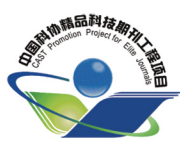


《中文核心期刊要目总览》收录  
Ei Compendex(核心版)收录  
百种中国杰出学术期刊  
RCCSE中国权威学术期刊



ISSN 1002-6819  
CN 11-2047/S  
CODEN NGOXEO  
www.tcsae.org

# 农业工程学报

NONGYE  
GONGCHENG  
XUEBAO

TRANSACTIONS OF THE CHINESE SOCIETY  
OF AGRICULTURAL ENGINEERING

2022年 02  
第38卷 VOL. 38



中国科学技术协会 主管

中国农业工程学会 主办



# 农业工程学报

2022 年 1 月 第 2 期 (总第 426 期) 第 38 卷

## 目次

### · 农业装备工程与机械化 ·

基于 MBD-DEM 耦合的联合收获机割台仿形机构设计与试验

..... 金诚谦, 刘岗微, 倪有亮, 杨腾祥, 王廷恩, 齐彦栋 (1)

大豆联合收获机对称可调式凹板筛设计与试验 ..... 康家鑫, 王修善, 谢方平, 罗 曜, 李 奇, 陈志刚 (11)

基于浸入边界法的翼型俯仰振摆动态特性 ..... 阚 阚, 李昊宇, 吕 品, 徐宇航, 郑 源, 徐 辉 (23)

苜蓿振动压缩成型过程中的力链演变 ..... 杜海君, 雷 霆, 张永安, 武 佩, 马彦华, 布 库 (33)

基于最优分布拟合的拖拉机三点悬挂牵引力载荷谱编制与台架试验

..... 王 玲, 宗建华, 王 禹, 扶兰兰, 毛 旭, 王书茂 (41)

### · 农业水土工程 ·

基于雨养指示线的灌溉概率指数计算与验证 ..... 朱秀芳, 刘 莹, 徐 昆 (50)

考虑可动-不动水体假设的河套灌区适宜秋灌定额 UBMOD 模拟 ..... 毛 威, 朱 焱, 伍靖伟, 杨金忠 (58)

基于水平吸渗确定土壤水分扩散率的解析-修正法

..... 帅嘉伟, 龙 平, 胡世丽, 王观石, 杨耀杰, 罗嗣海 (67)

基于 Hydrus-1D 的黄河泥沙充填复垦土壤夹层结构优化 ..... 王晓彤, 胡振琪, 梁宇生 (76)

拔节期水分冗余胁迫对淮北平原夏玉米产量形成机制的影响

..... 王成雨, 慕 丽, 李森郁, 鲁溢超, 陈 飞, 吕秋实, 乔明辉, 晏小凤, 李 欢, 朱英华 (87)

水肥耦合对基质栽培番茄产量及品质的影响 ..... 赵文举, 马 锋, 曹 伟, 马芳芳, 韩 丽 (95)

用于水肥系统的养分离快检装置研制与试验 ..... 张俊卿, 陈翔宇, 王儒敬, 刘 宜, 李 伟, 李梦雅 (102)

黑土表层有效养分含量和酶活性对雪被去除的季节性响应

..... 王子龙, 王 凯, 姜秋香, 刘传兴, 单家珣, 滕怀湜 (111)

基于 DSSAT-Canegro 模型的广西来宾市甘蔗生长对气象干旱的响应

..... 杨云川, 张会娅, 程禹灏, 廖丽萍, 杨家祯, 邓思敏, 谢鑫昌 (119)

超纤渗灌对绿色屋顶土壤水分和蒸散发的影响 ..... 吴昕宇, 张清涛, 黄思宇, 王志强 (131)

考虑水库来用水过程关联性的多维随机动态规划算法

..... 郭爱军, 畅建霞, 王义民, 黄 强, 吴 彬, 张 春 (139)

极端降雨条件下秸秆覆盖坡面水流流速空间分布 ..... 王 伟, 陈 杨, 庄晓晖, 马玉莹 (149)

基于边缘检测算法的坡面薄层水流深度测量系统研制

..... 朱 昱, 罗泉达, 田 野, 赖剑锋, 蒋芳市, 张 越, 葛宏力, 黄炎和, 林金石 (157)

