



中国科技核心期刊 河南省自然科学一级期刊  
科学出版社合作期刊

ISSN1004-3918  
CN41-1084/N

河南科学

# 河南科学

HENAN SCIENCE

第40卷 第5期 Vol. 40 No. 5 | 2022

二〇二二年五月

第四十卷

第五期

968-086

科学出版社



科学出版社  
Science Press

河南省科学院 主管 主办

# 河南科学

2022年 第40卷 第5期

## 目次

### 数学研究与信息科学

- 自适应高斯变异花授粉算法 ..... (689)  
李文超 贺兴时 贺飞跃 杨新社
- 基于微惯性传感器的行人室内定位方法 ..... (701)  
冯冲 孙宇 黄亮
- 基于新型混合智能算法的图像分割方法 ..... (709)  
刘俊梅 马永刚

### 建筑科学与工业技术

- 基于SVM的自密实水泥土强度预测模型研究 ..... (714)  
王响 邵应峰 沈霞 张燧 张子阳
- 空间变异液化夹层位置对盾构隧道地震响应影响规律研究 ..... (719)  
娄建高 许昊 张弛 慈伟
- 大庆长垣南部扶余油层高阻水层成因机理 ..... (726)  
刘闯
- 基于光纤感测技术的雪花形桩挤土效应模型试验研究 ..... (732)  
高磊 钱继奔 徐中权 陈和进 袁泽
- 基于霍夫直线检测的输电导线过热检测方法研究 ..... (739)  
刘云飞 李光泽 韩岳松 张新春

### 生命科学与环境科学

- 冰核蛋白对冻结与消融速度影响研究 ..... (745)  
陆丹旭 龚建英 何延青 郭嘉宇 李润玲
- 改性烟草秸秆生物炭对水中Cd<sup>2+</sup>和Cu<sup>2+</sup>的吸附特性 ..... (750)  
李海华 王志琛 张恒 王魁英 程新惠 王家琪

河南省生态系统脆弱性评价及时空变化特征分析 .....	(759)
马  进	
黄河流域PM <sub>2.5</sub> 浓度时空演变及其与城镇化的关系 .....	(769)
涂田云  杨东阳  苗长虹  张  晗	
基于MSPA模型的登封市生态网络构建与优化 .....	(776)
姚新治  杨  航  王立涛  许  磊  何鹏飞  田国行	

## 区域经济与管理科学

长江经济带生态福利绩效空间差距及动态演变 .....	(785)
樊媛媛  闫  莹  杜  苇	
淮海经济区城乡融合与绿色化耦合协调的空间分异格局 .....	(794)
马芳芳  张孟想  丁志伟	
乡镇经济发展水平的空间影响力差异与功能分区研究——以河南省澠池县为例 .....	(806)
张鹏博  丁志伟  赵  芮	
乡村振兴背景下林业与乡村旅游耦合发展分析——以河南省为例 .....	(815)
秦  怡  陈明珠  李喜梅	

## “双碳”研究专题

“双碳”目标倒逼下能源安全与能源系统可持续性协调发展研究 .....	(822)
白如月  李彦华  焦德坤	
中国省域碳减排能力时空格局演化研究 .....	(833)
李苏伦  张克勇	
碳约束下中国区域能源利用效率与经济增长非线性异质关联研究 .....	(843)
李治国  李莹莹  车  帅	
我国天然气消费与碳效率优化的耦合协调研究 .....	(853)
李宏勋  宋  臻  王晓涵	

# HENAN SCIENCE

Vol.40 No.5 2022

## CONTENTS

### Mathematics Research and Information Science

- Adaptive Gaussian Mutation Flower Pollination Algorithm ..... (689)  
LI Wenchao, HE Xingshi, HE Feiyue & YANG Xinshe
- Pedestrian Indoor Positioning Method Based on Micro Inertial Sensor ..... (701)  
FENG Chong, SUN Yu & HUANG Liang
- Image Segmentation Method Based on Novel Hybrid Intelligent Algorithm ..... (709)  
LIU Junmei & MA Yonggang

