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ALGORITHM TO DYNAMICALLY RECALCULATE THE INK LINEARIZATION TABLES IN PRINTING DIRECTION BASED ON THE POSITION OF IMAGES ON THE MEDIA

HP INC

Algorithm to Dynamically Recalculate the Ink Linearization Tables in Printing Direction based on the Position of Images on the Media

Abstract

Some PageWide array printers use two different ink linearization tables in the printing direction (and a transition table between them) to address the color density problem caused by the interaction between the airflows and the vacuum. All these tables are generated assuming zero-margin between the printed image and the leading edge of the media. Therefore, when printing with different margins or when images are clipped, the default ink linearization tables and the transition table are not valid. To overcome this limitation, we propose a method that dynamically recalculates the transition table so that the ink linearization tables are applied correctly.

Background

In some PageWide array printers, there is an interaction in the leading edge of the media between the airflows and the vacuum. As a result, the color density in that area is different than in the rest of the media, which may cause undesired color variations. To solve it, two different ink linearization tables are used in the printing direction. One of the tables is applied to the portion of the image placed on the leading edge of the media (where the interaction occurs) and the other table is applied to the remaining area of the image (which is not affected by the interaction at all). The leading-edge ink linearization table is built in such a way that it compensates the density variation, thereby providing color uniformity in the whole plot.

A transition table is also used to provide a smooth transition between the two ink linearization tables. This table indicates the weight of the values from every ink linearization table that is used at every moment. Figure 1 shows an example of how the ink linearization and transition tables are used. The blue arrow in the top left indicates the area of the conflict between the airflows and the vacuum. That area of the image, which is represented in red in the plot, has been processed using the leading-edge ink linearization table (complementary). On the other hand, the green area of the image does not have any problem and it has been processed using the nominal ink linearization table. The in-between area has been processed with an ink linearization that is the result of the combination of both ink linearization tables. The transition table indicates the weight of every ink linearization at every column.

Both the leading-edge ink linearization table and the transition table are built assuming that the first column of the image to print will start in the leading edge of the media. This is usually the case when printing from roll since the media is cut with the proper dimensions so that the printed image fully fits in it. Nevertheless, there are other scenarios where the printed images are not tight to the media. For instance:

- Users can add extra white margins (e.g., for post-processing tasks)
- Printings on single sheets where images are smaller than sheets
- Cropped images that do not fit on the media (from both roll and sheet)
- Internal plots with pre-defined offsets

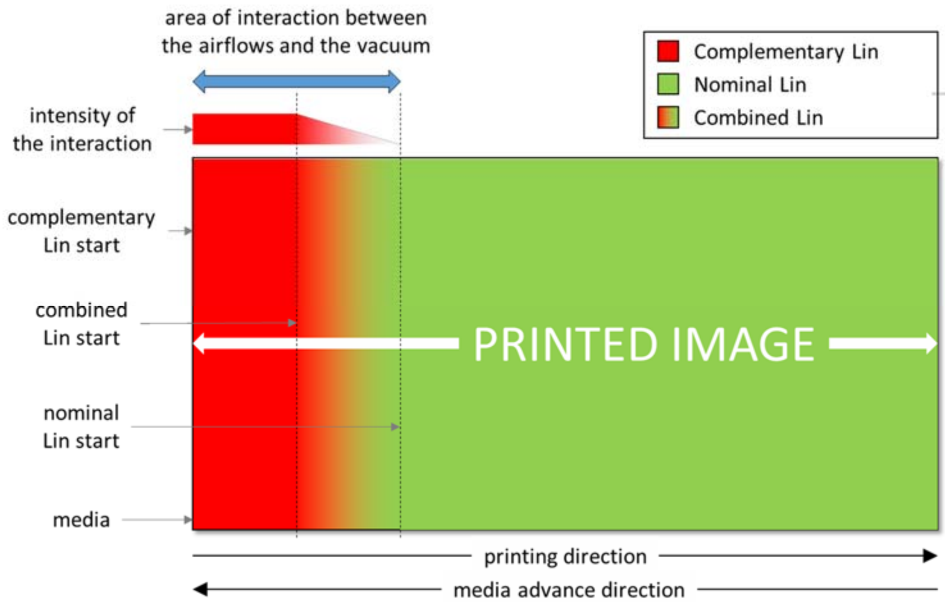

Figure 1. Example of the application of ink linearization tables to a printed image. The red area of the plot has been processed only with the complementary ink linearization table; the green area, only with the nominal ink linearization table; and the in-between area, with combined ink linearization tables. 'Lin' stands for ink linearization table.

