Predicting the Color of an Overprint of Two Spot Colors Using a Mathematical Model

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Abstract

Traditionally spot colors are used as single colors, and are not overprinted. However, graphic designers might want to take advantage of the possibility to overprint spot colors. The first time a graphic designer evaluates the color aspect of a design is probably on a monitor. At that stage, chances are that there is no color profiling data available for such overprints. Therefore, the question arises whether it is possible to predict the color of two color overprints without access to printed profiling target information.

Trapping equations can be used as a mathematical model to calculate the overprint color from the spectral densities of the two spot colors, however an estimate of trap and transparency of the second color is required. This research attempted to experimentally find the best average values for trap and transparency that can be used in a trapping equation to obtain a least maximum visual color difference between actual offset and HP Indigo prints and the mathematically predicted color.

Results from 60 different offset printing conditions (6 different inks, different tack sequences, two press speeds, coated and uncoated paper) indicate that, for one mathematical model, a trapping value of 79% and a simulated saturation density constant of 1.4 give predictions that are at most 8.5 ΔE^*_{94} away from the actually printed colors. 90 percent of the data points are below 5.5 ΔE^*_{94}. These results are good enough to warrant additional investigations, also using prints from digital presses.

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Introduction

Predicting the color of a two color overprint with CMYK colors is relatively easy because profiling data is available from previous press runs. Predicting the color of two color overprints for spot colors (for example Pantone®) is difficult because there are more than a thousand Pantone colors and there is no profiling data available for such overprints unless a company has used those same spot colors previously. Therefore, the question arises whether it is possible to predict the color of two color overprints during the design process without access to printed profiling target information. This is particularly important for designers of packaging printing where spot colors are predominantly used.

The investigation described in this paper addresses the prediction of two solid overprinted inks. This is a first step in predicting the color of more general overprints, such as three, four, or more overprinted solids (such as the Neugebauer primaries of an ink set) and overprinted tints. Our hypothesis is that the combined effect of two solid inks may be predicted with reasonable accuracy. If this is borne out, the color of overprinted tints of two inks may be accurately predicted using a two-colorant specialization of an existing model of halftone color. (Viggiano, 2010, e.g.) One may then test whether the spectra of multiple solids may be approached by repeated application of the formulae described herein. If this latter hypothesis is proven, the multiple-ink Neugebauer primaries may be estimated, allowing the color of multi-ink tints to be predicted.

Literature Review

In previous work, Viggiano proposed that ink trapping equations can be used as a mathematical model to predict the color of two color overprints. Viggiano and Prakhya (2008) determined that the Hamilton trapping equation or the Viggiano simplification of the Hamilton trapping equation were best suited for the purpose. Dr. Hamilton published his trapping equation in TAGA 1986 (Hamilton 1986). A preliminary test for predicting two spot color overprint pairs was performed by Khalid Husain (2008). The results were promising but needed to be confirmed by a larger sample size. It is the purpose of the present investigation to test this larger sample size.

Since this research involves ink trapping, the factors affecting trap are of interest. Ink tack is expected to have a major influence on trap. A literature search did not find any previous work that would show a predictable, quantitative relationship between tack and trap. Obviously, there are factors such as temperature, press speed and emulsification of the ink that affect tack, and temperature can vary considerably between different usages of ink. The tack measured by the ink manufacturer on a printability tester under standardized conditions probably does not represent printing conditions on a cold or warm press. The reason that no published data on the relation between trap and tack was found may be because the relationship is unstable and varies considerably depending on several process variables.

Our approach contrasts with that of Despande and Green, (2010) who have recently described a heuristic approach that permits prediction of multiple ink tints, the same as our ultimate goal. Their focus, in addition to accuracy, is on the simplicity of their model, while ours is on minimizing the amount of characterization data needed to attain a similar level of accuracy.

