December 2019

DETECTION AND EVALUATION OF PRINT QUALITY ATTRIBUTES

HP INC

Title: Detection and Evaluation of print quality attributes

Background

The method described in this document arose from a need to identify, monitor and resolve different contributors to print quality (PQ) defects for small-format dye sub photo printers as well as other types of printers, depending on the implementation. A variety of targets were tested to flag and measure the extent of issues like linefeed error and skew, both of which are typical of inkjet printing. Measuring those targets typically require high resolution scanners with custom software to plot linefeed and different types of visible skew. However, other issues aren't as easily detected, much less measured; these include misregistration, banding, and roller marks. In order to make the solution more effective for troubleshooting, added weight was given to streamlining the process to provide immediate feedback to engineers and operators.

Three clear goals were defined:

1. Development of a single target, to identify and quantify both old and new defects (Figure 1)
2. Reading in that target with a commercially available scanner and integrating that data into the manufacturing process (Figure 2)
3. A method to decipher the resultant output so operators at the manufacturing line have a simple pass/fail metric and a process to resolve issues (Figures 3 and 4)

New PQ Issues

Misregistration

The most persistent issue seen during development is misregistration. This defect occurs when one or more of the CMY ribbon panels doesn't align with the media advance. The resultant output appears blurry and cyan, magenta or yellow lines may be visible along edges within the scene. A series of small, slightly offset fiducials down the page detects occurrence and can help in the calculation of relative magnitude. If printed on both sides of the page, then a scan-axis misregistration calculation is also possible. And if this misregistration exceeds a certain threshold, operators are advised to change out the roller to one from a better lot.

Banding

Banding manifests as linear discontinuities across the page and appears periodic from the top of the print to the bottom. An initial investigation revealed the frequency of these patterns correlated with different runouts or gear teeth from the device gear train that might exceed tolerances. Printing a flat monochrome color can reveal these bands though filtering out frequencies that might be confounded with each other can be a problem. An algorithm that separates frequencies using Fourier analysis and then correlates the data with gear cluster information was developed.

Roller Marks

Another PQ artifact looks like a pair of vertical lines along the edges of each print. It became apparent that this is probably due to pressure from the roller that grips and guides the media through the print path. Further investigation revealed the position and intensity of these marks held steady for a given lot of rollers. Using information gathered from these measurements, a correction is applied to each device to compensate for the varying intensity induced by the rollers.

Implementation

Some systems may use separate tools to create a target and then perform analysis of each component. The unique attribute of this method is how detection and measurement of these new and old defects (like linefeed and skew) is integrated into a single target. The analysis component provides operators and engineers at the manufacturing line a simple pass/fail metric for each attribute and a path forward for each issue.

