BOĞAZİÇİ ÜNİVERSİTESİ

IE423

QUALITY ENGINEERING

Project Part 3

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What is linen?

Linen is a textile made from the fibers of the flax plant. It is valued for its softness, breathability, and natural appeal. Since it was first used thousands of years ago, linen has been valued for its strength and capacity to hold moisture. Clothes, tablecloths, bed linens, and other home goods are frequently made with it.

Why is it important to monitor processing of linens?

Compliance: When producing textiles, manufacturers frequently have to abide by rules and specifications. Legal compliance is ensured through monitoring.

Quality Control: Manufacturers must make sure the linen satisfies the required quality standards. It is possible to take corrective action by identifying any defects or deviations from specifications by keeping an eye on the various processing stages.

Consistency: Products made of linen should have consistent qualities like color, texture, and strength. Consistency in the end products is maintained through monitoring, which enhances customer satisfaction and builds brand reputation.

What are the motivations regarding the use of images and identification of defects in linen manufacturing?

Automated Inspection: An inspection process can be completed more quickly and effectively by using automated systems and images to identify defects. This is especially crucial in large-scale manufacturing because manual inspection can be labor-intensive and prone to errors.

Precision: Systems that use images can identify minute flaws that the human eye might find difficult to notice. This improves quality control measures' accuracy and guarantees that even small problems are fixed.

What has been done in the literature regarding the process monitoring on linen?

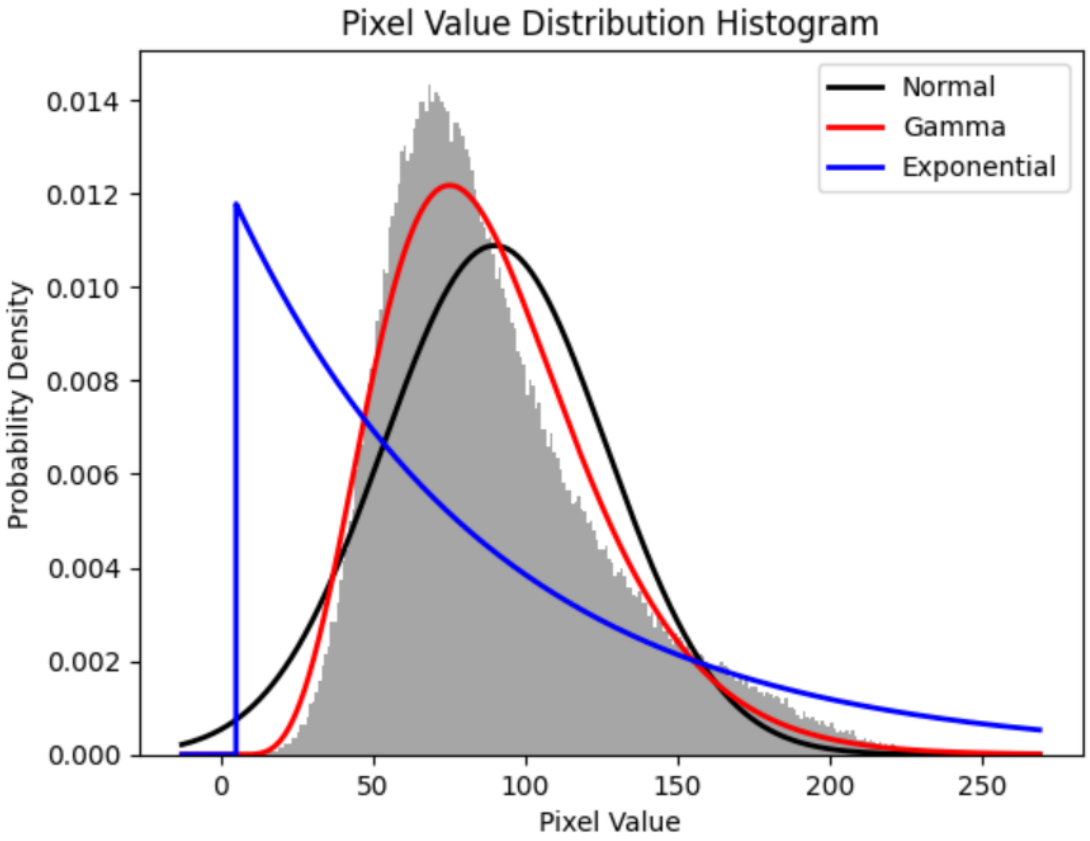
An Example:

