

**APPLICATION OF SIGNAL PROCESSING TECHNIQUES FOR  
CHARACTERISATION AND MONITORING OF YARN FAULTS**

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**DEPARTMENT OF TEXTILE TECHNOLOGY  
INDIAN INSTITUTE OF TECHNOLOGY DELHI**

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**APPLICATION OF SIGNAL PROCESSING TECHNIQUES FOR  
CHARACTERISATION AND MONITORING OF YARN FAULTS**

by

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Department of Textile Technology

Submitted

in fulfilment of the requirements of the degree of Doctor of Philosophy

to the



**INDIAN INSTITUTE OF TECHNOLOGY DELHI**

**AUGUST 2016**

**Dedicated to my parents, wife and children**

# Certificate

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This is to certify that the thesis titled **Application of Signal Processing Techniques for Characterisation and Monitoring of Yarn Faults** being submitted by Mr. Vijay Kumar Yadav for the award of the degree for Doctor of Philosophy in Textile Technology is a record of bona fide work carried out by him under our guidance and supervision. In our opinion, the thesis has reached the standards fulfilling the requirements of the regulations relating to the degree.

The work presented in this thesis has not been submitted elsewhere, either in part or full, for the award of any other degree or diploma.

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**Vijay Kumar Yadav**

# Abstract

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A continuous image acquisition system to monitor and characterize the yarn faults using two projection views has been successfully designed and developed. The virtual images are captured intermittently using a Leica stereomicroscope mounted with a CCD still camera. Further, the cross-sectional area signal is used to generate a volume signal for fixed band sections along the yarn. Two independent images are filtered using binary image processing technique after converting to a binary image. Binary morphological filtration method is used for processing bi-directional yarn images and to extract the individual yarn images corresponding to two projection views of the yarn. Means of generating 1-D signal are used and extended to determine the length of the faults. Different algorithms for extracting the physical dimensions of the faults are developed. Karhunen–Loève Transformation (KLT) basis for each fault class is formed. Projections of individual realization from the test sample on KLT basis are obtained for each class and Radon projection angle. The average weighted Euclidean criteria is applied using these Euclidean distances. The individual KLT basis developed above is used to extract such eigenvectors explaining only as single class. It is established that the respective fault has different configuration and therefore, makes possible to differentiate the fault on the basis of their configuration. It is established that the faults of a particular class has more than one type of configuration and different terms can be given for different type of sub-classes.

The proposed classification and measurement techniques are used for developing a scheme for characterization of faults which can be used in the ‘offline’ as well as ‘online’ scenario. The DIAMETRIC FAULTS system provides the detailed classification of faults based on their geometric dimensions and presents flexibility to the user to choose the boundary limits for fault

classification. The system is used to compare the characteristics of yarns made on two different spinning systems and on two different opening and carding technologies. Signal processing tools applied to the bi-direction view yarn image have shown new dimension to fancy yarn analysis. The developed system is used for characterizing and deriving constructional parameters of slub yarns.

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