中国工程科技知识中心
China Knowledge Centre for Engineering Sciences and Technology

《智慧农业发展战略研究》专题快报

2022年第24期（总第63期）

中国工程科技知识中心农业分中心

中国农业科学院农业信息研究所　　2022年12月19日

【动态资讯】

1．智慧农业有范儿 颠覆种田“土”印象

【海南日报】“瓶中液体呈现土黄色，此次展示的是一周前进行培育的桥头地瓜，根须已经长到5厘米，且地瓜头部也开始发芽长叶，生长情况良好。”周春谷指着水培地瓜设备介绍说，此次展示的水培地瓜大部分根系生长在营养液液层中，只通过营养液为其提供水分、养分、氧气，给作物创造一个良好生存环境，强化作物自身的免疫能力，结合良种良法，从而种出好品质的作物。据了解，澄迈县为实现特色农作物的提质增效，通过引进专业技术公司，将“科研、推广、生产”相结合，创新现代技术模式，以桥头地瓜、澄迈福橙以及福山咖啡等多种特色农产品为样本，培育脱毒健康种苗，探索增产提质关键技术，并推进贮藏销售加工发展，让特色产业成为助推桥头地区农民增收产业振兴的新引擎。

链接:

http://agri.ckcest.cn/file1/M00/03/46/Csgk0Yf2_xaAQjwGAAFTLw3W8Gs891.pdf

2．立足国情推动我国智慧农业发展

【新京报】“当前，我国农业数字经济产业规模约6000亿，预计到2025年将翻倍达到1.26万亿。”在12月16日举行的“智慧农业创新院士论坛”上，中国工程院院士、中国农科院原院长唐华俊表示，“发展中国智慧农业，需结合中国实际情况，建立好数字技术落地的数字生态，进一步强化农业农村数据资源整合建设等。”

链接:

http://agri.ckcest.cn/file1/M00/10/18/Csgk0GOgSSuANL7xABiDsDutErQ767.pdf

【文献速递】

1．水果采摘机器人视觉系统与机械手研究进展

文献源：计算机工程与应用,2022-12-14

摘要：水果采摘机器人对实现水果装备自动化智能化具有重要意义。本文对近年国内外水果采摘机器人领域关键技术研究工作进行总结，根据水果采摘机器人的重要组成结构与关键技术，首先对水果采摘机器人视觉系统的关键技术：传统基于水果特征的图像分割方法如阈值法、边缘检测法、基于颜色特征的聚类算法与基于区域的图像分割算法，基于深度学习的目标识别算法以及目标果实的定位等进行分析和对比；总结了水果采摘机器人机械臂与末端执行器的技术发展现状，指出水果采摘机器人存在的问题；最后对未来水果采摘机器人的发展趋势及方向进行了展望，可为水果采摘机器人相关研究提供参考。

链接:

http://agri.ckcest.cn/file1/M00/03/46/Csgk0Yf2fnGAB1blABFkN2M3Fa4570.pdf

2．基于BiLSTM-CNN的水稻问句相似度匹配方法研究

文献源：中国农机化学报,2022-12-01

摘要：中国农技推广信息平台（NJTG）问答社区可以帮助用户与农业专家进行交互，从而获得精准的问题答案以解决农业场景问题。在平台问答社区中，每天会新增关于水稻的提问语句上千百条，检测相同语义问句是农业智能问答的关键技术环节，针对此问题采用字符级别的Word2Vec表示初始化问句表征，使用Siamese神经网络作为基础模型框架，学习句子的语义特征，获取上下文信息，然后使用BiLSTM长短期神经网络提取语义时序特征，最后在语义层次上使用一种包含语义信息的余弦函数计算问句相似度，并与其他语义匹配模型进行对比试验。通过构建7 820对水稻问句的相似对数据集，用来优化和训练模型的重要参数。试验结果表明：本文提出的BiLSTM-CNN模型可高效提取文本不同粒度的特征，提高水稻问句相似度匹配效果，在所构建的数据集上BiLSTM-CNN模型准确率和F1值均高于其他文本匹配模型，达到98.2%和88.75%。与此同时，所提出的模型在6种不同类别的水稻问句对的准确率也优于其他对比模型，在数据量较小的情况下，仍然可以取得较高的准确率，证明提出的模型具有良好的鲁棒性。