The Trapping Equations

The color of a two color overprint depends on the colors of the two inks and the substrate, the transparency of the second ink and the trapping percentage of the second ink on top of the first ink. All of these variables are considered in the Hamilton trapping equation. Instead of solving the equation for the trapping ratio of the second ink, as it was originally done, the equation can also be solved for the color of the overprint. The originally published equation (Hamilton 1986) was converted to the form shown in Eq. 1 to make it useful for the present purpose.

$$D_{12,\lambda} = D_{2\infty,\lambda} - \left(D_{2\infty,\lambda} - D_{1,\lambda}\right)\left[\frac{D_{2\infty,\lambda} - D_{2,\lambda}}{D_{2\infty,\lambda} - D_{P,\lambda}}\right]^{T_H} \qquad \text{Eq. 1}$$

- D_{12} = Spectral density of the overprint
- D_1 = Spectral density of first ink down
- D_2 = Spectral density of second ink down
- $D_{2\infty}$ = Saturation density of the second ink down
- D_p = Density of the unprinted substrate
- λ = The equation is calculated for each wavelength of the spectral curves
- T_H = Hamilton equation trap
- T_V = Viggiano equation trap

The Viggiano Trapping equation, also solved for the overprint color, is a little simpler:

$$D_{12,\lambda} = D_{1,\lambda} + T_V \frac{D_{2\infty,\lambda} - D_{1,\lambda}}{D_{2\infty,\lambda} - D_{P,\lambda}} \left(D_{2,\lambda} - D_{P,\lambda}\right) \qquad \text{Eq. 2}$$

Note: The equation traps are photometrically derived, not to be confused with gravimetric trap. The assumption is that, as a first approximation, that optical density is a representation of inkfilm thickness.

It was found that both equations give almost the same results. Both equations were used for parts of the experiment.

Saturation Density of the Second Ink

Saturation density is the density of a very thick ink layer such as in an ink can. If the ink is opaque, light gets reflected by the pigments right at the ink surface, and ink film thickness does not matter. The color of the ink in the can will look essentially the same as when printed on paper. On the other hand, if the ink is transparent, then the light penetrates far down into the ink and gets absorbed by the pigments of the ink. Because of the long path, the light gets absorbed even at wavelengths where the pigment absorbs relatively little energy, and the ink in the can will look and measure very dark or black. Therefore, saturation density is a measure of transparency of an ink. (Note: A thick layer of ink may look different in the can and when dry because of changes of light scattering at the surface due to drying.)

For two color overprints it is important that the second ink is transparent. There are several ways that a value for saturation density can be obtained. The two used in this study were to either measure a very thick ink layer with a spectrophotometer, or to simulate it in order to avoid having to make and catalog measurements. The logic of simulation equations is this: a moderately thick ink film layer that looks very dark still shows a spectrophotometric curve that is not simply flat at a very high density. It still is proportionally higher at the high density regions of the spectral curve of the normal ink film layer. Therefore, one way to simulate the saturation density spectral curve is to add to each wavelength of the spectral density curve of the second ink a constant, or, each wavelength is multiplied with a constant, or both. Adding a constant of zero and choosing a multiplier of one represents an opaque ink. The bigger the constant or multiplier, the more transparent the ink. The equations for saturation density that were tested are:

$$D_{2,\infty,\lambda} = a + D_{2,\lambda} \quad \text{Eq. 3}$$

$$D_{2,\infty,\lambda} = D_{P,\lambda} + b + c \cdot \left(D_{2,\lambda} - D_{P,\lambda}\right) \quad \text{Eq. 4}$$

$$D_{2,\infty,\lambda} = D_{P,\lambda} + \frac{D_{2,\lambda} - D_{P,\lambda}}{b + c\left(D_{2,\lambda} - D_{P,\lambda}\right)} \quad \text{Eq. 5}$$

Where a, b and c are constants which are incremented for each trap value to find the smallest color difference. Having a more sophisticated equation for saturation density does not necessarily give better results. The incremental approach will simply balance the parameters of the equations until the minimum color difference is reached. Using a different saturation density simulation may give the same minimum color difference but perhaps at a different trapping value. For equation 4, ‘b’ is a constant that is added to D2, while ‘c’ is a multiplier for D2. If c=1, then equation 4 becomes equation 3. For equation 5, both the ‘b’ and ‘c’ parameters are in the denominator of the equation. That means that the smaller the values, the larger is the saturation density, the more transparent the ink. It was found that for both offset and Indigo prints, Eq. 3 provided comparable accuracy to the more complex equations (see Figure 5). When equation 4 is used, after the incremental procedure, the lowest color differences are found with a ‘c’ constant of one. Some of the shown results were obtained with Eq. 5, but similar results could have also been obtained with Figure 4.

