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# 基于序列图像三维重建的稻种品种识别

# Variety identification of rice seed based on three-dimensional reconstruction method of sequence images

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中文关键词: 机器视觉 神经网络 图像识别 序列图像 三维重建 聚焦测度法DFF 品种 稻种

英文关键词:computer vision neural networks image recognition sequence image three-dimensional reconstruction depth from focus (DFF) variety rice seed

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中文摘要:

利用机器视觉技术识别稻种表面形态，从而识别种子纯度，可以为种子品质确定提供一种快速精确的技术方法。该文应用序列图像聚焦测度法进行了稻种三维重建，在稻种的品种识别中，将三维特征作为识别依据，相对传统方法仅采用二维图像特征作为识别手段，具有稻种形态测量参数值更精确，外观特征及缺陷表达更全面的优势。该方法通过分析显微镜平台获取的多幅不同对焦距离的图像序列，计算聚焦测度和焦点深度值。结合序列图像聚焦测度法与表面纹理重现，实现稻种形态表面三维重建。通过构造BP神经网络模型，利用测量所得三维立体特征值进行稻种的品种识别，筛选适合稻种检测的BP神经网络算法。试验结果表明，序列图像方法应用于稻种三维重建，其测量精度可达到5 μm，将测量所得的三维特征值作为参数进行5个稻种的品种识别，识别率在90%以上。该研究可为农作物品种识别中三维形态及纹理特征的研究提供参考。

英文摘要:

Abstract: Rice seed surface morphology is an important aspect of seed purity identification and recognition. Considering that artificial recognition and identification methods have some faults, which including low efficiency, high labor costs, and poor accuracy. So scientifically selecting quality rice seeds by using computer vision methods is important. Different models and methods have been established in the field of crop seed identification. Studies on rice seed speciation analysis methods indicate that the current detection methods in computer vision mainly analyze 2D information and that the use of 3D models is lacking. This paper proposes a 3D rice seed reconstruction system which can be used to measure the morphology of rice seed, with more accurate shape measure parameters and more comprehensive appearance characteristics and defect expression.In this paper, a new crop seed reconstruction system that supports fast and accurate recognition was designed to build a 3D surface morphology. The depth-from-focus (DFF) method was applied in the analysis of crop surface morphology. Image sequences were acquired by using a specific vision device through setting different distances between the camera lens and the rice seed. High-pass filtering was used to extract pixels and analyze strength value changes in the frequency domain. The second-order differential was employed to strengthen the value in the frequency domain by using the improved Laplacian operator. The threshold statistical analysis was conducted in pixel windows, by which each pixel generated a value which showed the focusing condition. The focusing measure of the image sequence effectively determined the estimated depth value of a pixel, and a focusing pixel stack could be defined based on these values. Using the characteristics of the Gaussian distribution of the focal depth estimation value, the Gaussian interpolation was calculated to obtain a more precise surface morphology depth value. As a result, a depth image collected based on the estimated depth value of the pixel was developed. Finally, through depth image smoothing and edge pixel processing, a 3D point cloud could be produced. Thus, a rice seed reconstruction system which can be used in rice seed identification and recognition was designed. This novel system supports three main patterns, namely, shape, texture, and 3D recognition.Through further calculations, the surface morphology characteristics of seed are obtained. The new 3D surface morphology reconstruction system can effectively overcome the deficiencies of traditional seed speciation analysis methods and can be served as an important reference for researchers. Finally, the BP neural network model was constructed to support the variety identification. Suitable neural network algorithm was selected for five different sorts of rice seed, and the final identification rate is 90%. The research can provide a reference for study of three-dimension shape and texture in automation crops variety identification field.

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