链接:

http://agri.ckcest.cn/file1/M00/03/46/Csgk0Yftru6AESqUAA5FTtbPmo4732.pdf

3．基于本体与认知经验的农业机器人视觉分类决策方法

文献源：农业机械学报,2022-11-30

摘要：基于小样本数据下认知经验知识辅助计算机进行决策，对实现农业领域机器人智

能认知决策与助力智慧农业发展具有重要意义。本文在统计计数、支持向量机（SVM）等图像属性信息学习方法基础上，使用Protégé等工具基于认知经验，构建水果识别分类的专业知识库；然后根据图像颜色与形状信息，进行知识库搜索推理得到分类决策。实验在Fruit360数据集中共选择2091幅葡萄、香蕉、樱桃水果图像作为测试集，并各挑选30幅图像作为属性信息训练集与验证集，结果表明当前数据下葡萄与樱桃的识别准确率为100%，香蕉识别准确率为93.30%。仅在知识库添加黄桃知识后，对984幅黄桃图像样本进行测试，其分类准确率为97.05%。表明本文方法能有效完成图像分类决策任务，且具有良好的过程可解释性、能力共享性和可拓展性。

链接:

http://agri.ckcest.cn/file1/M00/10/18/Csgk0GOW8k2ATt0FAAidSfIsCQo762.pdf

4．Comprehensive analysis of services towards enhancing security in IoT-based agriculture

文献源：ScienceDirect,2022-11-25

摘要：The Internet's ever-increasing popularity may be attributed to its ubiquitous accessibility. At this point, IoT has reached its pinnacle, with a wide variety of devices and appliances effectively linked to sensors & Internet, ushering in a new age of convenience and connectivity. It is challenging to secure because of the diverse combination of sensors, the Internet, and objects. Using Internet of Things (IoT) sensors, farmers may control their crops and agricultural fields remotely. Recent studies have concentrated on finding ways to improve precision agriculture's security infrastructure. Prior efforts to improve security services in the case of precision agriculture enabled by IoT have been minimal. By resolving issues related to cluster key management and overcoming obstacles associated with web interface configuration, the proposed work has established a novel approach that enables cluster key management to enhance security. Additionally, a web interface for gathering information from sensor nodes has been developed. After an IoT sensor detects a signal, the user may handle notifications using a web interface. When dealing with the vast infrastructure of IoT, it may be challenging to ensure the security of individual sensor nodes, particularly when only partial details about the hardware and the capacity for deployment are available. As a result, key management has emerged as a critical issue, especially in light of the node-capturing assault. Using the EBS function Object() { [native code] } and the Chinese remainder theorem, this research provides a new method of cluster key management that may improve agricultural accuracy. After collecting information from the nodes, the

Backend Server sends a filtered list, together with preloaded keys and an authentication code, to the Cluster Head. This system incorporates a secondary layer of encryption for further protection. Our proposed method outperforms existing strategies in terms of delivery success rate, energy efficiency, and packet loss.

链接:

http://agri.ckcest.cn/file1/M00/03/46/Csgk0Yf2-tuAI1PlAFK8d9xxLFM270.pdf

5．基于微水发电系统的智慧农业物联网设备研发及应用

文献源：排灌机械工程学报,2022-11-10

摘要：鉴于中国水资源短缺且农业灌溉用水有效利用率低的现状，为提高农业灌溉用水效率与效能，加快高科技智慧型农业设备研发与推广，降低农业投入以及农业用水的比例，采用数值模拟与模型试验相结合的方法，制定四因素三水平的正交试验优化方案，对9种不同方案在设计流量点处的新型微型管道水轮机性能进行计算，并进行物理模型试验验证.研究结果表明：水轮机内的压力脉动主要受到叶片通过频率和导叶通过频率的影响；在设计流量点处，优化后的水轮机出力为6.30 W，效率为85.13%，与初步设计方案相比，分别提高了32.35%和2.58%。同时研发了智慧农业物联网前端与终端系统，建立一个集自发电、环境监测、远程控制、情况预警、生长状况分析于一体的综合性农业物联网智能管理系统，极大地方便了用户，为实现智能化种植、养殖技术提供了一种切实可行的方案。