Optimizing of Calculated Trap

Trap is the ratio of the ink film thickness transferred on top of the previously printed first ink, divided by the ink film thickness transferred to the unprinted substrate. If trap is one, then the same amount of the second ink is transferred, if trap is less than one, then less is transferred to the first ink. For offset printing, trap is normally less than one.

The Hamilton equation as shown above can be used to calculate the color of the two color overprint, but two variables are needed that are not known unless a test form is printed: trap and transparency. It is possible to obtain the saturation density of the second ink by measurement, therefore it would be possible to make a list of saturation density spectra of all Pantone colors. But it would be very impractical to make a list of trap values for all possible combinations of Pantone color overprints because two inks are involved for each of the measurements.

To see how well the models work, both the trap value and saturation density of the second ink can be incremented, and for each combination, the color difference to the actually printed sample can be calculated. An example of such a determination is shown in Figure 1.

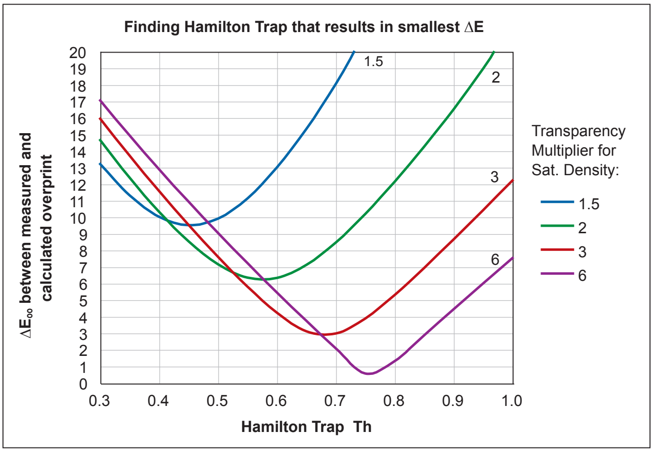


Figure 1. Incremental optimization of trap and saturation density multiplier.

Methodology

The method used for this research is to first print many combinations of spot colors and printing conditions on a printing press. Then, using an incremental approach, find the trap value and saturation density value that yield the lowest color difference agreement with each printed sample. The trap curves calculated by this method for all the ink combinations are plotted on the same graph as shown in Figure 4. If the lowest common color difference of all ink combinations is reasonably low, then the hope is, that this optimized trap and transparency value combination could also be used by the trapping model to predict the overprint color of other untested inks that have similar transparency and printing conditions.

Experimental Conditions

The tested inks were selected from the basic 14 Pantone colors from which the other hundreds of Pantone shades are mixed. They were printed in different combinations, at different press speeds, both on coated and uncoated paper and in different ink sequences on the Heidelberg Speedmaster 74 press at RIT. This resulted in 60 different printing condition samples.

A special test form was hand-coded in Postscript and is customizable to different sizes and ink set combinations. Prints from it can be read in an automated fashion on a XRite iSis scanning spectrophotometer. The PostScript code for the test form automatically generates ink usage compensating stripes, to make ink consumption across the press sheet as even as possible. Figure 2 shows the layout of a press sheet.