## · 农业信息与电气技术 ·

- 自适应加权算子结合主曲线提取玉米叶片点云骨架 ..... 胡建平, 刘 凯, 郭新宇, 吴 升, 温维亮 (166)
- 基于特征转移植被指数的水稻叶片氮素含量定量估算 ..... 于丰华, 邢思敏, 郭忠辉, 白驹驰, 许童羽 (175)
- 植物三维建模 ICP 点云配准优化 ..... 陆健强, 兰玉彬, 毋志云, 梁 效, 常虎虎, 邓小玲, 吴泽锦, 唐亚战 (183)
- 水体强反光环境中无人机多光谱影像的辐射一致性校正  
..... 席顺忠, 李 勇, 葛 莹, 吴 彤, 任孟杰, 袁晓慧, 庄翠珍 (192)
- 结合三维密集点云的无人机影像大豆覆盖度提取 ..... 何海清, 严柳丽, 凌梦云, 杨勤锐, 陈 婷, 李 麟 (201)
- 基于主被动遥感数据和面向对象的大蒜识别 ..... 马战林, 薛华柱, 刘昌华, 李长春, 房 旭, 周俊利 (210)

## · 农业生物环境与能源工程 ·

- 添加秸秆对水稻产量和土壤碳氮及微生物群落的影响  
..... 管方圆, 刘 琛, 傅庆林, 李 鹏, 林义成, 郭 彬 (223)
- 不同温度下水稻秸秆多孔生物炭结构与电化学性能  
..... 牛文娟, 邓继猛, 冯雨欣, 钟 菲, 李楚仪, 吴 可, 曹红亮 (231)
- 装配式配种妊娠猪舍冬季保温与能耗特征  
..... 王美芝, 李斯旋, 王 华, 阳林芳, 张校军, 游筱彤, 吴中红, 刘继军 (241)
- 基于热红外图像的奶牛乳区温度分布与乳房炎识别方法  
..... 郭艳娇, 杨圣慧, 迟 宇, 吴聪明, 许红岩, 沈建忠, 郑永军 (250)
- 基于辐射供热和个性化送风的分娩猪舍环境保障系统 ..... 刘营芳, 黄子硕 (260)

## · 土地保障与生态安全 ·

- 集成“适宜性-集聚性-稳定性”的永久基本农田储备区划定  
..... 翁 睿, 金晓斌, 张晓琳, 韩 博, 顾铮鸣, 周寅康 (269)
- GEE 联合多源数据的西安市土地利用时空格局及驱动力分析  
..... 杨丽萍, 张 静, 贡恩军, 刘 曼, 任 杰, 王 宇 (279)
- 内蒙古边际土地油莎豆种植及生产潜力评估 ..... 张鑫彤, 吴秀芹 (289)

## · 农产品加工工程 ·

- 射频辅助热风干燥对红枣脆片质构特性和微观结构的影响  
..... 牛玉宝, 姚雪东, 肖红伟, 王冬冬, 郑 霞, 王 强, 朱荣光, 臧永镇, 刘 欢 (296)
- 基于近红外光谱技术的眉茶拼配比例预测方法 ..... 宋 彦, 汪小中, 赵 磊, 张 叶, 宁井铭, 程福寿 (307)
- 燕麦抗冻蛋白对冻藏期间速冻饺子皮品质的影响  
..... 张艳杰, 王金慧, 刘胜男, 潘治利, 李 真, 范会平, 艾志录 (316)
- 低温水提松茸免疫活性因子的试验研究 ..... 杜汉廷, 葛 麒, 林松毅, 陈 冬 (323)

致谢：感谢中国农业大学沈建忠院士团队提供的“奶牛养殖场转盘式挤奶厅”。

**Transactions**  
**of the Chinese Society of Agricultural Engineering**  
**Vol.38 No.2 (Total No.426) Jan. 2022**  
**CONTENTS**