链接:

http://agri.ckcest.cn/file1/M00/03/46/Csgk0Yftp42AJZbNAAjnbeAXaZQ707.pdf

6．利用无人机高光谱估算冬小麦叶绿素含量

文献源：光谱学与光谱分析,2022-11-07

摘要：叶绿素含量（SPAD）是作物长势评价的重要指标，可以监测农作物的生长状况，对农业管理至关重要，因此快速、准确地估算SPAD具有重要意义。以冬小麦为研究对象，利用无人机高光谱获取了拔节期、挑旗期和开花期的影像数据，获取植被指数和红边参数，研究植被指数与红边参数估算SPAD的能力。先将植被指数与红边参数分别与不同生育期的SPAD进行相关性分析，再基于植被指数、植被指数结合红边参数，通过偏最小二乘回归（PLSR）方法估算SPAD,最后制作SPAD分布图验证模型的有效性。结果表明，（1）大部分植被指数与红边参数在3个主要生育期与SPAD相关性均达到极显著水平（0.01显著）;（2）单个植被指数构建的SPAD估算模型中，LCI表现最好（R^2=0.56, RMSE=2.96, NRMSE=8.14%）,红边参数中Dr/Drmin表现最好（R^2=0.49, RMSE=3.18,

NRMSE=8.76%）；（3）基于植被指数结合红边参数构建的SPAD估算模型效果最佳，优于仅基于植被指数构建的SPAD估算模型，同时，随着生育期推移，两种模型均在开花期达到最高精度，R^2分别为0.73和0.78, RMSE分别为2.49和2.22, NRMSE分别为5.57%和4.95%。因此，基于植被指数结合红边参数，并使用PLSR方法可以更好地估算SPAD, 可以为基于无人机遥感的SPAD监测提供一种新的方法，也可为农业管理提供参考。

链接:

http://agri.ckcest.cn/file1/M00/03/46/Csgk0Yf2gO2AVKtDAAieKUQQaps237.pdf

7．Prediction of exchangeable potassium in soil through mid-infrared spectroscopy and deep learning: From prediction to explainability

文献源：ScienceDirect,2022-10-18

摘要：The ability to characterize rapidly and repeatedly exchangeable potassium (Kex) content in the soil is essential for optimizing remediation of radiocaesium contamination in agriculture. In this paper, we show how this can be now achieved using a Convolutional Neural Network (CNN) model trained on a large Mid-Infrared (MIR) soil spectral library (40,000 samples with Kex determined with 1 M NH4OAc, pH 7), compiled by the National Soil Survey Center of the United States Department of Agriculture. Using Partial Least Squares Regression as a baseline, we found that our implemented CNN leads to a significantly higher prediction performance of Kex when a large amount of data is available (10000), increasing the coefficient of determination from 0.64 to 0.79, and reducing the Mean Absolute Percentage Error from 135% to 31%. Furthermore, in order to provide end-users with required interpretive keys, we implemented the GradientShap algorithm to identify the spectral regions considered important by the model for predicting Kex. Used in the context of the implemented CNN on various Soil Taxonomy Orders, it allowed (i) to relate the important spectral features to domain knowledge and (ii) to demonstrate that including all Soil Taxonomy Orders in CNN-based modeling is beneficial as spectral features learned can be reused across different, sometimes underrepresented orders.

