

Title Hyperspectral reflectance and fluorescence line-scan imaging for online defect and fecal contamination inspection of apples

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Abstract

We have recently developed a rapid online line-scan imaging system capable of both hyperspectral Vis/NIR reflectance and fluorescence in the Vis with UV-A excitation. The hyperspectral online line-scan system was integrated with a commercial apple-sorting machine and evaluated to inspect apples for fecal contamination and defects at a processing line speed of over three apples per second. Results showed that fluorescence imaging (using a two-band ratio) could achieve detection of fecal spots on artificially contaminated apples with a 100% detection rate and no false positives regardless of the presence of defects. A NIR two-band reflectance ratio coupled with a simple classification method based on the mean intensity and homogeneity of the ratio achieved a 99.5% apple defect classification accuracy with a false positive rate of only 2%. The presented NIR processing regime overcame the presence of stem/calyx on apples that typically has been a problematic source for false positives in the detection of defects. The most significant and important outcome of this investigation is a line-scan inspection system that can potentially provide the capability for current sorting mechanisms, such as by size and color, as well as additional sorting for quality and safety attributes of food products. This line-scan based online imaging system offers great potential as a value-added dynamic inspection system due to its capability for multi-tasking to meet a variety of inspection objectives. A multi-tasking inspection system that can meet current industry sorting needs with the added benefit of safety inspection without requiring significant modification of existing infrastructure or incurring significant costs may lead the apple industry to consider adopting voluntary measures to further enhance safe production and processing of fruits.

<http://www.springerlink.com/content/646w785128373lu6/fulltext.pdf>