“Novel pre-treatment processes to promote linen-containing fabrics properties. Carbohydrate Polymers. 74. 880-891. 10.1016/j.carbpol.2008.05.009. This study was undertaken to investigate the effect of plasma pre-treatment, followed by enzymatic treatment in the absence and presence of bleaching agent on the properties of linen and linen-containing fabrics. Different plasma gases (air, oxygen and nitrogen), enzymes (acid-cellulases, neutral-cellulase and alkaline-pectinase) as well as bleaching agents (peracetic acid and H2O2) were used. The changes in physico-mechanical properties, surface morphology and dyeing properties of the treated substrates have been investigated. The obtained results indicated that plasma pre-treatment followed by subsequent acid-cellulases/peracetic acid or alkaline-pectinase/H2O2 treatment result in: a dramatic improvement in hydrophilicity and wettability as well as in the degree of whiteness of the treated substrates, an improvement in reduction of surface roughness and extent of post-reactive dyeing, along with a weight loss and a drop in the tensile strength. The extent of surface modification as well as the changes in the above-mentioned properties are governed by the characteristics of the substrate, the plasma gas, the nature and dose of the used enzyme, as well as the type of bleaching agent and additive. The optimal treatment sequence for attaining better performance properties was O2-plasma followed by alkaline-pectinase/H2O2 treatment in presence of PEG 400.”

Approach:

Initially, the image given to our group (group 20, image number: 100) was uploaded to jupyter notebook. Afterwards the image was turned into a greyscale image. Now the pixels have values 0 (black) to 255 (white). RGB system would have been used if this operation had not been done.

With the color information of all pixels, a histogram is constructed with three probability distributions: normal distribution, exponential distribution, and gamma distribution. All three of them are shown on the histogram.



Their parameters and calculated results are:

Normal Distribution Parameters: Mean (mu): 89.93266296386719, Standard Deviation (sigma): 36.658301481795434

Estimated Gamma Distribution Parameters: Location (loc): 4.968375767993554, Scale: 14.782125288309775

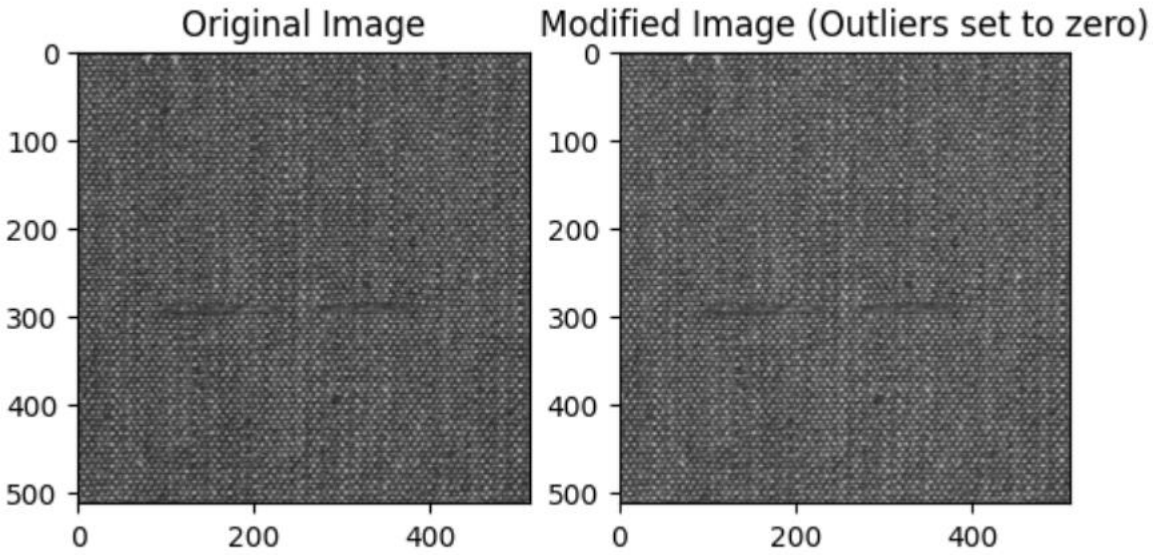
Estimated Exponential Distribution Parameters: Location (loc): 5.0, Scale: 84.93266296386719

According to results, as it is clearly visible in the histogram, the pixels of the related image have gamma distribution.

