

Development of an algorithm for separating densely contiguous wheat grains in 2D images

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Motivation and Aim: Counting grains manually is a labor-intensive and time-consuming task. Development of approaches based on image analysis by computer vision methods is relevant nowadays due to low cost and ease of use. Grains in such images are located close to each other, which complicates the process of their recognition. In addition, the characteristics of individual grains, such as length, width, volume, shape, color, and texture, are important in modern breeding and genetic experiments for the measurement of which grain boundaries must be precisely defined.

Methods and Algorithms: The algorithm consists of 2 main steps: preprocessing the image to obtain contours of grain groups and analyzing the obtained contours to separate contiguous seeds. The preprocessing consists of reducing the resolution of the image, removing noise using the Gaussian filtering method, and obtaining a binary mask using the Mean shift clustering algorithm and the OTSU algorithm. A combination of the corner point detection algorithm from [1, 2] and the elliptical contour analysis algorithm was used to analyze the obtained contours.

Results: The metric CR (correct ratio) [2] was used to evaluate the performance of the algorithm. A comparison was made with other commonly used classical computer vision approaches for object segmentation: the watershed algorithm and the erosion algorithm. The average value of the metric was 96 %, which is a higher result compared to other classical computer vision approaches.

Conclusion: The approach based on classic computer vision algorithms does not require image markup and allows counting the number and finding the contours of grains in loose arrangements. The algorithm using an approximation of the contour by ellipses significantly increases the accuracy of counting the number of grains using the corner point search algorithm.

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References

1. Tan S. et al. Segmentation and counting algorithm for touching hybrid rice grains. *Comp Electron Agriculture*. 2019;162:493-504
2. Zhang J. et al. Research on a rapid identification method for counting universal grain crops. *PloS One*. 2022;17(9): e0273785