产齐驱并进、农文旅协调统筹的态势[2]。结合乡土文化、特色农业、乡村旅游的农文旅模式成为实施乡村振兴战略的重要抓手[3]。且农文旅通常具有典型的产业多元化特征，能够保证本地居民的收入优于传统单一的旅游业、农业和畜牧业。相关实证研究证实了拥有“地理标志”[4]、“一村一品”[5]等标识的村镇在农产品销售时会产生“溢价效应”。获得“传统村落”[6]、“少数民族特色村寨”[7]、“非物质文化”[8]、“历史文化名镇名村”[9]、“重要农业文化遗产”[10]、“乡村治理示范村镇”[11]等代表乡土文化的要素对农文旅发展具有促进作用。同样在乡村“旅游热”现象中也推动了农产品销售与乡土文化传播[12]。然而，相较于发达国家且地缘邻近的日本、韩国等，我国虽为传统农业大国但由于经济发展水平、城镇化进程等原因造成农文旅融合发展的行动起步较晚。韩、日两国在1970—1980年代相继开展“新村运动”[13]和“一村一品”[14]等振兴乡村战略，培育出一批特色农产品优势区和乡村旅游示范区，并带来了大量客流，为当地注入活力，成功实现乡村转型与振兴。

长期以来，我国学者对乡村发展的研究主要关注农业[15]、旅游[16]等单一产业的带动作用或农旅[12]、文旅[17]融合效应。事实上，乡村旅游作为一种商业活动，在资本语境和消费驱动下，乡村极易沦为一个被动提供者[18]，且我国耕地资源的稀缺性和地理环境的复杂性不适宜全面推广规模化农业。近年来，随着农文旅融合与乡村振兴研究的日益开展，形成了武陵山片区[19]、安徽歙县[20]、贵州省[21]等农文旅融合的成功案例地，取得有益结论。并随着耦合协调度、地理探测器等空间分析模型的广泛运用，为探索农文旅耦合协调与影响因素提供了科学

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中国乡土文化多尺度空间分布特征及影响因素

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摘要　推进乡土文化整体性认知是修复我国文化空间基因、实施乡村振兴的重要举措。鉴于此,选取表征乡土文化的名录数据作为研究对象,综合运用数理统计、空间分析、地理探测器(geographic detector,GD)、地理加权回归(geographic weighted regression,GWR)等方法,定量探究乡土文化空间分布格局及其影响因素。结果表明:①乡土文化全国尺度下呈现聚集分布格局,省际分布不均衡特征突出;②乡土文化空间分布上呈现以胡焕庸线为界的"核心-边缘"特征,核心区集聚于长江、黄河流域及东部沿海带;③乡土文化空间分异的经济、社会因素比自然因素解释更强,人的能动性是乡土文化发展的主导力量;④乡土文化空间分异是多种因子复杂耦合作用的结果,经济和社会因子之间交互作用最强;⑤5 个最佳作用因子构建的 GWR 模型能解释乡土文化 34.9% 的空间分异特征,不同因子在空间上作用强度及方向差异显著。

关键词　乡土文化;分布特征;影响因素;地理探测器;地理加权回归
中图分类号:K901.2　　**DOI**:10.16152/j.cnki.xdxbzr.2023-04-004

Multi-scale spatial distribution characteristics and influencing factors of Chinese vernacular culture

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Abstract　Promoting the overall cognition of vernacular culture is an important measure to repair the genes of cultural space and implement rural revitalization in China. In view of this, taking the directory data representing vernacular culture as the research object, the methods such as mathematical statistics, spatial analysis, geographic detector (GD) and geographic weighted regression (GWR) were comprehensively used to quantitatively explore the spatial distribution pattern and influencing factors of vernacular culture. The results show that: ① vernacular culture presents a clustering distribution pattern at the national scale, and the interprovincial distribution is unbalanced; ② The spatial distribution of culture shows a "core-edge" characteristic bounded by Hu Huanyong Line, and the core area clusters in the Yangtze River and Yellow River basins and

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城市生活圈公共服务设施空间配置优化研究
——以天水市为例

Research on Spatial Allocation Optimization of Urban Public Service Facilities in Living Circle
——A Case Study of Tianshui City

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【摘要】公共服务设施的科学合理布局对于一字型河谷城市显得尤为重要。基于天水市592个居住小区、54所学校、34家社区医院、259个公交车站、15个菜市场等空间数据，引用核密度估计、Ripley's K函数、ArcGIS服务区分析等方法，从空间格局、设施网点步行可达性方面定量探究一字型河谷城市居住小区和公共服务设施的耦合性。研究发现：公共服务设施与居住空间二者的空间格局差异显著，形成老城区、麦积区两大核心并呈现由内向外减弱的特征，各类设施网点与居住小区的空间耦合性较差，不匹配问题突出；公共服务设施与居住空间在集聚特征方面差异明显，二者空间耦合水平仍需提高；越是小型的服务设施的步行等时圈覆盖范围越广，覆盖小区数量越多；公共服务设施布局主要存在设施供应不足、道路可达性差、大型设施缺乏灵活性等3个问题，并提出相应的优化策略与方案，改善其空间可达性。
【关键词】公共服务设施；居住空间；空间格局；可达性；空间耦合；一字型河谷城市
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Abstract：The scientific and reasonable layout of public service facilities is particularly important for the one-shaped city. The purpose of this experiment to quantitatively explore the coupling between the one-shaped river valley urban residential communities and public service facilities. The spatial data sample were collected from 592 residential areas，54 schools，34 community hospitals，259 bus stations，15 markets in Tianshui City. Methods such as kernel density estimation，Ripley's K function，ArcGIS service area analysis are used to analyze the data from the spatial pattern and the walkability of facility outlets aspects. The research found that：The spatial pattern between public service facilities and residential space is significantly different. But as a whole，the two cores of the old city and Maiji District are formed，and present a distribution characteristics that weakens from the inside to the outside. The spatial coupling between various facilities and residential areas is poor，which means mismatch problem is evident. The agglomeration characteristics of public service facilities and residential spaces are obviously different，which indicates the level of spatial coupling between the two still needs to be improved. The smaller the facility，the wider the reach and the larger the number of reachable cells. There are three main problems in the layout of public service facilities in Tianshui city：insufficient facility supply，poor road accessibility and lack of flexibility of large facilities. The corresponding optimization strategy and scheme are put forward to improve the spatial accessibility.
Key words：public service facilities；residential space；spatial pattern；accessibility；space coupling；one-shaped valley city

0 引 言

公共设施既是城市规划最重要的调控资源，也是城市规划工作的核心，包括教育、医疗、交通、文体等社会性基础设施，其空间布局、组织模式、供需平衡等是城市地理学和城市规划学研究的热点[1-2]。中国当前正处于城市化快速发展阶段，城乡人口、空间正处于快速的变动重组之中，必须在保障基本公平的情况下兼顾公共服务设施供给与运营的效益，进而促进健康城市化的进程，让所有人平等和有尊严地在一个健康的环境中充

张新红，李红军，杨海勤. 甘肃省传统村落的空间可达性与分布特征［J］. 亚热带资源与环境学报，2023，18（4）：69-79.
ZHANG X H，LI H J，YANG H Q. Spatial accessibility and distribution characteristics of traditional villages in Gansu Province［J］. Journal of Subtropical Resources and Environment，2023，18（4）：69-79. DOI：10.19687/j.cnki.1673-7105.2023.04.009.

甘肃省传统村落的空间可达性与分布特征

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摘要：探究传统村落的空间可达性与分布特征，对科学保护传统村落和促进乡村振兴具有重要的理论与现实意义。运用数理统计分析和空间分析方法，对甘肃省传统村落的空间可达性、分布特征及其影响因素进行研究。结果表明：1）传统村落的空间可达性总体不佳，全局可达性高的村落在天水、兰州形成了高密集区和次高密集区，局部可达性高的村落主要分布在天水、兰州、酒泉和陇南等市。2）国家级、省级及所有传统村落均呈凝聚型分布，县级尺度上的分形特征较明显，并呈现出沿某一地理线集中分布的态势。3）传统村落整体表现出“东南密、西北疏，强集中、大分散”的空间格局，高密度区位于天水—陇南地区。4）传统村落的空间分布受到自然地理条件和人文社会因素的共同约束。年均降水量、人均 GDP、人口密度和路网可达性 4 个因子的影响力较强，但任意两个因子的交互影响均大于单个因子，尤其是年均降水量与人均 GDP、人口密度与非物质文化遗产数量。

关键词：传统村落；空间可达性；空间分布特征；影响因素；地理探测器；甘肃省
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Spatial Accessibility and Distribution Characteristics of Traditional Villages in Gansu Province

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Abstract：Exploring the spatial accessibility and distribution characteristics of traditional villages has significant theoretical and practical significance for scientifically protecting traditional villages and promoting rural revitalization. Using mathematical statistical analysis and spatial analysis methods，this paper presented the study of spatial accessibility，distribution characteristics and its influencing factors of traditional villages in Gansu Province. The results show，1）in general，the spatial accessibility of traditional villages is poor. Villages with high global accessibility have formed high-density areas and sub-high-density areas in Tianshui and Lanzhou，but villages with high local accessibility are mainly distributed in Tianshui，Lanzhou，Jiuquan and Longnan. 2）The spatial distribution types of traditional villages at different levels are all agglomerative，their fractal characteristics at the county level are more obvious，which suggesting a concentrated distribution along a geographic line. 3）The overall distribution of traditional villages shows a spatial pattern，which is “dense in the southeast，sparse in the northwest，strong concentration，and large dispersion”，and their high-density area is in the mixed area of Tianshui and Longnan. 4）The spatial distribution of traditional villages is affected by natural