链接:

http://agri.ckcest.cn/file1/M00/03/46/Csgk0Yf26PGASPUUACqP4nIdrho523.pdf

8．Explainable deep convolutional neural networks for insect pest recognition

文献源：ScienceDirect,2022-10-15

摘要：Fungal infestation of crops is critical to food security as it affects yield and quality of

production. Indeed, one element responsible for this situation is insect pests. Early detection of pests based on parcel images is a real challenge in the context of precision agriculture.Nowadays, technical advances in deep neural networks have led to better results in all areas, including crop health management in agriculture. Despite these satisfactory results of deep neural networks in image classification tasks, one of the drawbacks is that it is difficult to decode what the neural networks have learned.The proposed method consists of identifying and locating insect pests in crops using a Convolutional Neural Network (CNN). The localization of insects from the input data is based on explainability methods. For this, explainability highlights the colors and shapes captured by the CNNs using visualization maps. This provides opportunities for human interaction with the learning system for validation of the results provided by the CNN models.In this study, we used over 75,000 images for 102 different pest categories from the IP102 reference dataset. Various explainability methods are combined to formally interpret insect location. The degree of combination is quantified by the mutual information score. The obtained results allow a better interpretation of the reasoning performed by the deep learning system and identified an optimal number of feature extraction layers. Consequently, we simplified a CNN model by decreasing the number of network parameters by 58.90%. This facilitates their explanation in the field of plant science for the effective application in crop diagnosis.

链接:

http://agri.ckcest.cn/file1/M00/10/18/Csgk0GOgPliAPsKNALZSe-KCJOk828.pdf

9．Estimation of spinach (Spinacia oleracea) seed yield with 2D UAV data and deep learning

文献源：ScienceDirect,2022-10-09

摘要：Precision agriculture has drawn much attention in the last few years because of the benefits it has on reducing farming costs while maximizing the harvest obtained. Yield prediction is of importance for farmers to fertilize accordingly to reach the potential yield. However, this task is still relying on manual work, which is expensive and time-consuming. Instance segmentation has been implemented in the last years for fruit detection and yield estimation, obtaining state-of-the-art metrics, and reducing the labor required. This research presents a novel approach for spinach seed yield estimation for seed production purposes, that consists of correlating the number of plants and two phenotyping variables (plant area and canopy cover percentage) with the number of harvested seeds and the thousand seed

weight. Mask R-CNN is applied to count the number of detections of spinach plants and obtain the object mask from which the plant area is derived. The results show that there is a high linear correlation between a multivariate linear mixed model of the three variables and the number of seeds, with an R2adj of 0.80. Furthermore, 77.42% of the variation in the weight of thousand seeds can be explained by the number of plants. For future studies, the algorithm should be trained with more spinach images from different locations and under varying weather conditions to allow it to generalize for the crop worldwide. It can be concluded, until further research, that Mask R-CNN can be applied for spinach counting and the computation of its individual plant area, with promising results.

链接:

http://agri.ckcest.cn/file1/M00/10/18/Csgk0GOgMi2AYYw-AK_b4E06irs906.pdf

10．基于协同判读机制的养殖蟹塘遥感智能检测方法

文献源：自然资源遥感,2022-09-26

摘要：挖塘养蟹是耕地“非粮化”行为的一种，若不及时发现制止，将对国家粮食安全造成危害。为了应对这一行为在遥感智能解译工作中所存在的人工判读量大、核查效率不足的挑战，提出了一种基于协同判读机制的养殖蟹塘遥感智能检测方法，该方法集成了HRNet分割网络和Swin-Transformer分类网络模型，并进一步介入人工核查，提高检测精度和工作效率。以江苏省南京市高淳区为研究区域进行了实验，结果表明，提出的基于协同判读机制的耕地“非粮化”遥感智能检测方法能够自动筛去83.4%的待检测图斑，最终识别精度为0.972，可在大幅降低识别难度与人工核查工作量的同时提高检测精度，为实现准确高效的蟹塘等“非粮”地物检测提供可靠的解决思路。

链接:

http://agri.ckcest.cn/file1/M00/03/46/Csgk0Yf2g-KAGjkZAB_AmIn_kqs983.pdf

11．AgroKy: An approach for enhancing security services in precision agriculture

文献源：ScienceDirect,2022-09-17

摘要：Precision agriculture allows farmers to manage their crops and agriculture field remotely by making use of IoT sensor. Present research has focused on enhancement of security services in precision agriculture. In previous research limited work has been made to improve security services in case of IoT based precision agriculture. Considering issues of cluster key management and problems in web interface configuration proposed work has introduced novel approach that is allowing cluster key management to enhance security.

