

## Abstract

Recently, a multispectral scattering method was proposed for measuring fruit firmness. The method is nondestructive, fast, and relatively easy to implement. The objective of this research was to compare multispectral scattering with visible/near-infrared (Visible/NIR) spectroscopy for measuring apple fruit firmness. A liquid crystal tunable filter based multispectral imaging system was assembled for measuring spectral scattering from apple fruit between 650 nm and 1000 nm. For comparison, a Visible/NIR spectroscopy system was used for acquiring reflectance spectra from apple fruit in transmittance mode between 500 nm and 1100 nm. Experiments with the two systems were performed on 'Red Delicious' and 'Golden Delicious' apples. A modified Lorentzian distribution function with four parameters was proposed for describing the scattering profiles of apple fruit at individual wave bands. A multi-linear regression model was developed for relating Lorentzian parameters to fruit firmness. The Lorentzian distribution function gave excellent fits to the spectral scattering profiles, including both saturation and scattering areas, with the average  $r$  equal to 0.999. Best firmness predictions from the multispectral scattering system were obtained with seven wavelengths (690, 770, 790, 810, 920, 980, and 1000 nm) for Red Delicious and eight wavelengths (650, 690, 740, 750, 820, 880, 910, and 990 nm) for Golden Delicious. With the optimal wavelengths, the multispectral scattering system predicted fruit firmness with  $r=0.82$  and  $0.81$  for Red Delicious and Golden Delicious, respectively, versus  $r=0.50$  and  $0.48$  from Visible/NIR spectroscopy. The multispectral scattering method is potentially useful for sorting and grading apples and other fruits for firmness.