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·文化遗产保护·

甘肃省石窟的时空分布特征及其影响因素

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摘要 时空分布特征研究是历史文化遗产空间整合保护的必要前提和重要依据。以甘肃省 166 处石窟为例,借助 GIS 空间分析技术,对其时空分布特征及影响因素进行了探析。研究发现:① 石窟的开龛造像呈现出先增加后减少再增加的演变趋势,魏晋南北朝和隋唐五代时期是开龛造像的高峰期;② 甘肃东部形成了以天水和平凉为核心的带状高密度区,自魏晋南北朝至明清时期新开凿窟龛的高密度区依次为天水、酒泉和张掖;③ 石窟空间分布在不同时期发生了明显移动,分布重心表现出由东南移至西北、再持续向东南转移的特征;④ 石窟的时空分布主要受到地形、河流水系、地层岩性以及政治经济、佛教发展和道路交通等因素的影响。研究结论对于甘肃石窟的整合保护、价值传承和持续利用具有重要的参考意义。

关键词 石窟;时空分布;影响因素;空间分析;甘肃省

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Spatial-temporal distribution characteristics and influencing factors of the grottoes in Gansu Province

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Abstract The research on spatial and temporal distribution is a necessary prerequisite and important basis for the spatial integration and protection of historical and cultural heritage. Taking 166 grottoes in Gansu Province as an example, the spatial and temporal distribution characteristics and influencing factors of grottoes were analyzed by GIS spatial analysis technology. The results show that: ① The open niche statues in grottoes show an evolutionary trend of increasing first and then decreasing and then increasing, with the peak periods of open niche statues in Wei, Jin, Southern and Northern Dynasties, Sui, Tang and Five dynasties. ② A belt-shaped high-density area with Tianshui and Pingliang as the core has been formed in eastern Gansu. From the Wei, Jin, Southern and Northern Dynasties to the Ming and Qing Dynasties, the high density area of new grottoes was Tianshui, Jiuquan and Zhangye. ③ The spatial distribution of grottoes shifted significantly in different periods, and the distribution center of grottoes shifted from the southeast to the northwest and then continued to the southeast. ④ The spatial and temporal distribution of grottoes is mainly affected by topography, river sys-

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甘肃省文物保护单位时空分布特征及其影响因素研究

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摘要:解析文物保护单位的时空分布特征,对于保护、挖掘和传承民族优秀文化具有重要价值。本文以甘肃省689处文物保护单位为研究对象,借助数理统计和GIS空间分析方法探讨其时空分布特征及其影响因素。结果表明:①六类文物保护单位在7个历史时期的占比不尽相同,古遗址、古墓葬、石窟寺及石刻、古建筑、近现代重要史迹及代表性建筑的分布具有很强的时代性。②文物保护单位的空间分布整体呈"东南高、西北低"特征,且古遗址、古墓葬、石窟寺及石刻、古建筑、近现代重要史迹及代表性建筑的空间分布具有十分鲜明的地域性。③不同历史时期的文物保护单位均呈凝聚型分布状态,但高密度区、次高密度区分布差异较大;分布重心随历史时期更替,呈现出向西北—东南—东南—东南—西北—东北方向迁移的特征。④地形地貌、河流水系等自然因素以及社会政治、经济发展、历史文化、道路交通等人文因素对甘肃省文物保护单位的产生、类型、数量和时空分布具有重要影响。

关键词:文物保护单位;时空分布;影响因素;甘肃省

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Study on spatial－temporal distribution characteristics and influencing factors of cultural relic protection units in Gansu Province

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Abstract:It was of great value to analyze the spatial－temporal distribution characteristics of cultural relic protection units for the protection,excavation and inheritance of national excellent culture.Taking 689 cultural relic protection units in Gansu Province as the research objects,this paper discussed their spatial－temporal distribution characteristics and influence factors by means of mathematical statistics and GIS spatial analysis.The results showed that:①The proportions of the six types of cultural relic protection units were different in the seven historical periods,and the distribution of ancient sites,ancient tombs,grotto temples and stone carvings,ancient buildings,modern and important historical sites and representative buildings had a strong chronological character.②The spatial distribution of cultural relic protection units showed a characteristic of "higher in southeast and lower in northwest",and the spatial distribution of the first five types of cultural relic protection units was very distinct.③The distribution of cultural relic protection units in different historical periods was agglomerative,but the distribution of high－density area and the secondary density area was different.The gravity center changed over time and showed the characteristics of moving to northwest－southeast－southeast－southeast－northwest－northeast in different periods.④Natural geographical factors such as landform and river system,humanity factors such as social politics,economic development,historic culture and road traffic,both of which had an important impact on the generation,type,number and spatial－temporal distribution of cultural relic protection units.

Key words:cultural relic protection units;spatial－temporal distribution;influence factors;Gansu Province

0　引言

文物保护单位(下文简称"文保单位")作为人类活动的文化遗存,真实记录了特定历史时期的社会、经济、文化形态,具有极高的历史、艺术和科学价值[1]。对其研究有助于加深对不同历史时期社会经济发展、历史文化演变等人地关系的认知,不仅对科学保护文物资源、传承民族优秀文化、增强文化自信具有重要意义,而且能彰显中华文明的世界地位和当代价值。近年来,国内学术界对文保单位展开了深入而广泛的研究,主要集中在文保单位的保护利用[2,3]、文保单位与旅游发展[4,5]、文保单位的制度建设[6,7]、文保单位的时空分布格局[8－25]等方面。就时空分布方面的研究而言,学者们主要以古建筑[8,9]、石窟寺及石刻[10]或全国重点文保[8,10－17]等为研究对象,囿于某一类型或单一等级;研究地域上主要聚焦于全国[8,10－12,14,15]、浙江省[18]、湖北省[19－21]、江西省[22,23]、安徽省[24]、京津冀[25]等,而对中华民族重要源头、历史文化悠久深厚的西北五省区的研究较为

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2024年第十二届

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教育部中国高等教育学会学科竞赛排行榜赛项

cmit

www.cmit.cn

全国大学生数字媒体科技作品及创意竞赛

全国总决赛：二等奖

参赛学校：兰州理工大学

参赛作品：碎·织文化综合体——破碎与组织下的图书馆设计

作品分类：人居环境设计

指导老师：毕晓莉

团队成员：武彦玮、郭莉莉、高敏、苏迪、方渊

作品赛道：本科及以上学历

证书编号：20241065743

中国人工智能学会

全国大学生数字媒体科技作品及创意竞赛组委会

二〇二四年十一月

教育部高教学会学科竞赛排行榜赛项

中国好创意（第十八届）暨全国数字艺术设计大赛

CHINA CREATIVE CHALLENGES CONTEST

简称"3C大赛"或"中国创意挑战大赛"

获奖证书

CERTIFICATE

THIS CERTIFIES THAT

国赛普通高等院校赛道

空间设计类

二等奖

作品名称 元宇宙背景下的未来游乐园设计

作者姓名 徐源

指导教师 张新红

参赛院校 兰州理工大学

2024年8月15日

证书编号：ZCS-国赛 GX-20242676

证书真伪查询

第17届 3D大赛

No. 20249462031301

全国三维数字化创新设计大赛

Digital Design Dimensions

龙鼎奖

（全国总决赛）

获得奖项：二等奖

参赛院校：兰州理工大学

参赛团队：美丽中国队

指导教师：安玉源 张涵

团队成员：王震 李若楠

参赛作品："千年药乡，狼渡滩头"—岷县当归博物馆

参赛板块：开放赛项

参赛方向：数字人居设计大赛

全国三维数字化创新设计大赛组委会

国家制造业信息化培训中心

北京光华设计发展基金会

全国3D技术推广服务与教育培训联盟

2024年12月

科学技术部 教育部 工业和信息化部 中国科学技术协会 指导

大赛官网：https://3DDS.3DDL.net

获奖证书

第12届未来设计师

全国高校数字艺术设计大赛全国总决赛

二 等 奖

作品名称：蘭・中学-校园规划及教学楼单体设计

作者姓名：李若楠、王震

参赛组别：研究生组

作品类别：人居环境规划与设计

参赛单位：兰州理工大学

指导老师：安玉源

大赛官网：www.ncda.org.cn

证书编号:HJNCDA202408000683

工业和信息化部人才交流中心

2024年08月26日

米兰设计周 CHINA COLLEGIATE DESIGN COMPETITION & EXHIBITION | 2025
中国高校设计学科师生优秀作品展

获奖证书

米兰设计周中国高校设计学科师生优秀作品展
全国决赛

三等奖

作品编号：438005

参赛组别：本科研究生组

作品类别：非命题赛场（图片类）

作者姓名：卜宇星

作品名称：绿洲回寰·可交互的社区体育综合体

指导老师：张新红

参赛单位：兰州理工大学

米兰设计周-中国高校设计学科
师生优秀作品展组委会

2025年6月

授权网站　微信公众号

证书编号：202500FM62010G030M1438005

2024年第十二届

数字未来·创意无限 DIGITAL FUTURE UNLIMITED CREATIVITY

教育部中国高等教育学会学科竞赛排行榜赛项

cmiT www.cmit.cn

全国大学生数字媒体科技作品及创意竞赛

全国总决赛：三等奖

参赛学校：兰州理工大学

参赛作品：向野而生，逐趣自然-儿童友好视角下郑州市金水区口袋公园改造设计

作品分类：人居环境设计

指导老师：张涵、刘奔腾

团队成员：廖玲玲

作品赛道：本科及以上学历

证书编号：20241102284

中国人工智能学会

全国大学生数字媒体科技作品及创意竞赛组委会

二〇二四年十一月

2025（第十三届） China College Student Digital MediaTechnology Works and Creativity Competition