**• Agricultural Equipment Engineering and Mechanization •**

- Design and experiment of header profiling mechanism for combine harvester based on MBD-DEM coupling  
..... *Jin Chengqian, Liu Gangwei, Ni Youliang, Yang Tengxiang, Wang Ting'en, Qi Yandong* (1)
- Design and experiment of symmetrical adjustable concave for soybean combine harvester  
..... *Kang Jiabin, Wang Xiushan, Xie Fangping, Luo Yao, Li Qi, Chen Zhigang* (11)
- Dynamic characteristics of pitching airfoil based on immersed boundary method  
..... *Kan Kan, Li Haoyu, Lyu Pin, Xu Yuhang, Zheng Yuan, Xu Hui* (23)
- Evolution of force chain in vibration compression of alfalfa  
..... *Du Haijun, Lei Ting, Zhang Yong'an, Wu Pei, Ma Yanhua, Bu Ku* (33)
- Compilation and bench test of traction force load spectrum of tractor three-point hitch based on optimal distribution fitting  
..... *Wang Ling, Zong Jianhua, Wang Yu, Fu Lanlan, Mao Xu, Wang Shumao* (41)

**• Soil and Water Engineering •**

- Calculation and verification of the irrigation probability index using rain-fed indicator line  
..... *Zhu Xiufang, Liu Ying, Xu Kun* (50)
- Numerical simulation of the suitable autumn irrigation quota in the Hetao Irrigation District considering the assumption of mobile-immobile water..... *Mao Wei, Zhu Yan, Wu Jingwei, Yang Jinzhong* (58)
- Analytical-modified method for determining soil water diffusivity based on horizontal imbibition  
..... *Shuai Jiawei, Long Ping, Hu Shili, Wang Guanshi, Yang Yaojie, Luo Sihai* (67)
- Structural optimization of reclaimed subsidence land interlayers filling with the Yellow River sediments using a Hydrus-1D model ..... *Wang Xiaotong, Hu Zhenqi, Liang Yusheng* (76)



Effects of water redundancy stress at the jointing stage on the yield formation mechanism of summer maize in Huaibei Plain of China ..... *Wang Chengyu, Mu Li, Li Senyu, Lu Yichao, Chen Fei, Lyu Qiushi, Qiao Minghui, Yan Xiaofeng, Li Huan,*

*Zhu Yinghua* (87)

Effects of water and fertilizer coupling on the yield and quality of tomatoes

..... *Zhao Wenju, Ma Feng, Cao Wei, Ma Fangfang, Han Li* (95)

Development and experiment of the rapid detection device of the nutrient ion concentrations for fertigation system

..... *Zhang Junqing, Chen Xiangyu, Wang Rujing, Liu Yi, Li Wei, Li Mengya* (102)

Seasonal response of available nutrient content and enzyme activity in black soil surface to snow removal

..... *Wang Zilong, Wang Kai, Jiang Qiuxiang, Liu Chuanxing, Shan Jiaxun, Teng Huaihao* (111)

Effects of meteorological drought on sugarcane growth using DSSAT-Canegro model in Laibin, Guangxi of China

..... *Yang Yunchuan, Zhang Huiya, Cheng Yuhao, Liao Liping, Yang Jiazhen, Deng Simin, Xie Xinchang* (119)

Effects of microfiber capillary wicking irrigation on soil moisture and evapotranspiration of green roofs

..... *Wu Xinyu, Zhang Qingtao, Huang Siyu, Wang Zhiqiang* (131)

Multi-dimensional stochastic dynamic programming algorithms considering the relevancy between streamflow and water demand ..... *Guo Aijun, Chang Jianxia, Wang Yimin, Huang Qiang, Wu Bin, Zhang Chun* (139)

Spatial distribution of overland flow velocity along straw-mulched slope under extreme rainfall

..... *Wang Wei, Chen Yang, Zhuang Xiaohui, Ma Yuying* (149)

Development of the depth measurement system for shallow flow on slopes using an edge-detection algorithm

..... *Zhu Yu, Luo Quanda, Tian Ye, Lai Jianfeng, Jiang Fangshi, Zhang Yue, Ge Hongli, Huang Yanhe, Lin Jinshi* (157)

## • Agricultural Information and Electrical Technologies •

Point cloud skeleton extraction of maize leaves based on adaptive weighting operator and principal curve

