

Improved prediction of soluble solid content of apple using a combination of spectral and textural features of hyperspectral images

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Abstract

We established prediction models based on the combination of spectral and different advanced image features to improve the prediction accuracy of solid-soluble content (SSC) of apple. Eight optimal wavelengths were selected using a new variable selection method called variable combination population analysis (VCPA). Image textural features of the first three principal component score images were obtained using a gray level co-occurrence matrix (GLCM) and a local binary pattern (LBP). Next, a random frog algorithm was developed to select optimal textural features for further analysis. A support vector regression (SVR) model based on spectral and different textural features was developed to predict the SSC of the apple. The model based on eight optimal wavelengths and nine optimal GLCM features of principal component images yielded the best result with the determination coefficient for prediction (R_p^2) of 0.9193, root mean square error for prediction (RMSEP) of 0.2955, and the ratio of the standard deviation of the prediction set to the root mean square error of prediction (RPD) with a value of 3.50. These results revealed that the spectral combined with optimal GLCM features from principal component images coupled with the SVR model has the potential for prediction of the SSC of apple.