2025

教育部中国高等教育学会学科竞赛排行榜赛项

cmit 全国大学生数字媒体科技作品及创意竞赛

www.cmit.cn 数字未来 ⊙ 创意无限

全国总决赛：

三等奖

参赛学校：兰州理工大学

参赛作品：康县凤凰谷设计

作品分类：乡村振兴，科创赋能

指导老师：刘奔腾、蔡文娟

团队成员：宁志杉

作品赛道：本科及以上学历

证书编号：2025191878

关注微信公众号

全国大学生数字媒体科技作品及创意竞赛组委会

中国人工智能学会

2025年10月

获奖证书

第13届未来设计师

全国高校数字艺术设计大赛全国总决赛

三 等 奖

作品名称：艺境流芳:基于可持续理念的校园规划

作者姓名：苏迪，贾龙，高敏

参赛组别：研究生组

作品类别：人居环境规划与设计

参赛单位：兰州理工大学

指导老师：毕晓莉

大赛官网：www.ncda.org.cn

证书编号:IITCHJNCDA25000877

工业和信息化部人才交流中心

2025年08月28日

获奖证书

第九届全国高校数字艺术设计大赛

全国总决赛

三 等 奖

参赛组别：学生组

作品类别：人居环境规划与设计

作者姓名：宋佳敏

作品名称：张坝古村 · 观村山舍休闲空间设计

参赛单位：兰州理工大学

指导老师：安玉源

大赛官网：www.ncda.org.cn

证书编号：HJNCDA202109004300

工业和信息化部人才交流中心

2021年08月31日

第三届“永创杯”全国高校创意设计作品展评

荣誉证书

HONOR CERTIFICATE

朱星友 同学：

作品《校园脉动——大学生活动中心建筑设计》在本届全国高校创意设计作品展评活动中荣获学生组

二等奖

指导教师：靳聪毅

单位名称：郑州轻工业大学

证书编号：32512S03050F

中国通信工业协会

互联网商业专业委员会

2025年12月

教育部中国高等教育学会学科竞赛排行榜赛项

全国大学生数字媒体科技作品及创意竞赛

www.cmit.cn 数字未来 ⊙ 创意无限

甘肃赛区：

三等奖

证书编号：2025201026

关注微信公众号

参赛学校：兰州理工大学

参赛作品：忆曲织新--民宿外观改造设计

作品分类：人居环境设计

指导老师：毕晓莉

团队成员：朱紫维、冯福江、张雅欣、黎梓旭

作品赛道：本科及以上学历

全国大学生数字媒体科技作品及创意竞赛组委会

中国人工智能学会

2025年10月

蓝桥杯大赛

获奖证书

学校名称：兰州理工大学

指导老师：刘奔腾

团队成员：姜懿轩，赵泽航宇

其作品《兰州老街空间激活——红城的唤醒》荣获第十六届蓝桥杯全国软件和信息技术专业人才大赛视觉艺术设计赛——环境艺术设计-非命题省赛优秀奖。

特发此证，以资鼓励。

工业和信息化部
人才交流中心

蓝桥杯大赛组委会

2025年6月17日

证书编号：1616029169

未来设计师大赛
FUTURE DESIGNER AWARDS

NCDAEOT132025009G

2025 NCDA Awards

NCDA AWARDS 未/来/设/计/师
全国高校数字艺术设计大赛

第13届未来设计师·全国高校数字艺术设计大赛

甘 肃 赛 区

董建红老师(兰州理工大学)

在2025第13届未来设计师·全国高校数字艺术设计大赛(NCDA)中表现出色，成绩优异，荣获

优秀组织教师

特发此证！

证书编号：
验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会
2025年8月

FUTURE DESIGNER · NCDA Awards

NCDA AWARDS 未来设计师 全国高校数字艺术设计大赛

12th National College Digital Art&Design Awards

2024 NCDA Awards

第12届未来设计师·全国高校数字艺术设计大赛

甘肃赛区

二等奖

作品名称：唤醒红城——老街空间激活规划设计

作者姓名：姜懿轩、赵泽航宇

参赛组别：研究生组

作品类别：人居环境规划与设计

参赛院校：兰州理工大学

指导老师：刘奔腾

证书编号：NCDA12S3N1262002G1D200801

验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会

2024年8月

NCDA AWARDS 未来设计师 全国高校数字艺术设计大赛

12th National College Digital Art&Design Awards

2024 NCDA Awards

第12届未来设计师·全国高校数字艺术设计大赛

甘肃赛区

二等奖

作品名称：茶沐敦煌—敦煌罗布麻茶文化空间设计

作者姓名：闫羽萱

参赛组别：研究生组

作品类别：人居环境规划与设计

参赛院校：兰州理工大学

指导老师：刘奔腾、张涵

证书编号：NCDA12S3N1262002G1D402701

验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会

2024年8月

FUTURE DESIGNER · NCDA Awards

未来设计师大赛
FUTURE DESIGNER AWARDS

NCDA AWARDS 未/来/设/计/师
全国高校数字艺术设计大赛

2025 NCDA Awards

第13届未来设计师·全国高校数字艺术设计大赛

甘 肃 赛 区

二 等 奖

作品名称：光影方舟——图书馆建筑设计

作者姓名：李晶

参赛组别：研究生组

参赛类别：人居环境规划与设计

指导老师：张新红

参赛院校：兰州理工大学

证书编号：NCDA13S3N1362002G1D101201
验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会
2025年8月

FUTURE DESIGNER · NCDA Awards

NCDA AWARDS 未来设计师 全国高校数字艺术设计大赛

12th National College Digital Art&Design Awards

2024 NCDA Awards

第12届未来设计师·全国高校数字艺术设计大赛

甘肃赛区

二等奖

作品名称：友邻共乐园——基于邻里友好的公共景观设计

作者姓名：徐源

参赛组别：研究生组

作品类别：人居环境规划与设计

参赛院校：兰州理工大学

指导老师：张新红

证书编号:NCDA12S3N1262002G1D305001

验证网址:https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会

2024年8月

中国国际大学生创新大赛（2025）兰州理工大学校赛

获奖证书

张雪涵、于新雨、黄子璇、徐源、李俊锋、童亚文、刘嘉倩、魏厚玓、梁昊彦、吴冰池、卜宇星、李晶、孙秋霞、牛惠莹、闫文文同学：

你们的作品《共益设计——设计下乡赋能黄河古村落文化遗产创新利用》，在中国国际大学生创新大赛(2025)兰州理工大学校赛中荣获

铜奖

指导教师：张新红、刘奔腾、董建红

特发此证，以资鼓励。

兰州理工大学创新创业学院

二〇二五年六月

NCDA AWARDS 未来设计师 全国高校数字艺术设计大赛

12th National College Digital Art&Design Awards

2024 NCDA Awards

第12届未来设计师·全国高校数字艺术设计大赛

甘肃赛区

二等奖

作品名称：乡村·乡情—文化体验空间设计

作者姓名：陈冉

参赛组别：研究生组

作品类别：人居环境规划与设计

参赛院校：兰州理工大学

指导老师：董建红、王鹏

证书编号：NCDA12S3N1262002G1D402901

验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会

2024年8月

NCDA AWARDS 未来设计师 全国高校数字艺术设计大赛

12th National College Digital Art&Design Awards

2024 NCDA Awards

第12届未来设计师·全国高校数字艺术设计大赛

甘肃赛区

三等奖

作品名称：马滩绿洲·湿地公园

作者姓名：赵皓琳、吴虎成、杜弘昇

参赛组别：研究生组

作品类别：人居环境规划与设计

参赛院校：兰州理工大学

指导老师：董建红、裴强强

证书编号：NCDA12S3N1262002G1D303101

验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会

2024年8月

NCDA AWARDS 未来设计师 全国高校数字艺术设计大赛

12th National College Digital Art&Design Awards

2024 NCDA Awards

第12届未来设计师·全国高校数字艺术设计大赛

甘肃赛区

二等奖

作品名称：寻影·溯流民俗博物馆设计

作者姓名：贾潇涵、郭兰馨、李昕睿

参赛组别：本科生组

作品类别：人居环境规划与设计

参赛院校：兰州理工大学

指导老师：安玉源、师鸿儒

证书编号：NCDA12S2N1262002G1D108101

验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会

2024年8月

FUTURE DESIGNER · NCDA Awards

NCDA AWARDS 未来设计师 全国高校数字艺术设计大赛

12th National College Digital Art&Design Awards

2024 NCDA Awards

第12届未来设计师·全国高校数字艺术设计大赛

甘肃赛区

二等奖

作品名称：凹晶里馆

作者姓名：文雯

参赛组别：研究生组

作品类别：人居环境规划与设计

参赛院校：兰州理工大学

指导老师：安玉源、师鸿儒

证书编号：NCDA12S3N1262002G1D103601

验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会

2024年8月

FUTURE DESIGNER · NCDA Awards

NCDA AWARDS 未来设计师 全国高校数字艺术设计大赛

12th National College Digital Art&Design Awards

2024 NCDA Awards

第12届未来设计师·全国高校数字艺术设计大赛

甘肃赛区

二等奖

作品名称：蜃楼

作者姓名：武建平

参赛组别：研究生组

作品类别：人居环境规划与设计

参赛院校：兰州理工大学

指导老师：安玉源

证书编号：NCDA12S3N1262002G1D103701

验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会

2024年8月

未来设计师大赛
FUTURE DESIGNER AWARDS

NCDA AWARDS 未/来/设/计/师 全国高校数字艺术设计大赛

2025 NCDA Awards

第13届未来设计师·全国高校数字艺术设计大赛

甘 肃 赛 区

二 等 奖

作品名称：雪域明珠，和谐共生

作者姓名：苟兆敏，曹璐曦

参赛组别：研究生组

参赛类别：人居环境规划与设计

指导老师：安玉源，陈伟东

参赛院校：兰州理工大学

证书编号：NCDA13S3N1362002G1D102201
验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会
2025年8月

