Predicting pull-out force of loop pile of woven terry fabrics usingartificial neural network algorithm

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REZUMAT – ABSTRACT

Evaluarea forței de smulgere a firelor de pluş din țesăturile flauşate, pe baza algoritmului rețelei neurale artificiale

În acest studiu, s-a analizat capacitatea metodei rețelei neurale artificiale, bazată pe algoritmul de învățare cu gradient conjugat, de modelare a forței de smulgere a firului de pluş din prosoapele flauşate. Prin urmare, au fost selectate 24 de mostre diferite, din care 21 de mostre ca set de instruire şi 3 mostre ca set de testare. Modelele dezvoltate au fost evaluate prin verificarea erorii pătratice medii de predicție a datelor de testare. Rezultatele obținute evidențiază faptul că modelul rețelei neurale artificiale este foarte eficient pentru predicția forței de smulgere a firului de pluş din țesăturile pluşate pe baza parametrilor procesului. Valoarea lui R^2 a modelului rețelei neurale artificiale a fost de 0,998. De asemenea, a fost investigată importanța relativă a parametrilor procesului asupra forței de smulgere a firului de pluş. S-a descoperit că finețea firului de pluş este principalul parametru care influențează acest proces.

Cuvinte-cheie: țesătură pluşată, forță de smulgere, rețea neurală artificială, gradient conjugat

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In this study, the capability of artificial neural network (ANN) method based on scale conjugate gradient learning algorithm for modeling the pull-out force of pile yarn in terry towel was investigated. Accordingly, 24 different samples were produced. 21 samples were selected as training set and 3 ones as testing set. The developed models were assessed by verifying mean square error (MSE) of prediction of testing data. The obtained results reveal that the artificial neural network model is very effective for predicting the pull-out force of pile yarn of terry fabrics based on process parameters. The R^2 value of artificial neural network model was 0.998. The relative importance of process parameters on pull-out force of pile loop has also been investigated. The count of pile yarn was found as the major contributing parameter.

Key-words: terry fabric, pull-out force, artificial neural network, scale conjugate gradient

TERRY FABRICS

A terry woven described as a textile product that is made with loop pile on one or both sides generally covering the entire surface or forming strips, checks or other patterns. A woven terry consists of five parts namely pile area, fringes beginning and end part, selvage and borders. The pile area is considered the toweling part of the towel [1].

The functionality of the pile area is very important and the users consider this part precisely. A terry woven fabric should be characterized by some characteristics such as high water absorption ability, heat insulation, crease resistance, friction coefficient and bulky handle. In the literature, there are some studies about the terry towels [2–10]. In this filed the work of Karahan [2] that studied the effect of fabric construction of terry woven fabrics on dynamic water absorption could be mentioned. It was shown that around 26% to 40% of water was absorbed during the first 10 seconds. Van der meeren et.al quantified wetting and wicking phenomena in cotton terry [3]. Performance of open-end and ring spun yarns in terry toweling were investigated by a variety of methods by lord [4]. Effect of pile height on static water absorption was also studied [5]. Wetting phenomenon of terry fabrics was studied by Petrulyte and Baltakyte [6].

One of the main problems in the terry fabrics is the poor resistance of pile yarns against pull-out which not only effect the functionality, but also the appearance of woven terry towel. Therefore, the structure and weaving parameters of terry fabrics should also be selected in ways, which improve the resistant of pile yarns against pull-out.

ARTIFICIAL NEURAL NETWORK ALGORITHM

An artificial neural network (ANN) is one of the intelligence technologies for data analysis, which has been employed extensively in various textile disciplines ranging from yarn manufacturing, fabric formation and fabric properties. This technique is useful when there are a large number of effective factors on the specific process.

The artificial neural network technique imitates the behavior of biological neural networks to learn a subject from the data provided to it. An Artificial Neural Network (ANN) is composed of simple elements, called neuron or processing elements, operating in parallel by biological nervous systems. There are different kinds of structure and learning