The press sheets contained two test forms with different ink combinations and was set up for two different plate sets to be printed on the Heidelberg Speedmaster 74 press at the Print Applications Laboratory at RIT. The following lists the printing conditions that were used in the experiment:

Press:	Heidelberg Speedmaster 74
Paper:	Coated and Uncoated
Press Speed:	8000 iph, and for coated paper also 4000 iph

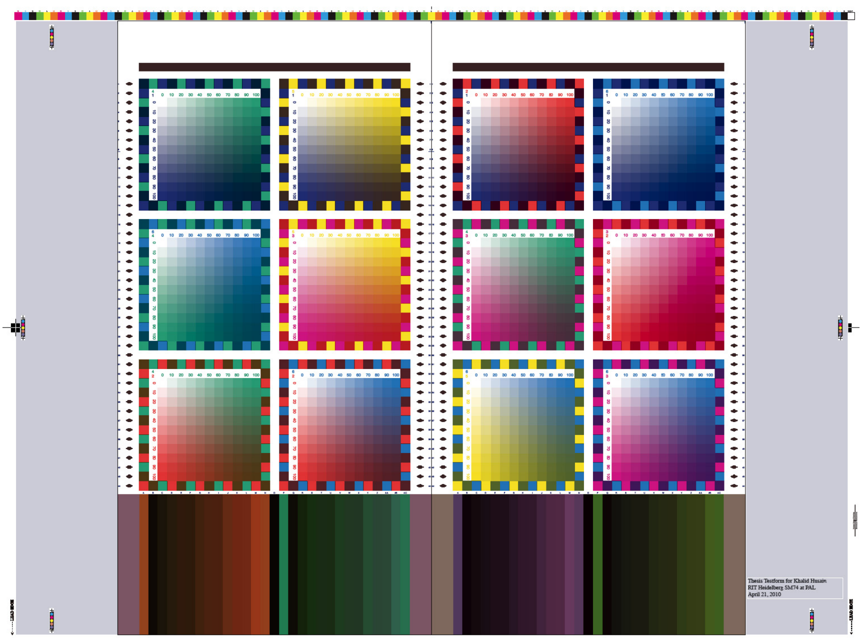


Figure 2. Press sheet layout for offset press run.

The inks were generously provided by Superior Printing Inks. The following values were supplied by the manufacturer:

	Tack	Viscosity	Yield
1 Rhodamine Red	13	1800	260
3 Yellow	11	1500	200
5 Green	11	2000	180
2 Warm Red	11	2100	200
4 Process Blue	12	2150	200
6 Purple	13	1500	200

To test for different ink sequences and time delays between printing units, for some press runs, the same ink was used in two printing units of the press. All of this resulted in 10 different printed test forms, each representing a different printing condition. Since each test form contains 6 blocks with overprints, 60 different combinations of inks and conditions were available for evaluation. For each block, the measurements of the color bars were averaged to obtain spectral measurements for the solids of the two inks, the overprint and the paper. These datasets were then used as input to the incrementation routine which was written as Visual Basic code in Microsoft Excel. The tints inside the blocks were not evaluated.

Tack Change as a Function of Setting Time

Tack difference between the 1st and 2nd ink could be used to help predict trapping. But ink tack as measured in the can and as functional at the time of printing is not the same value. One variable is the setting time that the first ink has before the second one is printed on top of it. As the ink sets, tack increases. Setting time is a function of press speed, and of the distance the paper travels between the printing of the first and second ink. On the Heidelberg Speedmaster 74 press, at 8000 iph, the time between two consecutive printing units is close to 1 second.

A test was done on a Prüfbau Deltack ink tester, to measure the change of tack as a function of time, right after it is applied to the paper. Figure 3 shows the results for some inks on coated paper. Ignoring the first second of the curves, the average slope is about .08 tack units per second delay. This means that at 8000 iph, for every additional print unit between the printing of the two inks, tack of the first down ink increases by .08 tack units. At 4000 iph, the increase is .16 tack units. These values can be used to refine the measured ink tack values to perhaps obtain a better correlation between the measured tack difference between the two inks and the incremented Hamilton minimum trap values. However, the calculated refinement has a small effect.