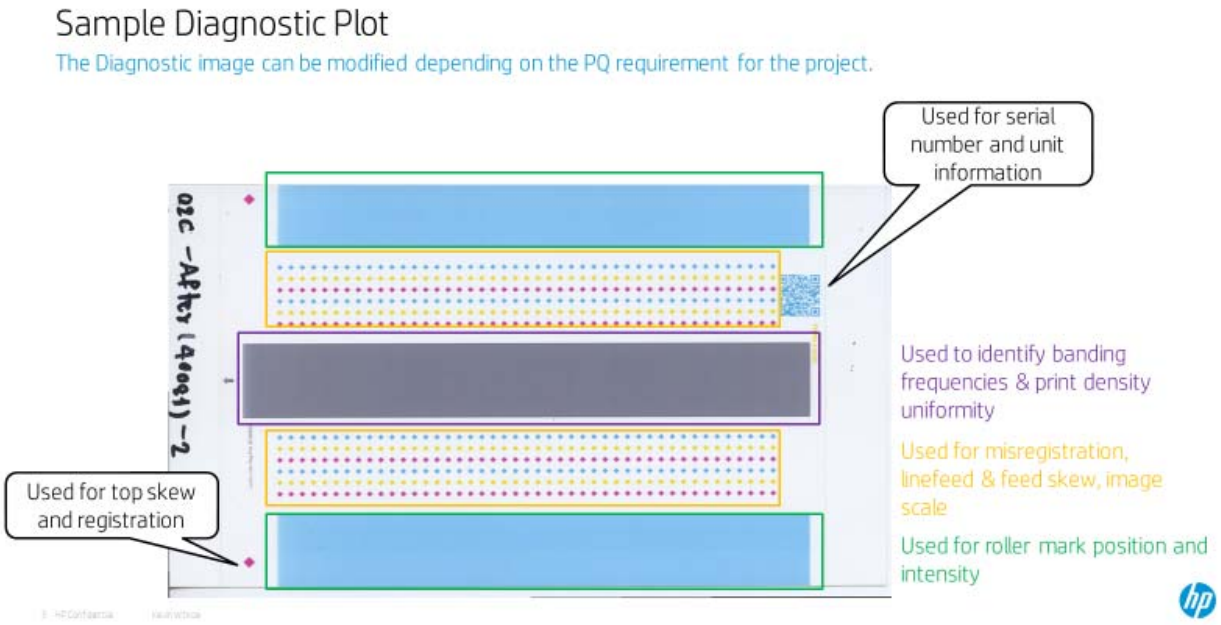

Figure 1: Sample Diagnostic Image. The Image can be modified depending of the PQ Requirements for the Project.

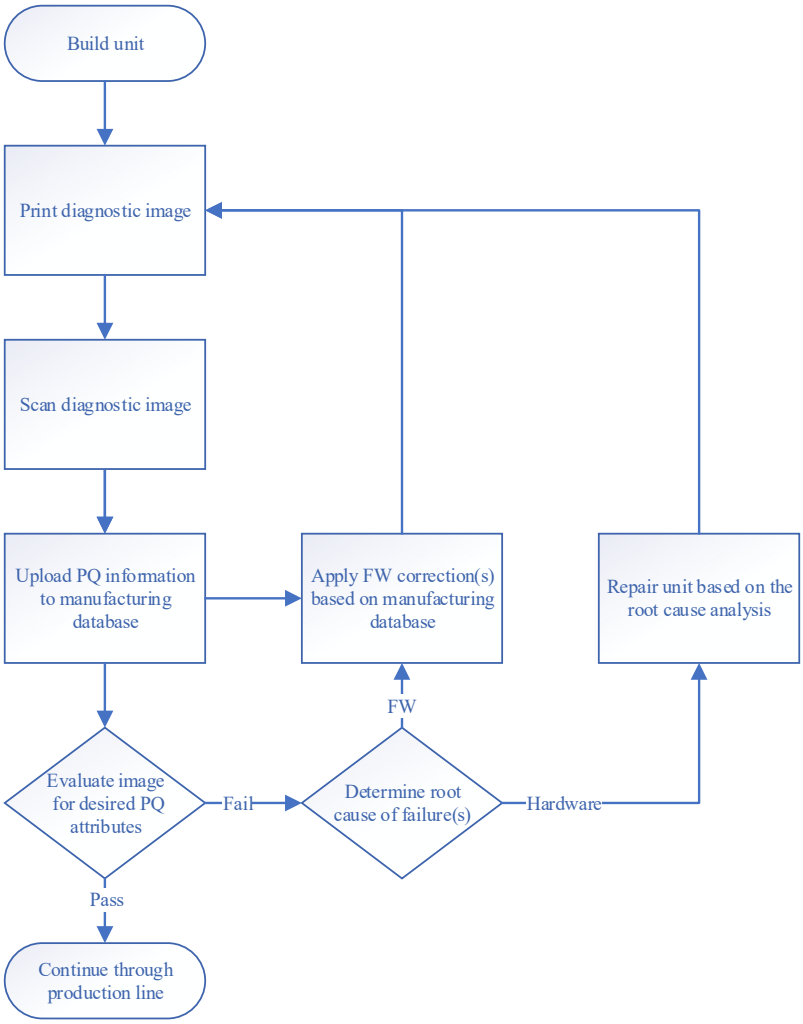

Figure 2: Sample Manufacturing Workflow using Diagnostic Image.

