A CIELab-based outlier detection proposal for quality control in denim slasher dyeing machine

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Abstract: The denim slasher dyeing machines are one of the most frequently used machines in denim production. These machines are more susceptible to quality defects than conventional yarn production machines due to the large number of yarn sizes and to ensure continuity of production. In this study, a color-based quality control system for slasher dyeing machines and an outlier detection system based on this system are proposed. In obtaining the color, CIELab based color system (see Figure 1) was used to obtain data from the entire surface area by reducing it to 10 different sections. Initially, a reference point was determined and measurements were taken. Accordingly, L*, a*, b* at each point, the deviation rate from the reference values and the black intensity in the image constituted the data set.

The quality control images at any given moment (e.g. Figure 2) do not represent a sufficient error, as the persistence of errors will constitute a quality control error if they recur relative to the observation point. In other words, persistent outliers on specific observation point can be considered as quality errors. Therefore, clustering approaches are suitable for this problem.

Different clustering approaches were tried to identify outliers based on the data. First, the local outlier factor (LOF) approach was tried. The LOF approach is a neighborhood-based approach where the relative isolation can be calculated [1]. Secondly, the isolation forest approach was applied. Isolation Forest [2] is an unsupervised machine learning algorithm for anomaly detection. It works by isolating data points that are different from most of the high dimensional data.

Both approaches were applied to 7205 observational test data generated by trial productions and the findings were compared.

Keywords: *Isolation forest, CIELab, Local outlier factor, quality error detection.*

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Figure 1 Color acquisition system

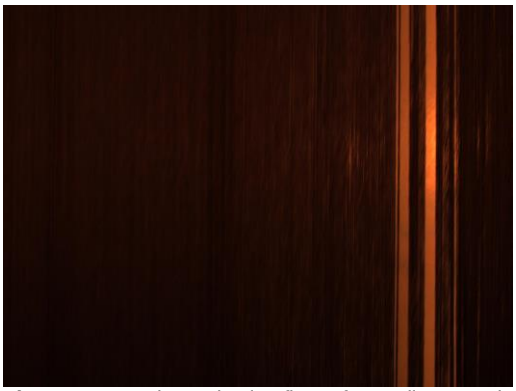

Figure 1 Example production figure for quality control

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