In all these cases, the application of the leading-edge ink linearization tables and the transition tables generated with zero-margin will not fix the color variation problem. On the contrary, an additional defect may be introduced since it is being compensated an area of the plot where the interaction does not happen, such as it is shown in Figure 2. The plot on the left shows a sample where three images (just an area fill) have been printed with different margins. As shown, if the default ink linearization tables and the transition table, which have been generated assuming zero-margin, are applied, new artifacts are caused. To address this issue, we propose an algorithm which dynamically recalculates the transition table based on the image location so that the ink linearization tables are applied where necessary. When using this algorithm, ink linearization tables are applied correctly and the color variations disappear, as depicted in the sample on the right of Figure 2.

Description of the Invention

Every ink linearization table is associated with a down-web area (e.g., leading-edge or trailing-edge part) of the media. Therefore, when the ink linearization tables are applied to the image to print, it must be considered the location of the image on the media so that the ink linearization tables are applied correctly. To identify the position on the media, we propose to use two parameters: the leading-edge margin and the leading-edge clipped area. On the one hand, the leading-edge **margin** is the distance between the leading-edge border of the media and the first column of the image that is printed. On the other hand, the **clipped area** is the amount of image columns that are not printed (notice that, although they are not printed, they are processed by the data pipeline and, consequently, they must be considered when applying the ink linearization tables). Both the margin and the clipped area are calculated from the media length, the image length, the blank columns of the image, and the cross-web alignment (left, right, or center).

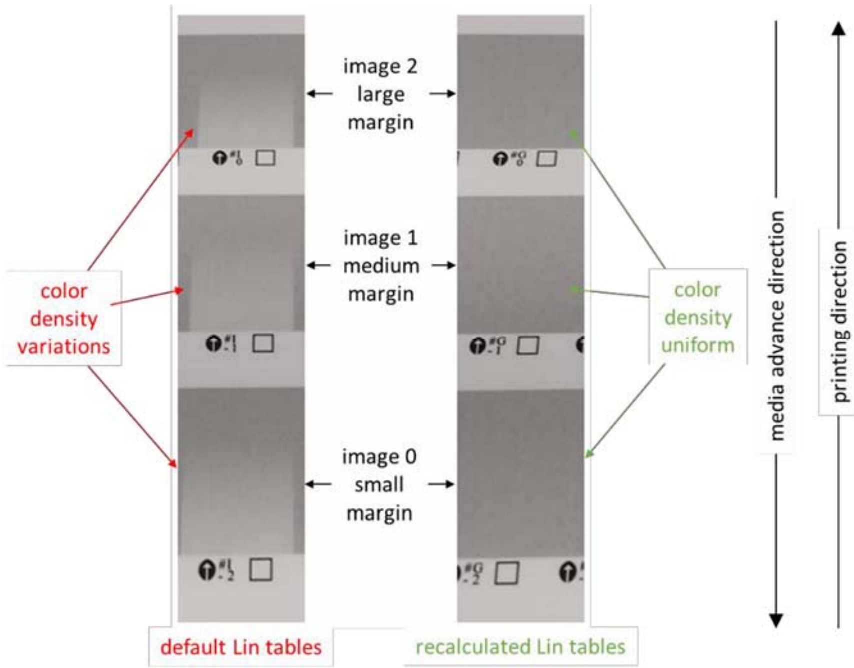

Figure 2. Samples of real plots. On the left, three images have been printed in the same sheet with different margins. In that case, the default ink linearization and transition tables cause a color variation. On the right, the three same images have been processed using the recalculated ink linearization tables based on the image position. 'Lin' stands for ink linearization.