### Construction Science and Industrial Technology

- Research on Strength Prediction Model of Self-compacting Cement Soil Based on SVM ..... (714)  
WANG Xiang, SHAO Yingfeng, SHEN Xia, ZHANG Yi & ZHANG Ziyang
- Study on the Influence of Spatial Variation Liquefaction Interlayer Location on Seismic Response of Shield Tunnel ..... (719)  
LOU Jianguo, XU Hao, ZHANG Chi & CI Wei
- Genetic Mechanism of High Resistivity Water Layer in the Fuyu Oil Layer of Southern Daqing Placanticline ..... (726)  
LIU Chuang
- Model Test Study on the Compacting Effect of Snowflake-shaped Pile Based on Optical Fiber Monitoring Technology ..... (732)  
GAO Lei, QIAN Jiben, XU Zhongquan, CHEN Hejin & YUAN Ze
- Overheating Detection Method of Transmission Line Based on Hough Linear Detection ..... (739)  
LIU Yunfei, LI Guangze, HAN Yuesong & ZHANG Xinchun

### Life Science and Environmental Science

- Effects of Ice Nucleoprotein on Freezing and Ablation Rates ..... (745)  
LU Danxu, GONG Jianying, HE Yanqing, GUO Jiayu & LI Runling
- Adsorption Characteristics of Cd<sup>2+</sup> and Cu<sup>2+</sup> in Water by Modified Tobacco Straw Biochar ..... (750)  
LI Haihua, WANG Zhichen, ZHANG Heng, WANG Kuiying, CHENG Xinhui & WANG Jiaqi

Ecosystem Vulnerability Assessment and Spatial-temporal Variation Analysis in Henan Province ..... (759)  
MA Jin

Temporal and Spatial Evolution Relationship Between PM<sub>2.5</sub> Concentration and Urbanization in the Yellow River  
Basin ..... (769)  
TU Tianyun, YANG Dongyang, MIAO Changhong & ZHANG Han

Construction and Optimization of Dengfeng City Ecological Network Based on MSPA Model ..... (776)  
YAO Xinzhi, YANG Hang, WANG Litao, XU Lei, HE Pengfei & TIAN Guohang

## **Regional Economy and Management Science**

Spatial Disparity and Dynamic Evolution of Ecological Welfare Performance in the Yangtze River Economic  
Belt ..... (785)  
FAN Yuanyuan, YAN Ying & DU Wei

Spatial Differentiation Pattern in the Coupling and Coordination of Urban-Rural Integration and Greening in  
Huaihai Economic Zone ..... (794)  
MA Fangfang, ZHANG Mengxiang & DING Zhiwei

Study on Spatial Influence Difference and Functional Zoning of Township Economic Development Level  
..... (806)  
ZHANG Pengbo, DING Zhiwei & ZHAO Rui

Coupling Development of Forestry and Rural Tourism under the Background of Rural Revitalization: A Case  
Study of Henan Province ..... (815)  
QIN Yi, CHEN Mingzhu & LI Ximei

## **Special Column of “Dual Carbon” Research**

Research on the Coordinated Development of Energy Security and Energy System Sustainability under the  
“Dual Carbon” Goal ..... (822)  
BAI Ruyue, LI Yanhua & JIAO Dekun

Evolution of Temporal and Spatial Pattern of China’s Provincial Carbon Emission Reduction Ability ..... (833)  
LI Sulun & ZHANG Keyong

Research on Nonlinear Heterogeneous Correlation Between Regional Energy Utilization Efficiency and Economic  
Growth in China under Carbon Constraint ..... (843)  
LI Zhiguo, LI Yingying & CHE Shuai

Research on Coupling and Coordination Between Natural Gas Consumption and Carbon Efficiency Optimization  
in China ..... (853)  
LI Hongxun, SONG Zhen & WANG Xiaohan