J3 A Study of Bandings in Printed Black Texts for the Identification of Monochromic Laser Printers

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After attending this presentation, attendees will understand: (1) the basis of the banding frequencies presented in printed black texts which can be the individual features of laser printers; and, (2) the improved methods of extracting the banding signals from printed black texts.

This presentation will impact the forensic science community by providing a way to use banding features in printed black texts as an individual feature for the identification of monochromic laser printers.

Banding artifacts caused by photosensitive drum velocity variation or its resultant scanline spacing variation were often perceived in outputs of monochromic laser printers as periodic light and dark bands perpendicular to the print direction in halftone images as well as in texts. This presentation includes three parts. First, this presentation addresses the fact that a set of specific banding frequency components characterized the class signature of a laser printer while the banding signals with the highest intensity often exhibited in the printed black texts. This corresponded with its primary frequency components shown in its frequency spectrum analyzed with fast Fourier transform. Other than the gear transmission errors that have been proven to be the sources of the output density fluctuations in various research, there were some primary banding frequency components that occurred from unknown sources. By detecting the angular velocity variation of photosensitive drums with an attached gyro sensor, experiments were conducted to locate the sources of the undetermined frequency components of the two models of laser printers: HP® LJ 1020 and HP® LJ P1008. Validation of both data was established by comparing the banding signals extracted from outputs to the signals detected with the gyro sensor.

Next, the performance of banding signals in printed black texts was investigated. Equipped with the original equipment manufacturer cartridges, 200 devices of the two models of Hewlett-Packard® laser printers were sampled and analyzed. The primary banding frequency components, as their individualities, were often presented in black texts printed by the tested printers. Third, the results of the banding extraction methods were compared. The bandings within printed black texts larger than 36pt were extracted with three methods: scanning in film mode, reflectance transformation imaging, and laser scanning confocal microscopy. The extracted signals from the digital images obtained with these three methods were compared to determine a method of improving the signal-noise ratio of banding frequency.

This study shows that banding artifact can be a promising feature for discriminating documents printed by individual laser printers of the same type, even for text-only documents, if the banding signals in black texts are detected.

Laser Printer Identification, Banding Frequency, Black Text