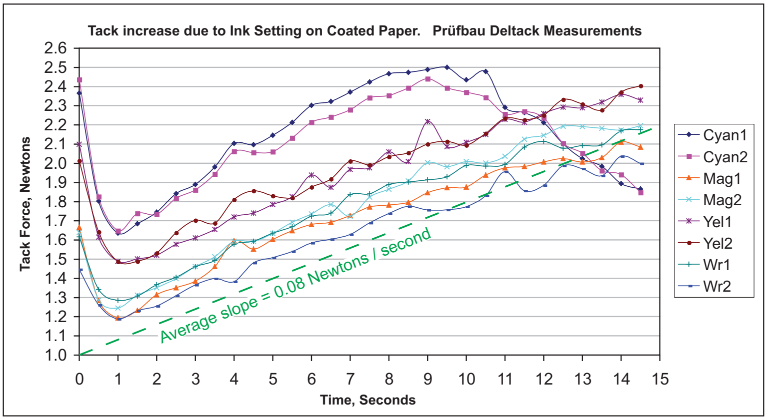


Figure 3. Change of tack as a function of setting time.

Results for Offset Prints

A first analysis of the data set resulted in the graphs of Figures 4a and 4b. Figure 4a uses the Hamilton equation, Figure 4b uses the Viggiano equation both with a saturation simulation equation where each wavelength of the second ink is multiplied with a constant of 3.85.

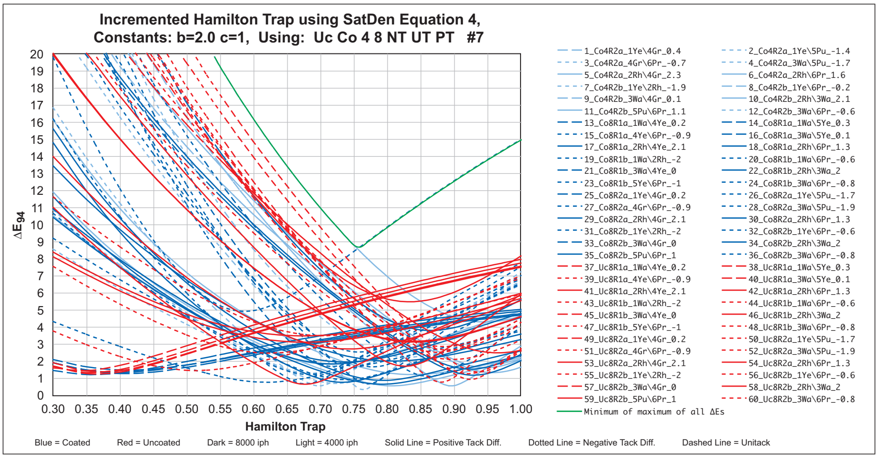


Figure 4a. Incremented Hamilton Trap for all data using a constant addition of 2.0 in Eq. 4 to simulate saturation density

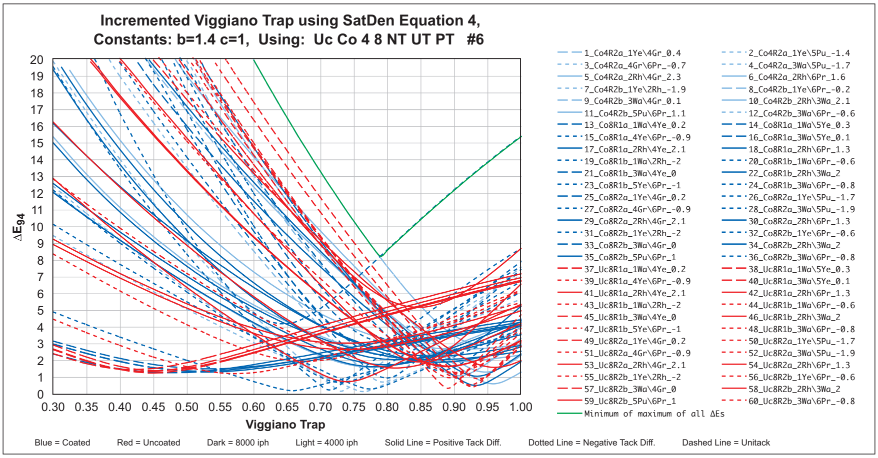


Figure 4b. Incremented Viggiano Trap for all data using a constant addition of 1.4 in Eq. 4 to simulate saturation density

