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SUBSTRATE LATERAL SKEW MEASUREMENT USING TWO LINE SENSORS

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Substrate lateral skew measurement using two Line Sensors

1. Abstract

In most Large Format printers, loaded substrates to be printed may present a defect called skew, in which the substrate is not aligned in the paper axis. This implies that the substrate advance and printing directions are not perpendicular and thus the resulting image orientation is slightly wrong. It might cause paper jams in the printer, as well as different image quality issues derived from corrections wrongly applied.

An *Optical Line Sensor* is mounted on the carriage facing downwards and consists of a light source and a densitometer. It can obtain a numeric value representing the darkness or lightness reflected by the surface measured.

The invention is composed of two optical line sensors mounted in the printing carriage. These sensors can measure the distance to the edge of the substrate at two different points, which allows the printer to calculate the skew and take actions in consequence.

2. Description

Some of the current solutions are:

- Vertical alignment marks in the printing zone to help the customer manually adjust the substrate to match the marks.
- Measuring the front edge of the paper with an optical sensor at two different positions along the media width.
- Measuring one lateral edge at two different substrate positions (measure, substrate advance and measure).

The following figure describes a printing system with the substrate being loaded with skew defects. The printed image would appear distorted once the plot is retrieved if no correction was applied. The solution proposed uses two optical line sensors mounted in the printing carriage, as shown in the figure.

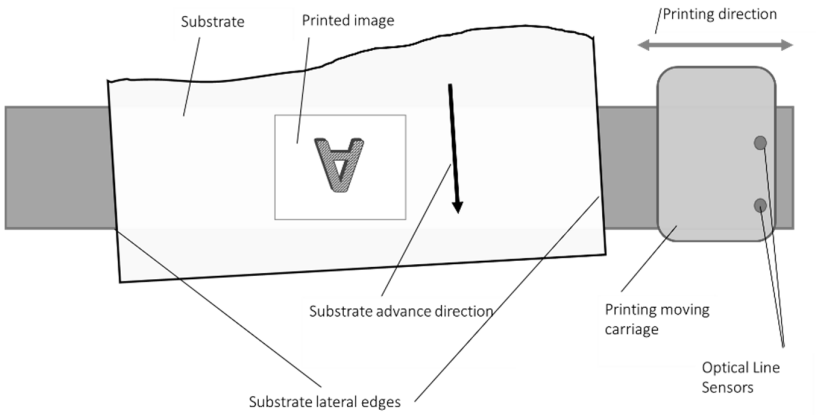

Figure 1 - Overview of a printer with two Line Sensors and a substrate loaded with skew

The procedure to measure the skew magnitude is as follows:

1. The printer will move the carriage along the Scan Axis (perpendicular to media advance direction). During this movement, the optical line sensors will be taking samples continuously, which can have basically two different values: dark for the zones without substrate, and light when scanning over it. Usually, these values are low for the dark samples, and very high for the light ones, meaning that they are clearly different when comparing them.
2. Once scanned the full platen, an algorithm detects the rising and falling edges in the scanned signals for both sensors. The position of the edge determines the distance from any reference point of the printer to the actual edge of the substrate, as indicated by the following figure:

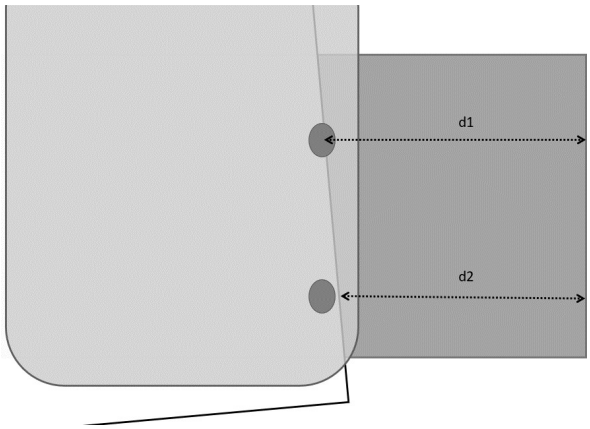

Figure 2 - Detail of the printing carriage scanning in search of the edge of a skewed substrate. d1 and d2 represent the distances from a given starting point to the edge of the substrate.

3. With these distances, the printer firmware calculates the skew of the loaded substrate. This measure can be given as an angle between the paper edge and a vertical line (e.g., 1 degree), or a deviation of the substrate per length advanced (e.g., 2 mm/m). If both distances measured are equal, then there is no lateral skew.
4. The printer will take a decision to accept or reject the skewed substrate, or even try to compensate for it, depending on thresholds previously set.

This solution relies on the measurement of distances using a sensor that is mounted in a moving part, all inside a system subject to mounting tolerances. In order to guarantee accurate measures, the printer must know the exact position of the sensors and compensate for any misalignment between them .

Some advantages of the solution are:

1. **Productivity and user experience:** the media loading workflow time is reduced. The time that it takes to advance the substrate and perform a second scanning is removed.

2. **Accuracy**: this solution does not imply advancing the substrate between measures, eliminating the effects of defective media advance.

3. **Media waste reduction:** since this solution prevents media jams and rejected plots caused by the skew, it can be said that it contributes to reducing media waste.

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