Moreover, web interface has been developed to capture the feedback from IoT sensor nodes. The web interface allows notification management after detecting signal from IoT sensor.

链接:

http://agri.ckcest.cn/file1/M00/10/18/Csgk0GOgRaWAKBhTADtr_yHvXHM579.pdf

12．遥感技术在苹果园精准种植管理中的应用现状及展望

文献源：自然资源遥感,2022-09-01

摘要：在果园种植管理向精准化和数字化发展的趋势下，苹果栽培对果园种植管理支撑技术提出了更高的要求。近些年，遥感技术的空间分辨率和重访频率不断突破，已经成为苹果园精准种植管理的主要支撑技术，然而目前尚没有综述文章进行这方面的现状梳理和展望，因此对这类研究进行总结很有必要。通过分析遥感技术在苹果园精准种植管理中的主要应用情况，将遥感技术的应用领域归纳为果园基础信息调查、果林参数反演和果园种植管理支撑3大类，并综述遥感技术在各领域中的应用方法、效果，探讨应用潜力。最后，总结出当前研究和应用存在机理性研究少且部分应用领域研究不足、多技术集成化程度不高、缺乏大范围的示范应用3类问题，并指出苹果树生长模拟机理模型、一体化苹果种植管理支撑系统、基于卫星数据的单木监测、遥感监测产品多元服务4个研究主题将成为下一步的研究和应用热点。

链接:

http://agri.ckcest.cn/file1/M00/10/18/Csgk0GOf0SSAejKkAA0UlexsfT4828.pdf

13．Real-time defect inspection of green coffee beans using NIR snapshot hyperspectral imaging

文献源：ScienceDirect,2022-08-27

摘要：Coffee beans are important agricultural commodities traded in the international market. Screening for defective beans is an important step before roasting. The main types of defective beans include black, fermented, moldy, insect damaged, shell, and broken. Insect-damaged beans are the most common type of defective beans. Previously, coffee beans were sorted manually, which was extremely labor intensive and prone to fatigue-induced errors, resulting in inconsistent quality. This study combines a near-infrared snapshot hyperspectral sensor and deep learning to create a multimodal real-time coffee-bean defect inspection algorithm (RT-CBDIA) for sorting defective green coffee beans. Furthermore, three convolutional neural networks (CNN) were designed to achieve real-time inspection, i.e., lean 2D-CNN, 3D-CNN, and 2D3D-merged CNN. Subsequently, principal component

analysis was used to select important bands. Our experimental results achieved an overall accuracy of 98.6% using 1026 green coffee-bean samples. Furthermore, the RT-CBDIA achieved a Kappa value of 97.2% and real-time sorting speeds. These achievements are considerably beneficial for subsequent applications and the commercialization of smart agriculture. Our main objective is to commercialize the proposed RT-CBDIA algorithm by combining it with a robot to create a comprehensive yet affordable coffee-bean real-time inspection system. It can be used to achieve real-time and noninvasive inspections while reducing labor costs. In the future, our real-time inspection system can also be applied to other crops to ultimately advance smart agriculture.

链接:

http://agri.ckcest.cn/file1/M00/03/46/Csgk0Yf280mAJbwcAL9iOmaWYRo556.pdf

14．基于YOLO__X和迁移学习的无人机影像玉米雄穗检测

文献源：农业工程学报,2022-08-08

摘要：玉米雄穗表型信息的获取对研究玉米长势及产量起着非常重要的作用，为实现复杂田间环境玉米雄穗的精确识别和计数，该研究使用无人机采集试验田的玉米雄穗影像，基于FasterR-CNN、SSD、YOLO__X目标检测模型，使用迁移学习方法实现玉米雄穗的高精度识别，并分析了模型对不同品种和不同种植密度的玉米雄穗检测效果。试验结果表明，基于迁移学习的FasterR-CNN、SSD、YOLO__X的目标检测效果相比于未使用迁移学习的模型有明显提升，其中，迁移学习后YOLO__X的识别精确度为97.16%，平均精度为93.60%，准确度为99.84%，对数平均误检率为0.22，识别效果最好；不同玉米品种对模型的适应性有所差异，其中郑单958对模型适应性最好，Faster R-CNN、SSD、YOLO__X的决定系数R~2分别为0.9474、0.9636、0.9712；不同种植密度下玉米雄穗的检测效果有所差异，在29985,44 978,67 466,89 955株/hm~2种植密度下，模型对郑单958检测的平均绝对误差分别为0.19、0.31、0.37、0.75，随着种植密度的增加，检测误差逐渐变大。研究为农田玉米雄穗高精度识别提供了一种可靠方法，对玉米表型性状高通量调查具有一定的应用价值。

链接:

http://agri.ckcest.cn/file1/M00/10/18/Csgk0GOW_k6AA4r5AD3_n0Rne9A313.pdf

15．智慧农业背景下的植物表型组学研究进展

文献源：河南农业科学,2022-07-15

摘要：我国农业正处于由传统农业转向现代化农业的关键阶段，智慧农业是现代化农业

发展的重要体现，是未来农业发展的必然趋势。智慧农业旨在将物联网、人工智能以及大数据等现代信息技术与传统农业深度结合，使农业生产实现智能化、绿色化、标准化、数字化。植物表型组学是研究植物表现型特征的科学，是智慧农业发展的关键技术之一，其通过采集细胞、器官、组织、植株以及群体各层面的表型数据，从海量数据中提取可重复性高、可信度高的重要性状信息，为基因挖掘、作物育种和农业生产过程精准管理提供数据支持和方法支撑。从表型数据采集、分析以及国内外植物表型分析平台建设方面综述了智慧农业背景下植物表型组学的发展现状，概述了植物表型组学研究在智慧农业生产中的应用，最后对植物表型组学未来发展趋势做出展望。

链接:

http://agri.ckcest.cn/file1/M00/10/18/Csgk0GOW9LSARmi2ABiYmaY5KV4969.pdf

16．基于ResNet18特征编码器的水稻病虫害图像描述生成

文献源：农业工程学报,2022-06-23

摘要：针对图像描述算法缺乏在农业领域中的应用，传统模型参数庞大的问题，该研究提出一种基于ResNet18特征编码器的图像描述算法，对作物患病类型进行识别并生成描述。首先，建立水稻病虫害图像描述数据集。其次，使用浅层ResNet18作为编码器，在保证特征提取能力的同时缩减网络模型大小，解码器使用融合了注意力机制的长短期记忆网络（Long Short Term Memory,LSTM）来生成图像描述。试验结果表明，改进后模型尺寸大小为原来的1/3，经过6 000次迭代后模型基本收敛，准确率达到98.48%。在水稻病虫害图像描述数据集上，改进编码器-解码器结构后的双语评估替换值（Bilingual Evaluation Understudy,BLEU）和METEOR（Metric for Evaluation of Translation with Explicit ORdering）分别达到0.752和0.404，其余指标结果也明显优于其他模型，具有描述细致准确、鲁棒性强等优点，能够更好地适用于小规模数据集上的训练，可为农作物相似病害特征的自动化描述提供有益参考。

链接:

http://agri.ckcest.cn/file1/M00/10/18/Csgk0GOfy5iAWCjcABqOwKWFE_4567.pdf

17．A survey of few-shot learning in smart agriculture: developments, applications, and challenges

文献源：BMC,2022-03-05

摘要：With the rise of artificial intelligence, deep learning is gradually applied to the field of agriculture and plant science. However, the excellent performance of deep learning needs to be established on massive numbers of samples. In the field of plant science and biology, it is

not easy to obtain a large amount of labeled data. The emergence of few-shot learning solves this problem. It imitates the ability of humans' rapid learning and can learn a new task with only a small number of labeled samples, which greatly reduces the time cost and financial resources. At present, the advanced few-shot learning methods are mainly divided into four categories based on: data augmentation, metric learning, external memory, and parameter optimization, solving the over-fitting problem from different viewpoints. This review comprehensively expounds on few-shot learning in smart agriculture, introduces the definition of few-shot learning, four kinds of learning methods, the publicly available datasets for few-shot learning, various applications in smart agriculture, and the challenges in smart agriculture in future development.

