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DYNAMIC AND HEURISTIC METHOD FOR PRINTING AND SCANNING WARM-UP CALCULATIONS

HP INC

Title

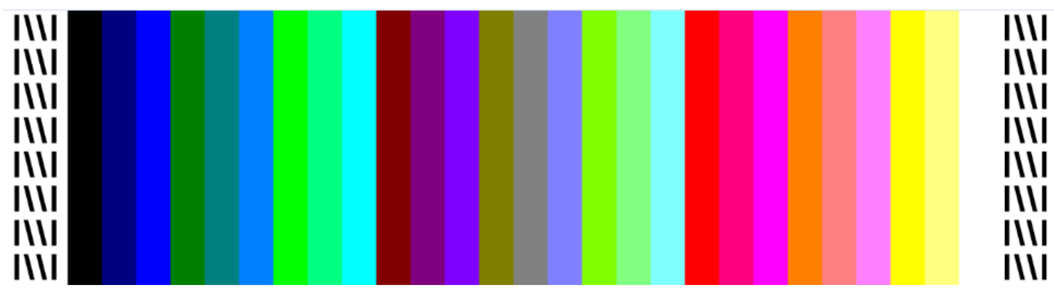
Dynamic and heuristic method for printing and scanning warm-up calculations.

Abstract

Current Large Format Printers have fixed warm-up periods for the printing and scanning systems when measuring a test chart to profile a printer and when doing calibrations (color, printhead alignment, media alignment). For instance, the chart we currently use for profile measurements have some patches that are only used to warm-up the printing system. Similarly, we warm-up the embedded spectrophotometer before taking measures. The length of the printing warm-up patches and the time we turn-on the spectrophotometer is fixed and based on a previous experience and/or knowledge. However, Printers and Scanners are dynamic systems that have printing and scanning warm-up times that have variability over time. They are also media dependent. This invention proposes a dynamic and heuristic method to calculate the length of the warm-up patches and spectrophotometer warm-up time instead of having it fixed(hard-coded). The heuristic is based on Marginal Standard Error Rule (MSER) and consist on removing initial measures that are a long way from the mean.

Description

We should print and measure a chart like the one below whenever we want to calculate the warm-up patches length.



Then we will do horizontal scanning passes measuring colors. The vertical step between horizontal scans can be as small as our expected accuracy in calculating the warm-up length. Let´s say we took m horizontal scanning measurement rows. For each color row we will calculate the mean of the distance for all colors in a row between each color patch versus the mean of all rows for that color. Let´s call this number Y and having Y_1, Y_2, Y_3, …, Y_m values.

Then we will calculate the MSER for each row d as:

$$MSER(d) = \frac{1}{(m-d)^2}\sum_{i=d+1}^{m}(Y_i - Y(m,d))^2$$

Where:

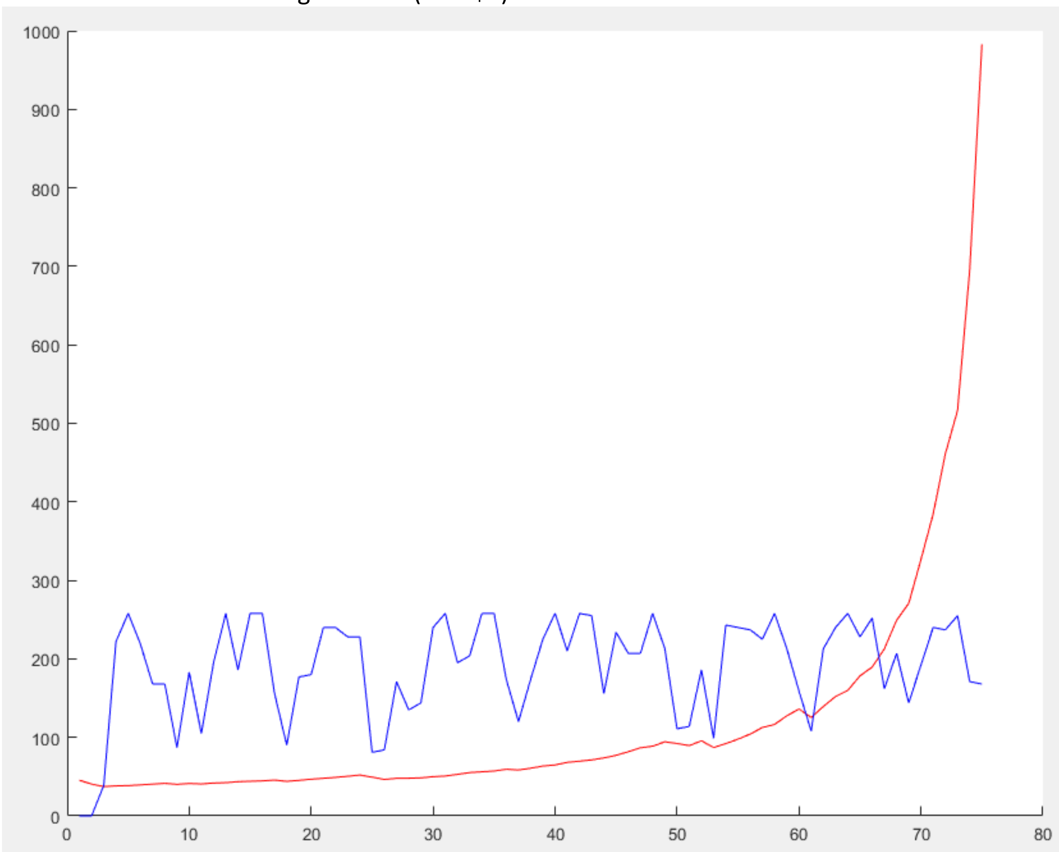
d = the proposed row of the warm-up period

m = number of rows (40)

Y(m,d) = mean of the observations from Y_{d+1} to Y_m

The MSER value is calculated for all values of d from zero to m-5 (i.e. except for the last five values in the time-series) and the warm-up period is chosen as the value of d that minimizes the MSER value. The MSER value is not calculated for the last five values in the time-series because it becomes unstable for small sample sizes and so can lead to erroneous conclusions. The value m must be chosen so that the value of d that minimizes MSER lies in the first half of m.

Find below a generic example of a MSER calculation. In red you have the MSER plotted in which we see that the minimum is around 3. So, 3 will be the number of iterations (rows in our color chart) that indicates that our system is initialized/warmed-up). The blue plot will be the data that we are calculating its MSER(the Y_i´s)



The MSER heuristic method is not a novelty presented by this disclosure but applying a heuristic method (like MSER) to printing and scanning warm-up calculations making it dynamic covering media dependencies, printer model dependencies and printer and scanning degradation/variability over time. Interested audience can read "White Jnr., K.P. and Robinson, S. (2010). The Problem of the Initial Transient (Again), or Why MSER Works. Journal of Simulation, 4 (4), pp. 268–272" for deeper understanding of MSER.

Disclosed by Francesc Costa, HP Inc.