APPLICATION OF ARTIFICIAL NEURAL NETWORKS FOR PREDICTING YARN PROPERTIES AND PROCESS PARAMETERS

by

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CERTIFICATE

This is to certify that the thesis titled "Application of Artificial Neural Networks for Predicting Yarn Properties and Process Parameters", being submitted by Mr. Anirban Guha to the Indian Institute of Technology, Delhi, for the award of the degree of Doctor of Philosophy is a record of bonafide research work carried out by him. Mr. Anirban Guha has worked under our guidance and supervision and fulfilled the requirements for the submission of the thesis. The results contained in this thesis have not been submitted, in part or in full, to any other university or institute for the award of any degree or diploma.

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ABSTRACT

Prediction of yarn properties from fibre properties and process parameters using artificial neural networks formed the prime focus of this thesis. The performance of neural network, mechanistic models and statistical tools for predicting ring yarn strength was judged - both on data reported in a paper as well as generated in the laboratory. Neural network outperformed the other techniques in both cases. The success of the neural network encouraged the use of this technique for predicting a range of properties of ring and rotor yarns spun in the industry and ring yarns spun in the laboratory. Half of the errors were less than 5% and about one out of ten result was very poor - more than 20%. The ability of a trained network to discern the relative importance of the input units has been investigated where the inputs were fibre properties. Skeletonization, an approach reported in literature failed in this task. A new approach proposed in this thesis - sensitivity analysis - has been found to be successful. Determination of process parameters from yarn properties, i.e the reverse of what was being attempted so far, was next attempted. It was found that neural networks can indeed be used for this 'reverse engineering' provided that the yarn property combinations are feasible (i.e. practically achievable). The feasibility of a yarn property combination could be examined with the aid of principal component analysis. In the final part of the study, the possibility of improving the performance of neural networks was explored. It has been shown that improvement in the performance of ANNs is possible by orthogonalising the input data. When correlation between inputs is high, reduction of the least important orthogonalised components can bring about a further improvement in the network's performance.

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