..... *Hu Jianping, Liu Kai, Guo Xinyu, Wu Sheng, Wen Weiliang* (166)

Remote sensing inversion of the nitrogen content in rice leaves using character transfer vegetation index

..... *Yu Fenghua, Xing Simin, Guo Zhonghui, Bai Juchi, Xu Tongyu* (175)

Optimization of ICP point cloud registration in plants 3D modeling

..... *Lu Jianqiang, Lan Yubin, Wu Zhiyun, Liang Xiao, Chang Huhu, Deng Xiaoling, Wu Zejin, Tang Yazhan* (183)

Radiometric consistency correction of UAV multispectral images in strong reflective water environment

..... *Xi Shunzhong, Li Yong, Ge Ying, Wu Tong, Ren Mengjie, Yuan Xiaohui, Zhuang Cuizhen* (192)

Extraction of soybean coverage from UAV images combined with 3D dense point cloud

..... *He Haiqing, Yan Yeli, Ling Mengyun, Yang Qinrui, Chen Ting, Li Lin* (201)

Identification of garlic based on active and passive remote sensing data and object-oriented technology

..... *Ma Zhanlin, Xue Huazhu, Liu Changhua, Li Changchun, Fang Xu, Zhou Junli* (210)

### • Agricultural Bioenvironmental and Energy Engineering •

Effects of straw addition on rice yield, soil carbon, nitrogen, and microbial community

..... *Guan Fangyuan, Liu Chen, Fu Qinglin, Li Peng, Lin Yicheng, Guo Bin* (223)

Structure and electrochemical performances of porous biochar from rice straw at different temperatures

..... *Niu Wenjuan, Deng Jimeng, Feng Yuxin, Zhong Fei, Li Chuyi, Wu Ke, Cao Hongliang* (231)

Thermal insulation and energy consumption characteristics of an assembled piggery for breeding and gestation in winter

..... *Wang Meizhi, Li Sixuan, Wang Hua, Yang Linfang, Zhang Xiaojun, You Xiaotong, Wu Zhonghong, Liu Jijun* (241)

Recognizing mastitis using temperature distribution from thermal infrared images in cow udder regions

..... *Guo Yanjiao, Yang Shenghui, Chi Yu, Wu Congming, Xu Hongyan, Shen Jianzhong, Zheng Yongjun* (250)

Thermal environment regulation and energy consumption of delivery pigsty based on radiation and personalized ventilation

..... *Liu Yingfang, Huang Zishuo* (260)

### • Land Security and Ecological Safety •

Delimitating permanent prime farmland reserve areas on the perspective of suitability-cluster-stability

..... *Weng Rui, Jin Xiaobin, Zhang Xiaolin, Han Bo, Gu Zhengming, Zhou Yinkang* (269)

Analysis of spatio-temporal land-use patterns and the driving forces in Xi'an City using GEE and multi-source data

..... *Yang Liping, Zhang Jing, Gong Enjun, Liu Man, Ren Jie, Wang Yu* (279)

Cultivation and production potential evaluation of *Cyperus esculentus* L. in marginal land of Inner Mongolia

.....Zhang Xintong, Wu Xiuqin (289)

• **Agricultural Produce Processing Engineering** •

Effects of radio frequency assisted hot air drying on the texture and microstructure of jujube slices

..... Niu Yubao, Yao Xuedong, Xiao Hongwei, Wang Dongdong, Zheng Xia, Wang Qiang, Zhu Rongguang,

Zang Yongzhen, Liu Huan (296)

Predicting the blending ratio of Mee Tea based on near infrared spectroscopy

..... Song Yan, Wang Xiaozhong, Zhao Lei, Zhang Ye, Ning Jingming, Cheng Fushou (307)

Effects of oat antifreeze protein on quick-frozen dumpling wrapper during freezing and storage

..... Zhang Yanjie, Wang Jinhui, Liu Shengnan, Pan Zhili, Li Zhen, Fan Huiping, Ai Zhilu (316)

Experimental study on low-temperature water extraction of immunity active factors of *Tricholoma matsutake*

..... Du Hanting, Ge Qi, Lin Songyi, Chen Dong (323)