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Extended Abstract

Application of Artificial Neural Network and Non-Destructive CT scan Test in Estimating the Amount of Pear Bruise Due To External Loads

Mohsen Azadbakht[1]*, Mohammad Vahedi Torshizi[2]

1- Associate Professor, Department of Bio-System Mechanics, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran
* Correspondence author (azadbakht@gau.ac.ir)
2- Master Student, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

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Abstract

Pear damage is one of the main causes of the loss of fruit quality. Bruises occur during dynamic and quasi-static loading, which causes damage to the healthy tissue of the fruit. In this research, pears were placed under quasi-static loading (thin edge and wide edge) and dynamic loading. Then they were stored in 5, 10 and 15 days and after each storage period, using the CT-Scan non-destructive technique the bruise percentage was estimated. In this study, multi-layer perceptron artificial neural network (MLP) by 2 hidden layers and 3, 5, 7 and 9 neurons hidden layers was selected for modeling of loading force and storage period to predict bruise rate. The highest R2 values for training and testing for quasi-static loading of thin edge and wide edge in a 9-neural network were training Thin-edge=0.91, test Thin-edge =0.99 and training Wide-edge=0.95, test Wide-edge =0.99. For the dynamic loading of a network with 3 neurons in the hidden layer has the highest value (training Wide-edge=0.98, test Wide-edge =0.99). For learning (9 neurons) quasi-static loading thin edge (7 neurons) quasi-static loading wide edge and dynamic loading (7 neurons) have been the best network. According to the results obtained for R^2, RMSE and learning cycle, it can be said that the neural network has the ability to predict the bruise percentage to an acceptable level for pears.

Keywords: Loading, Neural Network, Nondestructive Method, Pear Bruising

Introductıon

Agricultural products have unique characteristics that distinguish them from engineering materials. These qualitative characteristics of the fruits and the quantitative amount given to them making it easier to control the crops. On the other hand, a vital aspect that distinguishes fruits from other products is their rapid disappearance. The high levels of water and carbohydrates cause metabolic processes as well as the growth of microorganisms, which results in qualitative and quantitative damage. Therefore, non-destructive quality assessment of agricultural products has become an important sector for the agricultural industry. In recent decades, several studies have been carried out to conduct a rigorous evaluation of food products, due to increased consumer demand and their special attention to the quality of the fruits, including freshness, sweets, and nutritional content. Also, due to this complexity in recent decades, most agricultural engineering researchers have used the learning algorithms of conventional machines such as artificial neural network, which allows us to predict and model a process for obtaining better products. (Zarifneshat *et al*., 2012) conducted an experiment to predict apple bruises using a neural network. (Rostampour *et al*., 2013) investigated bruises in apple damage using artificial neural network techniques to predict bruising. The purpose of this research is to investigate experimental data with network data, as well as to evaluate the pear sensitivity under quasi-static and dynamic loading as compared to input power and storage time, and also to find the best network for analyzing the data of decay percent in order to be able to use the least amount of time to compare test data with network data and get the best results.

Material and methods

In this experiment, we first loaded two static and dynamic methods. The static loading forces were divided into two wide edges and a thin edge, with a massive loading force of 70, 100 and 130 N for a wide edge, 15, 20 and 25 N for a thin edge, and three weights of 300, 350 and 400 g were used for impact. Samples were stored at 5, 10, and 15 days. After each storage period, photographs were taken using a CT scan and the amount of bruise in each period was obtained, then data were analyzed regularly using neural network software. In this study, multi-layer perceptron artificial neural network (MLP) by 2 hidden layers and 3, 5, 7 and 9 neurons hidden layers was selected for modeling of loading force and storage period to predict bruise rate.

Results and discussion

According to the results obtained for the network in the quasi-static loading mode of the thin edge, the highest values of training and testing in a layer with the same neuron for R^2 in a network with 9 neurons (training=0.91, test=0.99) in the hidden layers are shown. This indicates a high correlation between the input and output data of the network. According to Table 3 for the network in quasi-static loading mode of the wide edge, the highest values of training and testing in a layer with the same neuron for R^2 in a network with 9 neurons (train=0.95, test=0.99) are shown in the hidden layers. Of course, this number of neurons also has the highest R^2. In dynamic loading mode, the highest values of training and test in a layer with the same neuron for R^2 in a network with 3 neurons (training=0.98, test=0.99) are shown in the hidden layers. Of course, this number of neurons also has the highest R^2 in training and test.

Conclusion

The best R^2 network for training and testing for quasi-static loading modes of the thin edge and, the quasi-static load of the wide edge with 9 neurons in the layers is obtained. For dynamic loading, the best value is obtained in a network with 3 neurons in the hidden layer. The best RMSE and MAE values for training and testing for quasi-static load-loading modes of the thin edge are hidden in a network with 3 and 9 neurons in the hidden layer and in the loading mode, the quasi-static loading of the wide edge is 9 and 7 neurons respectively, and for dynamic loading The best value is obtained in a network with 3 and 7 neurons in the hidden layers respectively.

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