甘 肃 赛 区

三 等 奖

参赛组别：学生组

作品类别：人居环境规划与设计

作者姓名：孙浩楠、闫芊汝、王广正

作品名称：成都江安河景观概念设计

参赛院校：兰州理工大学

指导老师：安玉源

证书编号：NCDA10SA80931D202501
验证网址：http://www.ncda.org.cn

主办单位：甘肃省教育厅

未来设计师·全国高校数字艺术设计大赛组委会
2022年8月

NCDA AWARDS
未/来/设/计/师
全国高校数字艺术设计大赛

11th National College Digital Art&Design Awards

2023 NCDA Awards

第11届未来设计师·全国高校数字艺术设计大赛
甘肃赛区

三等奖

作品名称：《丝路视觉》

作者姓名：刘璐

参赛组别：研究生组

作品类别：视觉传达设计

参赛院校：兰州理工大学

指导老师：安玉源

证书编号：NCDA11S3N1162002G1A101101
验证网址：http://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会
2023年8月

NCDA AWARDS 未来设计师 全国高校数字艺术设计大赛

12th National College Digital Art&Design Awards

2024 NCDA Awards

第12届未来设计师·全国高校数字艺术设计大赛

甘肃赛区

三等奖

作品名称：兰州骆驼巷

作者姓名：吴芳、武建平

参赛组别：研究生组

作品类别：数字摄影

参赛院校：兰州理工大学

指导老师：安玉源

证书编号：NCDA12S3N1262002G1J200201

验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会

2024年8月

未来设计师大赛
FUTURE DESIGNER AWARDS

NCDA AWARDS 未/来/设/计/师
全国高校数字艺术设计大赛

2025 NCDA Awards

第13届未来设计师·全国高校数字艺术设计大赛

甘 肃 赛 区

三 等 奖

作品名称：重叠校园--校园规划及教学楼单体设计

作者姓名：文雯

参赛组别：研究生组

参赛类别：人居环境规划与设计

指导老师：安玉源，师鸿儒

参赛院校：兰州理工大学

证书编号：NCDA13S3N1362002G1D100801
验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会
2025年8月

未来设计师大赛
FUTURE DESIGNER AWARDS

NCDA AWARDS 未来设计师 全国高校数字艺术设计大赛

2025 NCDA Awards

第13届未来设计师·全国高校数字艺术设计大赛

甘 肃 赛 区

三 等 奖

作品名称：黑河湾·减碳记

作者姓名：李晶

参赛组别：研究生组

参赛类别：乡村设计

指导老师：张新红

参赛院校：兰州理工大学

证书编号：NCDA13S3N1362002G1O300601
验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会
2025年8月

未来设计师大赛
FUTURE DESIGNER AWARDS

NCDA AWARDS 未/来/设/计/师
全国高校数字艺术设计大赛

2025 NCDA Awards

第13届未来设计师·全国高校数字艺术设计大赛

甘 肃 赛 区

三 等 奖

作品名称：基于环境心理学的别墅空间设计

作者姓名：朱紫维，冯福江，郭莉莉

参赛组别：研究生组

参赛类别：人居环境规划与设计

指导老师：毕晓莉

参赛院校：兰州理工大学

证书编号：NCDA13S3N1362002G1D403501
验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会
2025年8月

未来设计师大赛
FUTURE DESIGNER AWARDS

NCDA AWARDS 未/来/设/计/师
全国高校数字艺术设计大赛

2025 NCDA Awards

第13届未来设计师·全国高校数字艺术设计大赛

甘 肃 赛 区

三 等 奖

作品名称：茶旅融合背景下的”茶疗“景观设计研究

作者姓名：冯福江，朱紫维，郭莉莉

参赛组别：研究生组

参赛类别：艺术疗愈

指导老师：毕晓莉

参赛院校：兰州理工大学

证书编号:NCDA13S3N1362002G1I301101
验证网址:https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会
2025年8月

FUTURE DESIGNER · NCDA Awards

2024年第十二届

数字未来 · 创意无限 DIGITAL FUTURE UNLIMITED CREATIVITY

教育部中国高等教育学会学科竞赛排行榜赛项

cmiT www.cmit.cn

全国大学生数字媒体科技作品及创意竞赛

甘肃省赛区： 三等奖

参赛学校：兰州理工大学

参赛作品：“智种管家”——全天候智能种植与除草机器人设计

作品分类：智能产品设计

指导老师：毕晓莉、杜先君

团队成员：苏迪、董明月、贾龙、姚艳平、高敏

作品赛道：本科及以上学历

证书编号：20241084812

中国人工智能学会

全国大学生数字媒体科技作品及创意竞赛组委会

二〇二四年十一月

2024年第十二届

数字未来·创意无限 ITAL FUTURE UNLIMITED CREATIVITY

教育部中国高等教育学会学科竞赛排行榜赛项

全国大学生数字媒体科技作品及创意竞赛

www.cmit.cn

甘肃省赛区： 三等奖

参赛学校：兰州理工大学

参赛作品：文化综合体——图书馆

作品分类：人居环境设计

指导老师：张涵

团队成员：郭晓雪

作品赛道：本科及以上学历

证书编号：20241479195

中国人工智能学会

全国大学生数字媒体科技作品及创意竞赛组委会

二〇二四年十一月

未来设计师大赛
FUTURE DESIGNER AWARDS

NCDA AWARDS 未/来/设/计/师
全国高校数字艺术设计大赛

2025 NCDA Awards

第13届未来设计师·全国高校数字艺术设计大赛

甘 肃 赛 区

三 等 奖

作品名称：5分钟魔法圈，童趣任意门

作者姓名：廖玲玲

参赛组别：研究生组

参赛类别：人居环境规划与设计

指导老师：张涵

参赛院校：兰州理工大学

证书编号：NCDA13S3N1362002G1D302601
验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会
2025年8月

未来设计师大赛
FUTURE DESIGNER AWARDS

NCDA AWARDS 未/来/设/计/师
全国高校数字艺术设计大赛

2025 NCDA Awards

第13届未来设计师·全国高校数字艺术设计大赛

甘 肃 赛 区

三 等 奖

作品名称：桃缘

作者姓名：元泽锋，李冲，魏佳运

参赛组别：研究生组

参赛类别：人居环境规划与设计

指导老师：刘奔腾

参赛院校：兰州理工大学

证书编号：NCDA13S3N1362002G1D301801
验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会
2025年8月

未来设计师大赛
FUTURE DESIGNER AWARDS

NCDA AWARDS
未/来/设/计/师
全国高校数字艺术设计大赛

2025 NCDA Awards

第13届未来设计师·全国高校数字艺术设计大赛

甘 肃 赛 区

三 等 奖

作品名称：照晴岚接画檐 江南地区某地级市博物馆设计

作者姓名：王佳瑶，金鑫

参赛组别：研究生组

参赛类别：人居环境规划与设计

指导老师：刘奔腾

参赛院校：兰州理工大学

证书编号：NCDA13S3N1362002G1D101701
验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会
2025年8月

FUTURE DESIGNER · NCDA Awards

米兰设计周 CHINA COLLEGIATE DESIGN COMPETITION & EXHIBITION | 2025
中国高校设计学科师生优秀作品展

获奖证书

米兰设计周中国高校设计学科师生优秀作品展
甘肃赛区

三等奖

作品编号：349153

参赛组别：本科研究生组

作品类别：非命题赛场（图片类）

作者姓名：廖玲玲

作品名称：归野新生，逸趣悠园——郑州市金水区儿童友好型口袋公园改造设计

指导老师：张涵

参赛单位：兰州理工大学

米兰设计周-中国高校设计学科师生优秀作品展组委会

2025年5月

投稿网站　微信公众号

证书编号：202500FM62010S030ML349153

NCDA AWARDS 未来设计师 全国高校数字艺术设计大赛

12th National College Digital Art&Design Awards

2024 NCDA Awards

第12届未来设计师·全国高校数字艺术设计大赛

甘肃赛区

三等奖

作品名称：“回归自然”—银川中山公园景观改造设计

作者姓名：郭莉莉、李秀琴、边婧

参赛组别：研究生组

作品类别：人居环境规划与设计

参赛院校：兰州理工大学

指导老师：毕晓莉

证书编号：NCDA12S3N1262002G1D301101

验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会

2024年8月

FUTURE DESIGNER · NCDA Awards

未来设计师大赛
FUTURE DESIGNER AWARDS

NCDA AWARDS 未/来/设/计/师
全国高校数字艺术设计大赛

2025 NCDA Awards

第13届未来设计师·全国高校数字艺术设计大赛

甘 肃 赛 区

三 等 奖

作品名称：童梦乐园——亲子小农庄规划设计

作者姓名：郭莉莉，武彦玮，高敏

参赛组别：研究生组

参赛类别：人居环境规划与设计

指导老师：毕晓莉

参赛院校：兰州理工大学

证书编号：NCDA13S3N1362002G1D301701
验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会
2025年8月