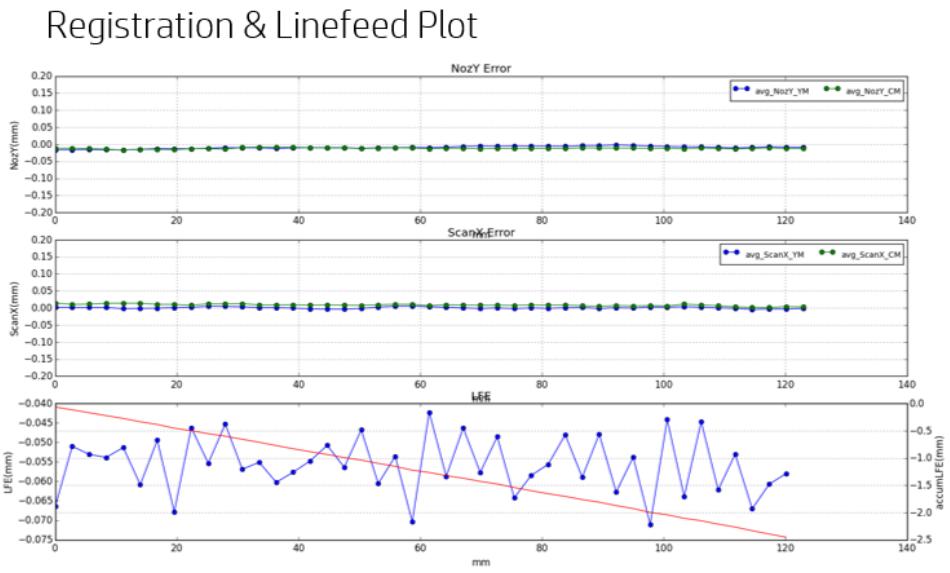

Figure 3: Sample Evaluation Plot: Measures Color Registration and Image Length. Misregistration is attributed to Defective Rollers; Image Length Variation can be compensated for using a FW Constant.

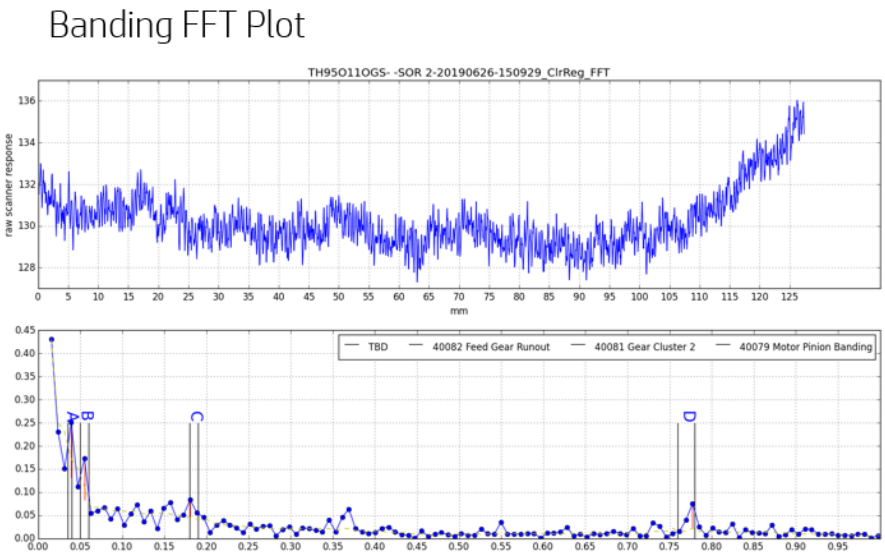

Figure 4: Sample Evaluation Plot. Used to correlate Specific Frequencies with Gear Train Components that cause Banding.

Disclosed by Hsue-Yang Liu, Ranjit Bhaskar, Kevin Witkoe, Stu Spencer and Angel Astorgano, HP Inc.