By using both the leading-edge margin and the leading-edge clipped area, we apply the algorithm shown in Figure 3 to decide how the transition table must be modified. As it can be seen, when the margin and the clipped area are 0, the transition table does not need to be modified because it means that the image is adjusted to the printable area. An example of this situation is shown in Figure 1, where the processed image is equal to the printed image, which fits in the media. Therefore, the default tables can be applied directly.

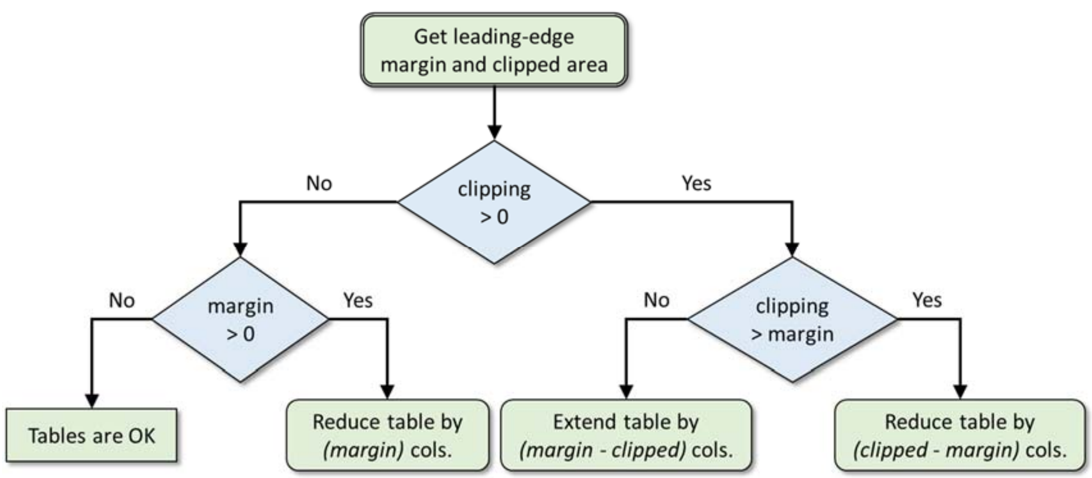

Figure 3. Algorithm used to decide how the transition table is modified so that the ink linearization tables are applied correctly. 'Cols.' stands for printing columns.

When the image is not clipped, but there is a leading-edge margin, the transition table needs to be reduced because some area of the media is not printed. Figure 4 illustrates an example of this situation. In this case, the image to print is shorter than the media and the image is center. As a result, there is a leading-edge margin. Therefore, when the image is processed, the complementary ink linearization cannot be applied for the same number of columns as if it was placed on the edge of the media. In this case, the transition table is recalculated by removing as many columns as the leading-edge margin occupies.