FUTURE DESIGNER · NCDA Awards

教育部中国高等教育学会学科竞赛排行榜赛项

全国大学生数字媒体科技作品及创意竞赛

www.cmit.cn 数字未来 ⊙ 创意无限

甘肃赛区：

三等奖

证书编号：2025195578

关注微信公众号

参赛学校：兰州理工大学

参赛作品：墨里时光--书吧改造设计

作品分类：人居环境设计

指导老师：毕晓莉

团队成员：朱紫维

作品赛道：本科及以上学历

全国大学生数字媒体科技作品及创意竞赛组委员会

中国人工智能学会

2025年10月

米兰设计周 CHINA COLLEGIATE DESIGN COMPETITION & EXHIBITION | 2025
中国高校设计学科师生优秀作品展

获奖证书

米兰设计周中国高校设计学科师生优秀作品展
甘肃赛区

三等奖

作品编号：538899

参赛组别：本科研究生组

作品类别：非命题赛场（图片类）

作者姓名：武彦玮、郭莉莉、苏迪

作品名称：素盒——交往行为特征研究下的锦州中小学生素质拓展基地方案设计

指导老师：毕晓莉

参赛单位：兰州理工大学

米兰设计周-中国高校设计学科
师生优秀作品展组委会

2025年5月

投稿网站　微信公众号

证书编号：202500FM62010S030ML538899

NCDA AWARDS 未来设计师 全国高校数字艺术设计大赛

12th National College Digital Art&Design Awards

2024 NCDA Awards

第12届未来设计师·全国高校数字艺术设计大赛

甘肃赛区

三等奖

作品名称：“回归自然”—银川中山公园景观改造设计

作者姓名：郭莉莉、李秀琴、边婧

参赛组别：研究生组

作品类别：人居环境规划与设计

参赛院校：兰州理工大学

指导老师：毕晓莉

证书编号：NCDA12S3N1262002G1D301101

验证网址：https://www.ncda.org.cn

未来设计师·全国高校数字艺术设计大赛组委会

2024年8月

FUTURE DESIGNER · NCDA Awards

教育部中国高等教育学会学科竞赛排行榜赛项

全国大学生数字媒体科技作品及创意竞赛

www.cmit.cn 数字未来 ⊙ 创意无限

甘肃赛区：

三等奖

证书编号：2025228272

关注微信公众号

参赛学校：兰州理工大学

参赛作品：丫山元宇宙空间设计—鸟类观察站

作品分类：元宇宙及科幻数字作品

指导老师：毕晓莉

团队成员：南旭元

作品赛道：本科及以上学历

全国大学生数字媒体科技作品及创意竞赛组委会

中国人工智能学会

2025年10月

米兰设计周 CHINA COLLEGIATE DESIGN COMPETITION & EXHIBITION | 2025
中国高校设计学科师生优秀作品展

获奖证书

米兰设计周中国高校设计学科师生优秀作品展
甘肃赛区

三等奖

作品编号：400591

参赛组别：本科研究生组

作品类别：非命题赛场（图片类）

作者姓名：卜宇星

作品名称：未来绿洲-编织城市梦想

指导老师：张新红

参赛单位：兰州理工大学

米兰设计周-中国高校设计学科
师生优秀作品展组委会

2025年5月

投稿网站　微信公众号

证书编号：202500FM62010S030ML400591

荣誉证书

兰州理工大学

刘传奇、侯祖行、王志璀、许超前同学：

指导老师：杨鹏源、牛全福

荣获第二届“南方杯”安宁五校战略联盟测量技能大赛四等水准测量项目 **二等奖**

特发此证 以资鼓励

西北师范大学教务处　兰州交通大学教务处　甘肃农业大学教务处　甘肃政法学院教务处　兰州城市学院教务处

二〇一八年十一月三日

荣誉证书

兰州理工大学

任杰、袁鹰、张文杰、苏瑞鹏同学：

指导老师：杨鹏源、牛全福

荣获第三届“南方杯”安宁五校战略联盟测量技能大

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教务处 教务处 教务处 教务处 教务处

二〇一八年十一月三日

中国国际大学生创新大赛（2025）兰州理工大学校赛

获奖证书

高敏、郭莉莉、武彦玮、苏迪同学：

你们的作品《让工业建筑活起来——AIGC赋能下的工业遗产修复创意互动平台》，在中国国际大学生创新大赛(2025)兰州理工大学校赛中荣获

铜奖

指导教师：毕晓莉

特发此证，以资鼓励。

兰州理工大学创新创业学院

二〇二五年六月

证书号第12975332号

实用新型专利证书

实用新型名称：一种城市医疗设施规划布局用的标识装置

发　明　人：李鸿飞;何颖茹;杨芷琼;杨雪莲;艾博茎;于水童;郭姝婕
刘奔腾;蔺慧媛

专　利　号：ZL 2020 2 2187141.2

专利申请日：2020年09月29日

专利权人：兰州理工大学

地　　址：730050 甘肃省兰州市七里河区兰工坪路287号

授权公告日：2021年04月16日　　授权公告号：CN 212990626 U

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局长
申长雨

国家知识产权局

2021年04月16日

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证 书 号 第 12975332 号

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甘 肃 省 工 程 建 设 标 准 设 计

DBJT25-212-2024

建筑标准设计图集

甘24J1　　工程做法

《工程做法》
编审名单

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项目技术负责人： 裴昕昕　华维军

主　编　单　位： 兰州有色冶金设计研究院有限公司

参　编　单　位： 甘肃省建筑科学研究院（集团）有限公司
兰州理工大学
中国市政工程西北设计研究院有限公司

ICS 93.080.10
CCS P 66

DB62

甘 肃 省 地 方 标 准

DB62/T 5075—2024

国省干线货车停车场设计规范

Code for design of truck parking national and provincial trunk lines

2024－12－31 发布　　2025－03－31 实施

甘肃省市场监督管理局　　发 布

前　言

本文件按照GB/T 1.1—2020《标准化工作导则　第1部分：标准化文件的结构和起草规则》的规定起草。

请注意本文件的某些内容可能涉及专利。本文件的发布机构不承担识别专利的责任。

本文件由甘肃省交通运输厅提出并监督实施。

本文件由甘肃省交通运输标准化技术委员会归口。

本文件起草单位：甘肃省交通规划勘察设计院股份有限公司、甘肃新发展城市开发建设运营集团有限公司、甘肃省高速公路运营服务中心、兰州理工大学。

本文件主要起草人：臧兴震、曹永军、来文森、邹维军、曹凯频、刘奔腾、王恒、雷凯、陈国瑞、沈映春。

本文件由甘肃省交通规划勘察设计院股份有限公司负责解释。

ICS 03.220.20
CCS R 10

DB62

甘 肃 省 地 方 标 准

DB62/T 4134—2024
代替 DB62/T 4134—2020

高速公路服务区设计规范

Code for design of expressway service area

2024－12－31 发布　　2025－03－31 实施

甘肃省市场监督管理局　　发 布

前　言

本文件按照GB/T 1.1—2020《标准化工作导则　第1部分：标准化文件的结构和起草规则》的规定起草。

本文件替代DB62/T 4134—2020《高速公路服务区设计规范》，与DB62/T 4134—2020相比，除结构调整和编辑性改动外，主要技术变化如下：

——删除了术语加速车道、减速车道、贯穿车道、连接匝道、快速充（换）电站、第三卫生间、母婴室、司机之家、设备用房、标识牌（见 2020 年版的 3.3、3.4、3.5、3.6、3.9、3.11、3.12、3.13、3.14、3.15）；

