Title Analysis of spatially resolved hyperspectral scattering images for assessing apple fruit firmness and soluble solids content

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Abstract

Hyperspectral scattering is a promising technique for nondestructive sensing of multiple quality attributes of apple fruit. This research evaluated and compared different mathematical models for describing the hyperspectral scattering profiles over the spectral region between 450 nm and 1000 nm in order to select an optimal model for predicting fruit firmness and soluble solids content (SSC) of 'Golden Delicious' apples. Ten modified Lorentzian distribution functions of various forms were proposed to fit the spectral scattering profiles at individual wavelengths, each of which gave superior fitting to the data with the average correlation coefficient (r) being greater than 0.995. Mathematical equations were derived to correct the spectral scattering intensity and distance by taking into account the instrument response and individual apples' size. The 10 modified Lorentzian distribution functions were compared for predicting fruit firmness and SSC using multi-linear regression and cross-validation methods. The modified Lorentzian function with three parameters (representing scattering peak value, width and slope) gave good predictions of fruit firmness with $r = 0.894$ and the standard error of prediction (S.E.P.) of 6.14 N, and of SSC with $r = 0.883$ and S.E.P. = 0.73%. Twenty-one and 23 wavelengths were needed to obtain the best predictions of fruit firmness and SSC, respectively. This new function, coupled with the scattering profile correction methods, improved the hyperspectral scattering technique for measuring fruit quality.