Early detection of moldy apple core based on time-frequency images of vibro-acoustic signals

Kang Zhao, Zhihua Zha, He Li and Jie Wu

Abstract

A nondestructive vibro-acoustic device with piezoelectric transducers was employed to detect the moldy core of apples. In this study, 15 texture features were extracted from the time-frequency images of acoustic signals using the gray-level gradient co-occurrence matrix method. A total of 11 texture features were selected and subsequently concentrated in the first four principal components. The principal component dataset was fed into three supervised classifiers, i.e., a back-propagation neural network (BP-NN), support vector machine (SVM), and an extreme learning machine (ELM) to identify slightly diseased apples. The ELM model achieved a relatively higher classification accuracy of 92.3% for the slightly diseased apples with moldy-core degree less than 6.5%. The overall classification accuracy reached to 93.9%. Consequently, the proposed method can be applied for the early detection of apples with moldy core.