——增加了术语可视化交互应用、可视化交互服务（见 3.8、3.9）；

——更改了服务区功能配置推荐表（见 5.2.2，2020 年版的 5.2.2）；

——更改了服务区各类设施建设面积规模推荐表（见 5.3，2020 年版的 5.3）；

——删除了服务区匝道、贯穿车道布置示意图（见 2020 年版的 6.1.1）；

——删除了服务区竖向设计的相关要求（见 2020 年版的 7.1.1）；

——更改了服务区竖向设计原则（见 7.1.1、7.1.2，2020 年版的 7.1.2）；

——更改了中型车区及小型车区布设要求（见 7.3.3，2020 年版的 7.3.2）；

——更改了快速充（换）电站、房车驿站布设要求（见 7.3.5，2020 年版的 7.3.6）；

——增加了特大件货物运输车辆的布设要求（见 7.3.6）；

——更改了停车区中停车位数量推荐值（见 7.3.10，2020 年版的 7.3.9）；

——增加了充电站设计要求（见 7.4）；

——删除了道路路线方向及位置确定原则 （见 2020 年版的 7.4.1）；

——删除了行车道应满足特殊车辆等的通行要求（见 2020 年版的 7.4.6）；

——删除了服务区内道路与地下工程管线的埋设要求（见 2020 年版的 7.4.7）；

——更改了服务区室外工程管线布设要求（见 7.6.1，2020 年版的 7.5.1）；

——更改了服务区综合楼的总体要求（见 8.1.1，2020 年版的 8.1）；

——更改了服务区综合楼公共服务空间的相关要求（见 8.2.1，2020 年版的 8.2.1）；

——更改了服务区综合楼公共厕所的相关表述（见 8.2.2，2020 年版的 8.2.2）；

——更改了服务区综合楼超市的相关表述（见 8.2.3，2020 年版的 8.2.3）；

——更改了服务区综合楼餐厅及厨房的相关表述（见 8.2.4，2020 年版的 8.2.4）；

——更改了服务区综合楼客房的相关要求（见 8.2.5，2020 年版的 8.2.5）；

——更改了服务区综合楼商业业态的相关要求（见 8.2.6，2020 年版的 8.2.6）；

——更改了高速公路服务区员工宿舍配置推荐表（见 8.3.3，2020 年版的 8.3.3）；

——删除了汽车修理间面积大小设计要求（见 2020 年版的 8.4.2）；

——删除了临近城市景区等路段汽车修理间设置功能（见 2020 年版的 8.4.5）；

——删除了设备用房符合国家现行有关标准的规定的要求（见 2020 年版的 8.5.1）；

——删除了旅游景点服务区设计要求（见 2020 年版的 9.5）；

——更改了给排水系统的总体要求（见 11.1.1、1.1.2、11.1.3，2020 年版的 11.1.1）；

——更改了计量装置的相关规定（见 11.1.6，2020 年版的 11.1.4）；

——更改了供配电系统的相关规定（见 11.1.7，2020 年版的 11.1.5）；

——更改了计量装置的相关规定（见 11.1.6，2020 年版的 11.1.4）；

——增加了水质的相关规定（见 11.2.1）；
——增加了给水系统技术措施的相关规定（见 11.2.2）；
——增加了热水系统的相关规定（见 11.2.4）；
——增加了非饮用水系统的相关规定（见 11.2.5）；
——更改了污水收集系统的相关表述（见 11.2.7，2020 年版的 11.2.4）；
——增加了污水处理设施的相关规定（见 11.2.8）；
——增加了房车驿站给排水设施的相关规定（见 11.2.9）；
——增加了分项计量的相关规定（见 11.3.1.4）；
——增加了水平平衡的相关规定（见 11.3.1.5）；
——删除了热源设置位置的相关规定（见 2020 年版的 11.3.1.1）；
——删除了供暖方式选择的相关表述（见 2020 年版的 11.3.1.2）；
——删除了管道补偿的相关规定（见 2020 年版的 11.3.1.6）；
——增加了补风系统的相关规定（见 11.3.3.4）；
——更改了供电半径的相关规定（见 11.4.2, 2020 年版的 11.4.2）；
——增加了照度的相关规定（见 11.4.4）；
——更改了照度的其他规定（见 11.4.4, 2020 年版的 11.4.5）；
——更改了灯具的相关规定（见 11.4.5, 2020 年版的 11.4.6）；
——增加了光伏发电系统的相关规定（见 11.4.10、11.4.11）；
——增加了充电的相关规定（见 11.4.12、11.4.13、11.4.14）；
——删除了污废水的相关表述（见 2020 年版的 12.2）；
——删除了过路烟气的相关规定（见 2020 年版的 12.3.2）；
——增加了服务区智慧化建设相关内容（见第 13 章）；
——更改了绿色服务区的相关规定（见 15.1.1、15.1.2、15.1.3, 2020 年版的 14.1.1、14.1.2、14.1.3）；
——删除了场地规划的相关表述（见 2020 年版的 14.2）；
——增加了空气源热泵的相关规定（见 15.4.4）；
——删除了电气智能化管理的相关规定（见 2020 年版的 14.6）。

请注意本文件的某些内容可能涉及专利。本文件的发布机构不承担识别专利的责任。

本文件由甘肃省交通运输厅提出并监督实施。

本文件由甘肃省交通运输标准化技术委员会归口。

本文件起草单位：甘肃省高速公路服务集团有限公司、甘肃省交通规划勘察设计院股份有限公司、兰州理工大学、兰州交通大学。

本文件主要起草人：张升伟、刘建国、李怀珠、周彦红、王鸣捷、臧兴震、马俊、刘奔腾、许星晨、关惠元。

本文件由甘肃省高速公路服务集团有限公司负责解释。

证书号第8028664号

外观设计专利证书

外观设计名称：室内定位感应器（室内设计）

设　　计　　人：史佳欣;毕晓莉

专　　利　　号：ZL 2023 3 0056344.4

专利申请日：2023年02月17日

专　利　权　人：兰州理工大学

地　　址：730000 甘肃省兰州市七里河区兰工坪路287号

授权公告日：2023年04月28日　　授权公告号：CN 308004662 S

国家知识产权局依照中华人民共和国专利法经过初步审查，决定授予专利权，颁发外观设计专利证书并在专利登记簿上予以登记。专利权自授权公告之日起生效。专利权期限为十五年，自申请日起算。

专利证书记载专利权登记时的法律状况。专利权的转移、质押、无效、终止、恢复和专利权人的姓名或名称、国籍、地址变更等事项记载在专利登记簿上。

局长
申长雨

国家知识产权局

2023年04月28日

其他事项参见续页

证书号第8028664号

专利权人应当依照专利法及其实施细则规定缴纳年费。本专利的年费应当在每年02月17日前缴纳。未按照规定缴纳年费的，专利权自应当缴纳年费期满之日起终止。

申请日时本专利记载的申请人、设计人信息如下：

申请人：

兰州理工大学

设计人：

史佳欣;毕晓莉

证书号第8102988号

外观设计专利证书

外观设计名称：变形灯（室内）

设　　计　　人：王冉;毕晓莉

专　　利　　号：ZL 2023 3 0089052.0

专利申请日：2023年03月03日

专　利　权　人：兰州理工大学

地　　址：730000 甘肃省兰州市七里河区兰工坪路287号

授权公告日：2023年06月13日　　授权公告号：CN 308079682 S

国家知识产权局依照中华人民共和国专利法经过初步审查，决定授予专利权，颁发外观设计专利证书并在专利登记簿上予以登记。专利权自授权公告之日起生效。专利权期限为十五年，自申请日起算。

专利证书记载专利权登记时的法律状况。专利权的转移、质押、无效、终止、恢复和专利权人的姓名或名称、国籍、地址变更等事项记载在专利登记簿上。

局长
申长雨

国家知识产权局
2023年06月13日

其他事项参见续页

证书号第8102988号

专利权人应当依照专利法及其实施细则规定缴纳年费。本专利的年费应当在每年03月03日前缴纳。未按照规定缴纳年费的，专利权自应当缴纳年费期满之日起终止。

申请日时本专利记载的申请人、设计人信息如下：

申请人：

兰州理工大学

设计人：

王冉;毕晓莉

证书号第8089951号

外观设计专利证书

外观设计名称：隔断墙（室内设计）

设　　计　　人：王冉;毕晓莉

专　　利　　号：ZL 2023 3 0114635.4

专利申请日：2023年03月14日

专　利　权　人：兰州理工大学

地　　址：730000 甘肃省兰州市七里河区兰工坪路287号

授权公告日：2023年06月06日　　授权公告号：CN 308070518 S

国家知识产权局依照中华人民共和国专利法经过初步审查，决定授予专利权，颁发外观设计专利证书并在专利登记簿上予以登记。专利权自授权公告之日起生效。专利权期限为十五年，自申请日起算。

专利证书记载专利权登记时的法律状况。专利权的转移、质押、无效、终止、恢复和专利权人的姓名或名称、国籍、地址变更等事项记载在专利登记簿上。

局长
申长雨

国家知识产权局
2023年06月06日

其他事项参见续页

证书号第8089951号

专利权人应当依照专利法及其实施细则规定缴纳年费。本专利的年费应当在每年03月14日前缴纳。未按照规定缴纳年费的，专利权自应当缴纳年费期满之日起终止。

申请日时本专利记载的申请人、设计人信息如下：

申请人：

兰州理工大学

设计人：

王冉;毕晓莉

证书号第22755272号

专利公告信息

实用新型专利证书

实用新型名称：一种设计图架

专 利 权 人：兰州理工大学

地　　址：730000 甘肃省兰州市七里河区兰工坪路287号

发 明 人：史佳欣;毕晓莉

专 利 号：ZL 2024 2 1420187.6　　授权公告号：CN 222764953 U

专利申请日：2024年06月20日　　授权公告日：2025年04月18日

申请日时申请人：兰州理工大学

申请日时发明人：史佳欣;毕晓莉

国家知识产权局依照中华人民共和国专利法进行审查，决定授予专利权，并予以公告。

专利权自授权公告之日起生效。专利权有效性及专利权人变更等法律信息以专利登记簿记载为准。

局长
申长雨

国家知识产权局

2025年04月18日

证书号第22789402号

专利公告信息

实用新型专利证书

实用新型名称：一种基于变电站主控通信楼的顶层阳光房

专 利 权 人：兰州理工大学

地　　址：730050 甘肃省兰州市七里河区西湖街道兰工坪287号兰州理工大学

发 明 人：毕晓莉;冯泳洁;龚美玲

专 利 号：ZL 2024 2 0622593.4　　授权公告号：CN 222797160 U

专利申请日：2024年03月28日　　授权公告日：2025年04月25日

申请日时申请人：兰州理工大学

申请日时发明人：毕晓莉;冯泳洁;龚美玲

国家知识产权局依照中华人民共和国专利法进行审查，决定授予专利权，并予以公告。

专利权自授权公告之日起生效。专利权有效性及专利权人变更等法律信息以专利登记簿记载为准。

局长
申长雨

国家知识产权局
2025年04月25日

荣誉证书

中国能源建设集团甘肃省电力设计院有限公司

兰州理工大学

贵单位申报的 能动陇上 乐享农耕—通渭县常家河镇胜义村光伏扶贫村级电站规划设计获评“为世界塑造美”工程创新设计与建造

优秀案例

中国能源建设股份有限公司

二〇二四年五月二十八日

获奖证书

张新红同志：

您主持完成的《甘肃河谷城市公共步行空间无障碍设计研究》课题经专家组评审，被评为“甘肃省残疾人基本服务状况和需求数据动态更新调查成果应用研究”科研成果三等奖，特发此证。