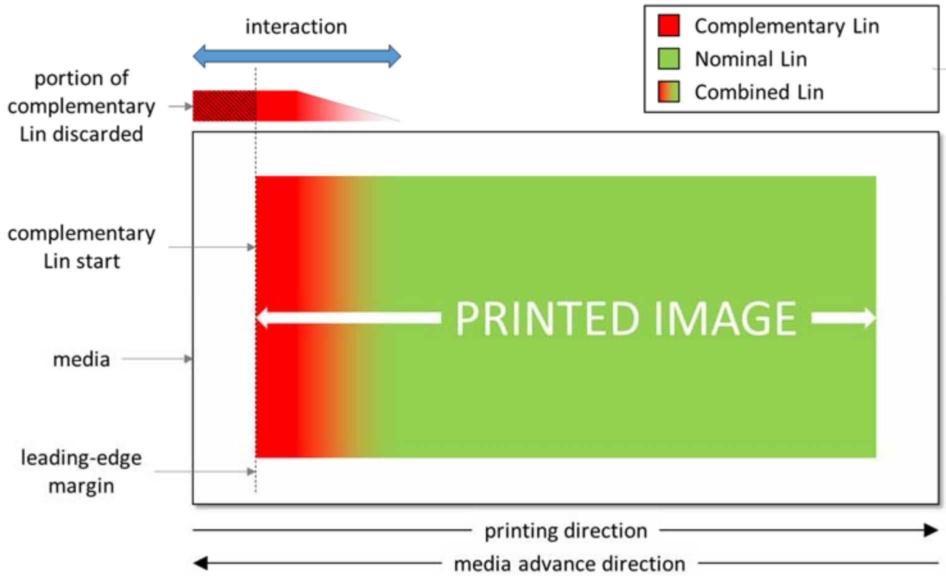

Figure 4. Example of the application of the ink linearization tables when the printed image is smaller than the media. The image is centered in the media and there is a leading-edge margin. The ink linearization table associated with the area of the leading-edge margin is discarded when the image is processed. 'Lin' stands for ink linearization table.

When the image is clipped but there is not any margin, the application of the first ink linearization table needs to be extended. An example of this is shown on the left side of Figure 5. In this case, the image to print is longer than the media and, therefore, the image is clipped. Notice though that the data pipeline will process the full image (i.e., including the clipped columns). Thus, to correctly apply the ink linearization tables, the first entry of the transition table is incremented by the number of columns in the clipped area.

Finally, the last case is when the image to print is clipped, there is a leading-edge margin, and the clipped area is larger than the margin. In this case, the transition table must be reduced. An example of this situation is shown on the right side of Figure 5. As depicted, the image fits on the media, but it does not fit on the printable area. Therefore, the transition table is recalculated by removing as many columns as the difference between the leading-edge margin and the leading-edge clipped area.

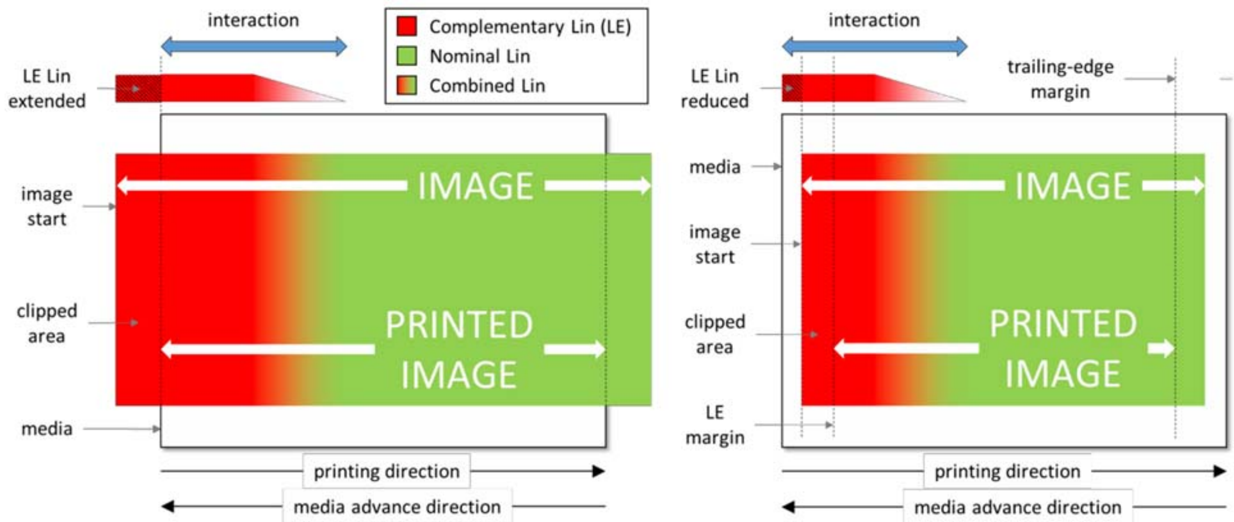

Figure 5. Example of the application of the ink linearization tables when the image to print is clipped. 'LE' stands for leading-edge and 'Lin' for ink linearization. On the left, the LE margin is 0 and the image is clipped. In this case, the application of the LE ink linearization is extended. On the right, the image to print is smaller than the media, but it is larger than the printable area. In this case, the application of the LE ink linearization table is reduced.

Disclosed by ***Blas Cuesta, David Peinado, HP Inc.***