Development and evaluation of a new algorithm to extract morphological features from FESEM images: a case study on rice kernels

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The automatic extraction of morphological features from images is of fundamental importance for efficiently processing large datasets. In this research, a novel algorithm was developed to extract diverse morphological features from FESEM images, starting from a specific application on rice kernels. In this context, a dataset of 220 images from 54 distinct rice varieties was used to develop and test the algorithm [1]. The aim of this approach is to identify the round-shaped starch granules naturally present in rice kernels from FESEM greyscale images and extract a set of morphological features from them.
The algorithm follows a structured workflow that includes image segmentation, object identification, and feature extraction. Through these steps, it quantifies morphological features such as granule area, perimeter and eccentricity, as well as the number of detected objects, and the empty spaces between them, which correspond to kernel porosity (Figure 1). The use of adaptive thresholds and correction steps enhances robustness, enabling the analysis of diverse images while effectively filtering out defective objects and non-representative areas.

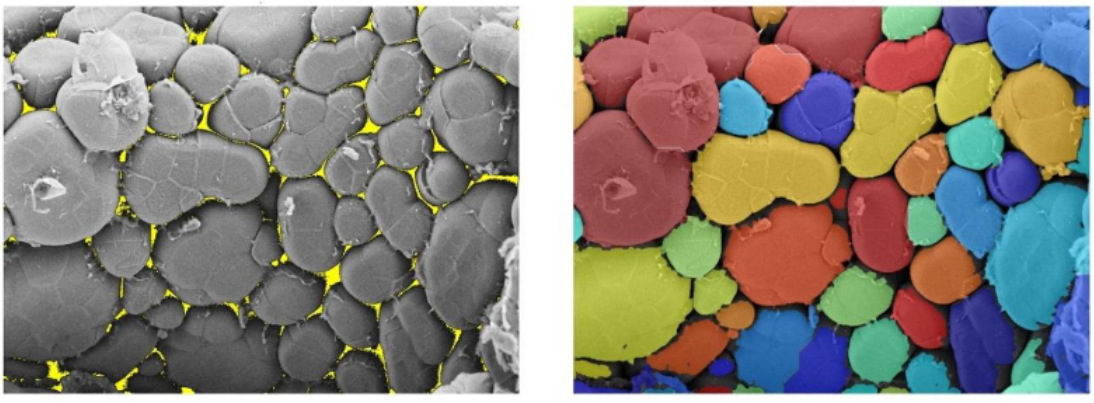

Figure 1. Output image generated by the algorithm. Left: representation of the empty spaces (in yellow) that correspond to the porosity. Right: representation of the starch particles identified by the algorithm and coloured differently to visualize the result obtained before the correction steps.

Furthermore, to evaluate and optimize the algorithm's performance, a Design of Exper-

iment (DoE) approach was employed to assess the influence of input parameters on the output results and on algorithm processing runtime. The experimental data were subsequently inspected using ANOVA Simultaneous Component Analysis (ASCA) and Multi-Linear Regression (MLR).

References

[1] F. Haxhari et al., "Endosperm structure and Glycemic Index of Japonica Italian rice varieties", Front Plant Sci, 2023 (14), doi: 10.3389/fpls.2023.1303771