链接:

http://agri.ckcest.cn/file1/M00/10/18/Csgk0GOgKf2ALshKABw8ckjhTRc387.pdf

18．Review: Precision Livestock Farming technologies in pasture-based livestock systems

文献源：ScienceDirect,2021-12-22

摘要：Precision Livestock Farming (PLF) encompasses the combined application of single technologies or multiple tools in integrated systems for real-time and individual monitoring of livestock. In grazing systems, some PLF applications could substantially improve farmers' control of livestock by overcoming issues related to pasture utilisation and management, and animal monitoring and control. A focused literature review was carried out to identify technologies already applied or at an advanced stage of development for livestock management in pastures, specifically cattle, sheep, goats, pigs, poultry. Applications of PLF in pasture-based systems were examined for cattle, sheep, goats, pigs, and poultry. The earliest technology applied to livestock was the radio frequency identification tag, allowing the identification of individuals, but also for retrieving important information such as maternal pedigree. Walk-over-weigh platforms were used to record individual and flock weights. Coupled with automatic drafting systems, they were tested to divide the animals according to their needs. Few studies have dealt with remote body temperature assessment, although the use of thermography is spreading to monitor both intensively reared and wild animals. Global positioning system and accelerometers are among the most applied technologies, with several solutions available on the market. These tools are used for several purposes, such as animal location, theft prevention, assessment of activity budget, behaviour,

and feed intake of grazing animals, as well as for reproduction monitoring (i.e., oestrus, calving, or lambing). Remote sensing by satellite images or unmanned aerial vehicles (UAVs) seems promising for biomass assessment and herd management based on pasture availability, and some attempts to use UAVs to monitor, track, or even muster animals have been reported recently. Virtual fencing is among the upcoming technologies aimed at grazing management. This system allows the management of animals at pasture without physical fences but relies on associative learning between audio cues and an electric shock delivered if the animal does not change direction after the acoustic warning. Regardless of the different technologies applied, some common constraints have been reported on the application of PLF in grazing systems, especially when compared with indoor or confined livestock systems. Battery lifespan, transmission range, service coverage, storage capacity, and economic affordability were the main factors. However, even if the awareness of the existence and the potential of these upcoming tools are still limited, farmers' and researchers' demands are increasing, and positive outcomes in terms of rangeland conservation, animal welfare, and labour optimisation are expected from the spread of PLF in grazing systems.

链接:

http://agri.ckcest.cn/file1/M00/03/46/Csgk0Yf22lSAYmNaAA5gJ0iZDOU004.pdf

【会议论文】

1．A Survey on Wireless Sensor Networks and Instrumentation Techniques for Smart Agriculture

发布源：SpringerLink

发布时间：2022-07-23

摘要：Agriculture is the primary source for the development of our country's economy. It involves production, processing, marketing, and distribution of agricultural produce. Smart agriculture is one of the modern farming practices that increase the agricultural production in a most efficient manner. Smart agriculture involves wireless sensor networks (WSN) for various operations. Wide variety of sensors are used in WSN that assists farmers to know the statistical details of their field which helps them to take accurate decisions and provides instantaneous feedback for various agricultural parameters. Numerous researchers and manufacturers aim to develop real-time sensors based on different approaches, namely electromagnetic, electric, optical, mechanistic, acoustic, or electrochemical, which calculates the physical and chemical properties of soil in agricultural fields. The main objective of this study is to review the application of wireless sensors used in agriculture, the principle and

various instrumentation techniques in measuring different parameters in agriculture.

链接:

http://agri.ckcest.cn/file1/M00/03/46/Csgk0Yf24UCAaNtHAWw_KdteAX8659.pdf

---

主编：赵瑞雪　　本期编辑：陈亚东
地址：北京市海淀区中关村南大街12号　　邮编：100081
电话：010-82106649　　邮件地址：agri@ckcest.cn