课题组成员：张新红 刘奔腾 李鸿飞 闫海龙 李沁鞠 杨仕恩

课题承担单位：兰州理工大学

证书编号：GSDPF-SKYJ3-01

甘肃省残疾人联合会

2018年2月8日

荣誉证书

兰州理工大学建筑勘察设计院有限责任公司　刘奔腾、毕晓莉、李力、马刘全、彭双、陈宇、曹静、马丽、李志文、杨振亮等同志参加设计的甘肃省康县岸门口镇朱家沟村传统村落保护与发展规划项目，被评为2020年度甘肃省优秀工程勘察设计二等奖。特发此证。

甘肃省人力资源和社会保障厅　　甘肃省住房和城乡建设厅　　甘肃省自然资源厅

二〇二一年九月十五日

荣誉证书

兰州理工大学建筑勘察设计院有限责任公司 刘奔腾、毕晓莉、李力、马刘全、曹静、马丽、李志文、杨振亮、彭双、陈宇等同志参加设计的康县城区生态修复与城市修补专项规划项目，被评为2020年度甘肃省优秀工程勘察设计三等奖。特发此证。

甘肃省人力资源和社会保障厅　甘肃省住房和城乡建设厅　甘肃省自然资源厅

二〇二一年九月十五日

成果应用证明

兰州理工大学建筑与艺术设计学院完成的“扎根陇原·工程赋能：新时代西部乡村建设高层次复合型人才培养模式探索与实践”教学成果，对我院乡村振兴方向的研究生培养发挥了引领与支撑作用。

该成果提出的“扎根陇原”的地域坚守与“工程赋能”的跨学科理念，启发我院在乡村振兴方向研究生培养中，更加注重西部地域特色与工科优势的深度融合。我院借鉴其以“三育融合”为内核、以“四向协同”为支撑、以“五链贯通”为驱动的研究生培养体系，优化了相关专业的人才培养方案。

该成果所构建的西部乡村建设特色课程模块，为我院相关课程建设提供了重要参照。其系统梳理的甘肃及西北地区乡村建设典型案例，已转化为我院研究生课堂教学的专题内容，有效弥补了以往教学案例的地域性不足。

长安大学建筑学院

2026 年 2 月 8 日

成果应用证明

兰州理工大学建筑与艺术设计学院围绕国家乡村振兴战略，探索形成了以“工程赋能”为导向的西部乡村建设高层次复合型人才培养模式，并在我院研究生教学与人才培养过程中得到有效推广应用。

该成果以真实乡村建设情境为依托，将工程技术、空间设计与乡土文化有机融合，有效提升了研究生面向复杂乡村问题的综合分析能力与实践创新能力。其在教学中强化问题导向与项目驱动，引导研究生深入理解乡村建设中的技术逻辑与文化价值，对完善我院乡村振兴相关课程体系、优化实践教学模式具有重要借鉴意义。

通过应用该成果，我院在乡村振兴领域的人才培养质量得到显著提升，研究生在服务地方建设、参与实际工程项目及开展相关学术研究方面的能力明显增强。

宁夏大学建筑学院

2026 年 1 月 2 日

成果应用证明

兰州理工大学建筑与艺术设计学院关于城乡规划与地域文化保护领域的研究成果，自引入青海大学城乡规划专业教学以来，已在人才培养与课程建设中取得显著成效。该成果依托兰州理工大学在西北地域建筑、城乡遗产保护、生态城市规划等领域的学术积累，涵盖人居环境与城乡生态保护、城市更新与空间形态发展、城乡历史文化遗产保护与传承等研究方向，已被有效融入我系城乡规划专业的核心课程教学，特别是在城市设计概论、城乡历史与文化保护概论等课程中引入前沿理论与西北地区实践案例，拓展了学生的学术视野。

青海大学土木水利学院建设与管理系

2026 年 3 月 2 日

成果应用证明

兰州理工大学建筑与艺术设计学院依托“扎根陇原·工程赋能：新时代西部乡村建设高层次复合型人才培养模式探索与实践”教学成果，将其产出的研究与教学资源系统融入我院乡村振兴领域的研究生培养与教学实践之中，并得到广泛推广和应用。

该成果立足西北地域特征，构建了面向传统村落认知、分析与保护的系统知识框架，将自然环境、历史演进与聚落空间形态有机整合，为研究生理解乡村人居环境演变规律与开展相关研究提供了重要支撑。在教学过程中，该成果有效融入课程体系与科研训练环节，强化了研究生的问题导向意识与田野调查能力，提升了其在传统村落保护与乡村振兴领域的综合研究与实践能力。

通过应用该成果，我院在乡村振兴相关方向的研究生培养质量得到明显提升，对完善西部地区乡村建设类高层次人才培养体系具有积极借鉴与示范意义。

西藏大学工学院

2026 年 2 月 8 日

内蒙古工业大学建筑学院

ᠥᠪᠥᠷ ᠮᠣᠩᠭᠣᠯ ᠶᠡᠬᠡ ᠰᠤᠷᠭᠤᠯᠢ ᠤᠨ ᠪᠠᠷᠢᠯᠭ ᠤᠨ ᠰᠤᠷᠭᠤᠯ

成果应用证明

兰州理工大学建筑与艺术设计学院完成的“扎根陇原·工程赋能：新时代西部乡村建设高层次复合型人才培养模式探索与实践”教学成果，已在内蒙古工业大学建筑学院研究生培养及教学科研工作中得到深入应用，取得显著成效。

依托该教学成果，两校建立了常态化的人才联合培养与学术交流机制。双方通过联合开展乡村建设田野调查、共建地域聚落研究数据库、互派研究生参与科研项目等方式，实现了教学资源与科研平台的深度共享。两校研究生在联合调研中互学互鉴，在跨地域比较研究中深化对西部乡村建设复杂性与多样性的理解，显著提升了系统思维、工程意识与协同创新能力。该成果的应用有力促进了两校在服务西部乡村振兴战略中的协同发力，为培养具有跨区域视野的高层次乡村建设人才探索出有效路径。

该成果以其系统的理论框架、丰富的本土案例和成熟的培养模式，对我院研究生培养质量提升及两校深度合作发挥了重要支撑作用，具有显著的示范价值和推广意义。

内蒙古工业大学建筑学院

2026年2月8日

成果应用证明

兰州理工大学建筑与艺术设计学院依托“扎根陇原·工程赋能：新时代西部乡村建设高层次复合型人才培养模式探索与实践”教学成果，将其产出的研究与教学资源系统融入我院乡村振兴领域的研究生培养与教学实践之中，并得到广泛推广和应用。

该成果立足西部地域特征，构建了面向传统村落认知、分析与保护的系统知识框架，将自然环境、历史演进与聚落空间形态有机整合，为研究生理解乡村人居环境演变规律与开展相关研究提供了重要支撑。在教学过程中，该成果有效融入课程体系与科研训练环节，强化了研究生的问题导向意识与田野调查能力，提升了其在传统村落保护与乡村振兴领域的综合研究与实践能力。

通过应用该成果，我院在乡村振兴相关方向的研究生培养质量得到明显提升，对完善西部地区乡村建设类高层次人才培养体系具有积极借鉴与示范意义。

西南民族大学建筑学院

2026 年 2 月 8 日

成果应用证明

兰州理工大学建筑与艺术设计学院围绕西部传统村落保护与乡村建设形成的相关研究成果，已在我院研究生教学与人才培养中得到有效应用。

该成果立足区域实践，系统构建了传统村落空间形态认知与分析的方法体系，将历史演进、空间结构与人居环境特征有机整合，为研究生开展乡村遗产保护与乡村振兴相关研究提供了重要理论支撑与方法指导。在教学与科研训练过程中，相关成果的引入有效强化了研究生的空间分析能力与田野研究能力，促进其形成面向复杂乡村问题的综合研究思维与实践能力。

通过应用该成果，我院在乡村振兴相关方向的研究生培养质量得到持续提升，对完善西部地区乡村建设与遗产保护领域高层次人才培养模式具有积极的示范与推广价值。

昆明理工大学建筑与城市规划学院

2026年3月2日

成果应用证明

兰州理工大学建筑与艺术设计学院完成的“扎根陇原 •工程赋能：新时代西部乡村建设高层次复合型人才培养模式探索与实践”教学成果，已在我院艺术设计学院环境设计专业教学中得到深入应用，在生态环境设计人才培养方面取得良好成效。

该成果将西北地域生态特征与工程实践理念融入环境设计教学，为我院优化人居环境方向课程体系、丰富生态设计教学内容提供了重要支撑。依托该成果对甘肃典型村落空间形态与营建智慧的系统梳理，我院引导学生深入理解传统聚落中蕴含的生态智慧——从村落选址与自然地形地貌的有机融合，到乡土建筑营建中就地取材、适应气候的低环境影响手法，这些内容有效补充了具有西北地域特色的生态环境设计教学资源，拓展了师生对人与自然和谐共生传统营建理念的认知视野。

该成果的应用不仅提升了环境相关专业教学在生态保护与绿色设计方面的针对性和实践性，也为我院开展西北地区乡村人居环境改善、生态景观修复等科研实践提供了理论支撑与方法参考。