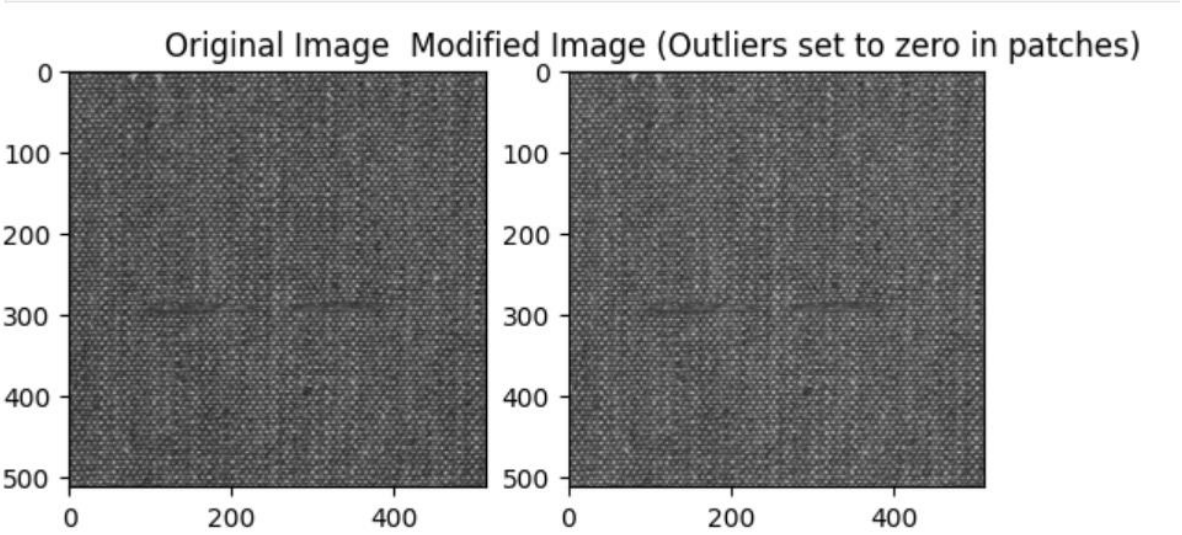
At this point, it is wanted to identify outliers and turn those pixels into black (0) ones. Upper & lower bounds are set according to these values. The value set for outlier identification is 0.001 (upper: 1-0.001 = 0.999). According to this information, transformation operation was done. The mathematical result is: a=5.747776501921191, loc=4.968375767993554, scale=14.782125288309775

Lower Bound: 19.893559544354606, Upper Bound: 242.0961880638341

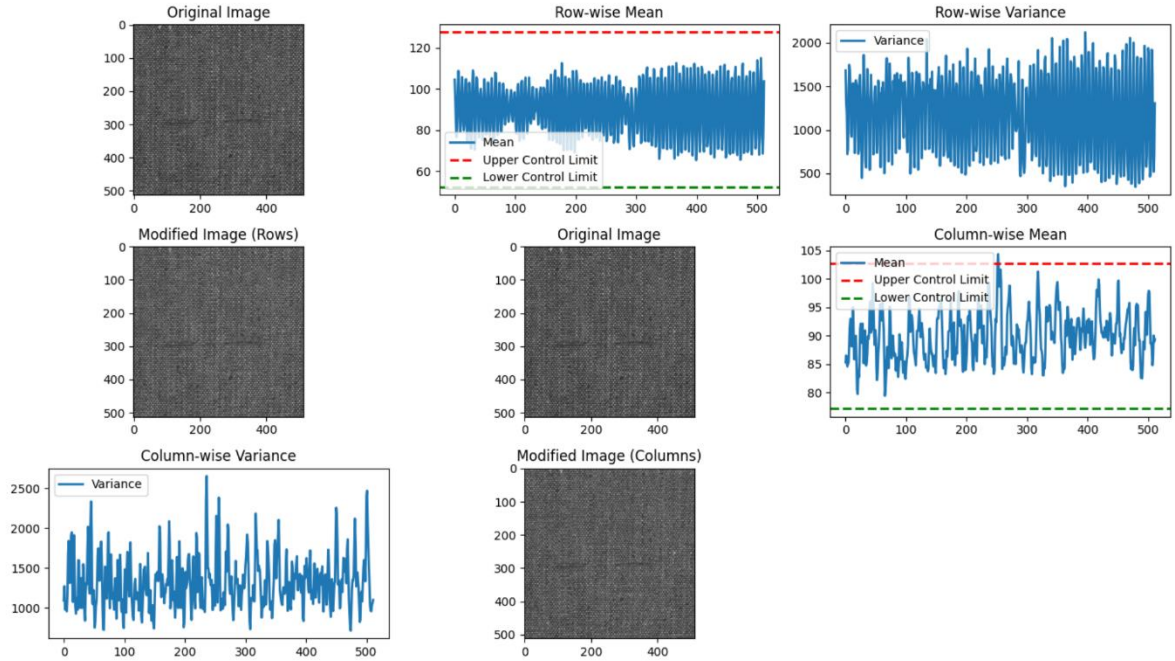
The visual result is:



Now, it is asked to examine by parts. The image is divided into 100 pieces with scales of 51x51 pixels. Then the same application is done again. The visual result:



After this application, control charts (x-bar) are constructed. A sigma limit of three has been set since this limit means if there is an excess value, interruption must be made. The values of the rows and columns are separately evaluated. Their mean values and variances are calculated and visualized. According to these calculations, a newly greyscaled and corrected linen is drawn.



In conclusion, with the help of the control charts, it is determined that there is (an) excess value(s) in the column values of the pixels. This suggests the manufacturing of this linen piece is faulty. This approach is successful in terms of examining and determining outliers. However, turning outliers into black pixels is questionable since it is obvious that it is not the correct solution and approximation. There could have been a prediction method that comes from the chart construction which predicts the outlier pixels' values by examining the adjacent pixels and take an approximation.

Bibliography:

Ibrahim, Nabil & El-Hossamy, M. & Hashem, Mohamed & Refai, R. & Eid, Basma. (2008).