

The information and data contained in this document were prepared by a technical committee of the Association. The committee and the Association assume no liability or responsibility in connection with the use of such information or data, including but not limited to any liability or responsibility under patent, copyright, or trade secret laws. The user is responsible for determining that this document is the most recent edition published.

Calculation and partitioning of variance using paper machine scanning sensor measurements

Scope

Today's on-line quality control systems (QCS) scan the sheet and provide information to the paper manufacturer on paper properties. These systems also provide statistical information regarding the variation in the process and the product. This Technical Information Paper provides a definition of terms and method of comparison so that people in the industry will be able gain a further understanding of the role variability statistics play in monitoring the performance of the process.

This TIP provides the user with a recommended method of calculating variance from scanning sensor measurements. Examples of scanning sensor measurements include basis weight, moisture, caliper, and other paper property parameters. The sensors traverse the sheet of paper in the cross direction during normal operation of the paper machine. The machine direction rate of paper machine travel is greater than the cross direction rate of sensor travel, the result is a diagonal path across the paper, the system must then differentiate between machine direction (MD), cross direction (CD), and total variation. It is desirable to use this information as an aid to assessing paper quality, determining paper machine performance, and to compare performance between paper machines.

As a prerequisite to the use of this document, the user must have general knowledge regarding scanning sensor measurements and any vendor specific functions. To aid in this understanding, a discussion of the factors that influence sensor measurements is presented. The interested reader is encouraged to consider the references in the bibliography for further information on the subject.

Safety precautions

There are no safety precautions.

Recommended calculation

- Two standard deviation (2 sigma) is used to represent variability.

Description of the Measurement Statistic Calculations

CD Data Boxes

		1		j		m
M D S c a n s	1	x_{11}				x_{1m}
	.					
	.					
	.					
	j	x_{i1}		x_{ij}		x_{im}
	.					
	.					
	.					
	n	x_{n1}				x_{nm}

NOTE: The diagonal trace of the scanning sensor is represented by the horizontal rows.

Consider a sensor scanning a sheet of paper. Let the scans be indexed:

$$i = 1 \dots n$$

Let the data boxes or CD cells or slice positions be indexed:

$$j = 1 \dots m$$

Each data point is an average of real-time sensor readings made while the sensor CD position in the CD direction, is within the CD boundaries of the cell j on scan i . Let this be denoted as:

$$x_{ij}$$

Consider the $n.m$ matrix of data points which would exist at the end of a reel, then define the following quantities.

The scan average for the i^{th} scan is:

$$\bar{x}_i = \sum_{j=1}^m \frac{x_{ij}}{m}$$

The data box average for the j^{th} data box is:

$$\bar{x}_j = \sum_{i=1}^n \frac{x_{ij}}{n}$$