兰州交通大学艺术设计学院

2026 年 3 月 4 日

成果应用证明

兰州理工大学建筑与艺术设计学院刘奔腾教授所著《甘肃传统村落》及其相关研究成果，已在我院美术学院环境设计专业教学中得到深入应用，取得显著成效。该成果以甘肃自然地理与历史演变为背景，将全省传统村落划分为陇中、陇东南、甘南、河西四个片区进行系统梳理，从村落选址格局、传统建筑特色、多民族交融空间形态等维度构建了完整的地域研究框架。我院环境设计专业依托该成果，在《乡土建筑》《人居环境设计》等课程中引入河口村、连城村、街亭村等典型村落的田野调查案例，丰富了西北地域特色的教学资源。该成果的应用有效提升了我院师生对甘肃传统聚落空间形态的认知深度，为环境设计专业的课程教学、毕业设计及服务地方乡村振兴实践提供了重要理论支撑与方法参考。

西北民族大学美术学院

2026 年 1 月 2 日

成果应用证明

兰州理工大学建筑与艺术设计学院完成的“扎根陇原·工程赋能：新时代西部乡村建设高层次复合型人才培养模式探索与实践”教学成果系统回应了西部乡村建设对高层次复合型人才的迫切需求，其核心理念与实践路径已深度融入我院人才培养体系，产生了积极而深远的影响。

该成果提出的“扎根陇原”的地域坚守与“工程赋能”的跨学科融合理念，深刻启发了我院对乡村振兴人才培养定位的重新思考。该成果多年来深耕陇原大地，系统梳理的甘肃及西北地区乡村建设典型案例库，直接转化为我院实践课堂教学的专题内容和经典案例。无论是河西走廊的传统聚落形态研究，还是陇南山地的乡村更新实践，这些鲜活的本土案例有效弥补了以往教学中“重普适性理论、轻地域性案例”的不足，极大丰富了建筑设计类专业教学资源，使我院实践课堂教学更贴近西部乡村建设实际，为培养建筑设计类专业高技能人才提供了重要教学案例资源。

甘肃建筑职业技术学院人居工程学院

2026 年 3 月 2 日

成果应用证明

兰州理工大学建筑与艺术设计学院“扎根陇原·工程赋能：新时代西部乡村建设高层次复合型人才培养模式探索与实践”教学成果已在我司人员培养及规划设计咨询工作中得到深入应用。

该成果立足西部乡村建设实际需求，构建了多学科交叉融合的课程体系与培养模式。其核心教学理念强调以真实地域性工程项目驱动教学，将乡村聚落空间优化、地域文化传承保护、工程技术与设计深度融合等内容贯穿于人才培养全过程。成果中相关乡村保护与发展的理论方法，以及针对不同地貌特征提出差异化规划策略的研究路径，为我司在参与西北地区历史文化名镇保护、传统村落更新、乡村基础设施完善等项目中，提供了系统的理论支撑与方法指导。

通过将该成果的教学模式与案例引入我司的实践培养环节，显著提升了相关人员的系统思维、工程意识与服务乡村建设的综合能力。

中规院（北京）规划设计有限公司西北分公司

2026 年 2 月 20 日

中国城市发展研究院有限公司西北研究院

成果应用证明

兰州理工大学建筑与艺术设计学院完成的“扎根陇原·工程赋能：新时代西部乡村建设高层次复合型人才培养模式探索与实践”教学成果已在我院规划咨询及研究生培养工作中得到深入应用。

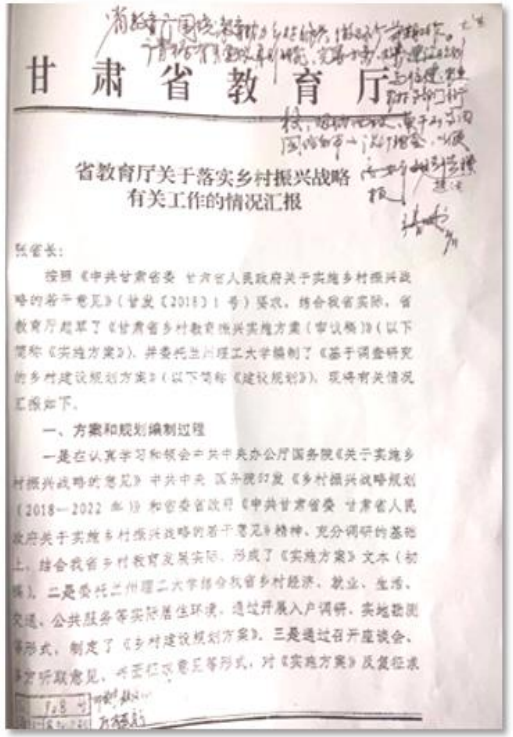
该成果立足西部乡村建设实际需求，构建了多学科交叉融合的课程体系与培养模式。其核心教学理念强调以真实地域性工程项目驱动教学，将乡村聚落空间优化、地域文化传承保护、工程技术与设计深度融合等内容贯穿于人才培养全过程。成果中关于乡村保护与发展的理论方法，以及针对不同地貌特征提出差异化规划策略的研究路径，为我院在参与西北地区历史文化名镇保护、传统村落更新、乡村基础设施完善等项目中，提供了系统的理论支撑与方法指导。

通过将该成果的教学模式与案例引入我院员工实践培养环节，显著提升了相关人员的系统思维、工程意识与服务乡村建设的综合能力。该成果对我院培养扎根西部、具备多学科视野和工程实践能力的高层次乡村建设人才具有重要的推广价值。

中国城市发展研究院有限公司西北研究院

2026 年 2 月 5 日

科研成果受到省市各级部门的肯定，收到了良好的社会效果。



甘肃省教育厅

省教育厅关于落实乡村振兴战略有关工作的情况汇报

副省长的批示

甘肃省自然资源厅关于2021年度优秀村庄规划案例评选结果的通知

甘肃省自然资源厅 营城设计咨询 2022-08-05 17:00 发表于甘肃

甘肃省自然资源厅

政府信息公开

甘肃省自然资源厅关于2021年度优秀村庄规划案例评选结果的通知

甘肃省自然资源厅关于2021年度优秀村庄规划案例评选结果的通知

甘资规划函〔2022〕86号

各市、州自然资源局，兰州新区、甘肃矿区自然资源局，各相关单位：

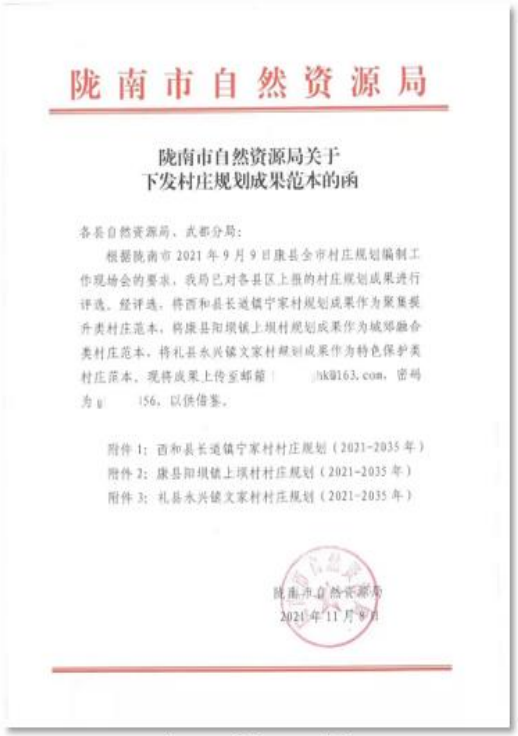
为加快推进村庄规划编制工作，总结和交流各地村庄规划编制工作经验，我厅组织村庄规划相关领域专家评选出2021年度优秀村庄案例，现将评选结果印发你们（见附件）。相关案例将在“甘肃省自然资源厅”官网上陆续发布，请各地认真学习、参考、借鉴。并继续做好2022年度优秀村庄规划案例推荐工作。

甘肃省自然资源厅

2022年8月4日

附件：

省厅的推广



陇南市自然资源局

陇南市自然资源局关于
下发村庄规划成果范本的函

各县自然资源局，武都分局：

根据陇南市2021年9月9日康县全市村庄规划编制工作现场会的要求，我局已对各县区上报的村庄规划成果进行评选。经评选，将西和县长道镇宁家村规划成果作为聚集提升类村庄范本，将康县阳坝镇上坝村规划成果作为城郊融合类村庄范本，将礼县永兴镇文家村规划成果作为特色保护类村庄范本。现将成果上传至邮箱[redacted]，密码为[redacted]，以供借鉴。

附件1：西和县长道镇宁家村村庄规划（2021-2035年）
附件2：康县阳坝镇上坝村村庄规划（2021-2035年）
附件3：礼县永兴镇文家村村庄规划（2021-2035年）

陇南市自然资源局
2021年11月9日

市局的示范

设计服务

甘肃省2026年国家级高等教育（研究生）教学成果奖培育推荐书

发布时间:2026-03-23

甘肃省2026年国家级高等教育（研究生）教学成果奖培育推荐书

成　果　名　称　扎根陇原 工程赋能：新时代西部乡村建设高层次复合型人才培养式探索与实践

成果主要完成人　张立峰　刘奔腾　何　毅　牛全福　曾　彪　毕晓莉　张新红　余　勇　安玉源　董建红

成果主要完成单位　兰州理工大学　兰州交通大学　兰州大学

推荐等级建议　特等奖

推荐单位名称及盖章　兰州理工大学

推　荐　时　间　2026　年　3　月　18　日

成　果　科　类　工学(08)

类别代码 0 8

推荐序号 1 0 7 3 1 0 1

下一条：设计艺术学院开展兰州理工大学学位证书和毕业证书设计作品海选活动