The question that needs to be answered is this: is the color difference at the lowest common trap value for all the experimental conditions low enough to be practically useful? The data in Figure 4a suggests that at a Hamilton Trap of 76%, the color difference between the actual overprint color and predicted color is not more than 8.6 ΔE^*_{94} for all tested printing conditions. A surprisingly low result, considering that the optimum trap for each curve varies over a range from 35% to 95%. It is also a practically useful maximum deviation, considering that ISO12647 specifies 5 ΔE_{76} for production tolerances.

As can be seen, the two trapping models give almost the same results. The minimum common color difference is the same for both, however, the trap value at the minimum color difference is slightly different. The Viggiano equation was used for the remaining tests because it is a little simpler.

Saturation Equations with Two Constants

When saturation equations with two constants are used, then the incremental procedure has to be done two dimensionally. That is, each of the 'b' constants has to be evaluated in combination with each 'c' constant. It is the lowest areas of the resulting color difference surface where the good combinations are. It is possible that several combinations result in essentially equivalent minimum color difference values. Figure 5 shows an example of such a color difference surface.

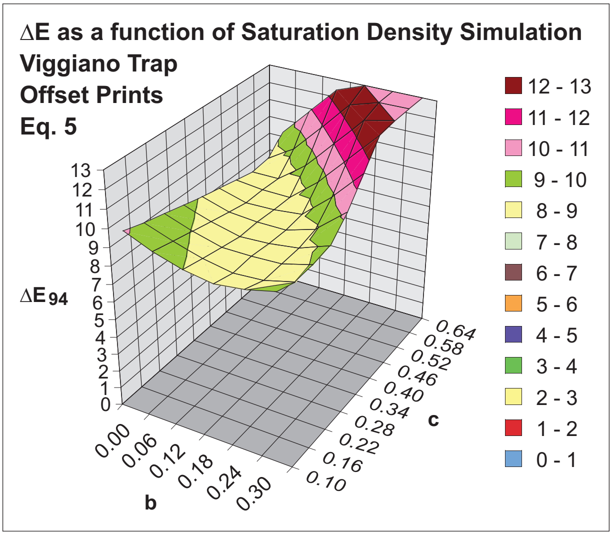


Figure 5. Saturation Density equation with two constants.

The reader might have noticed that for the pre-Taga-conference extended abstract of this document, different optimal values have been published than are mentioned in this document. Both are correct, they simply resulted from different combinations of trapping equations and/or saturation density equations.

The choice of saturation density equation and constants was determined after studying the CRF curves which are discussed next.

Cumulative Relative Frequency Curves

Most curves of Figure 4 show color difference values lower than the minimum common color difference at the optimum iterated Hamilton trap value. To also consider these lower values, a histogram of all color difference values at that minimum trapping value can be plotted in the form of a CRF (Cumulative Relative Frequency, also known as the Empirical Distribution Function) curve as shown in Figure 6. The more the curve is located to the left, the better the performance (smaller color difference values). The CRF curves can be used as additional criteria to select the parameters for the trapping equations. Not only do we want to find the lowest common color difference of all the sets, but the average of the minimum color differences above the 50 percentile relative frequency should also be as low as possible.

Determining the Best Saturation Density Parameters

There are different ways to determine saturation density. Figure 6 shows a comparison of the effect of equations 3,4 and 5 and also indicates the results from actual measurements of saturation density. At the chosen values of the equations, all methods yield about the same minimum common color difference, but the curves differ slightly in the color differences above the 50 percentile. It turns out that for offset inks, simply adding a constant to each wavelength of the density of the second ink is as good as the other, more complicated methods tested.

The graph also shows that the measured saturation density does not result in better predictions than the simulated saturation densities. This is fortunate, it means that it is not necessary to go through the messy procedure of measuring all spot colors.

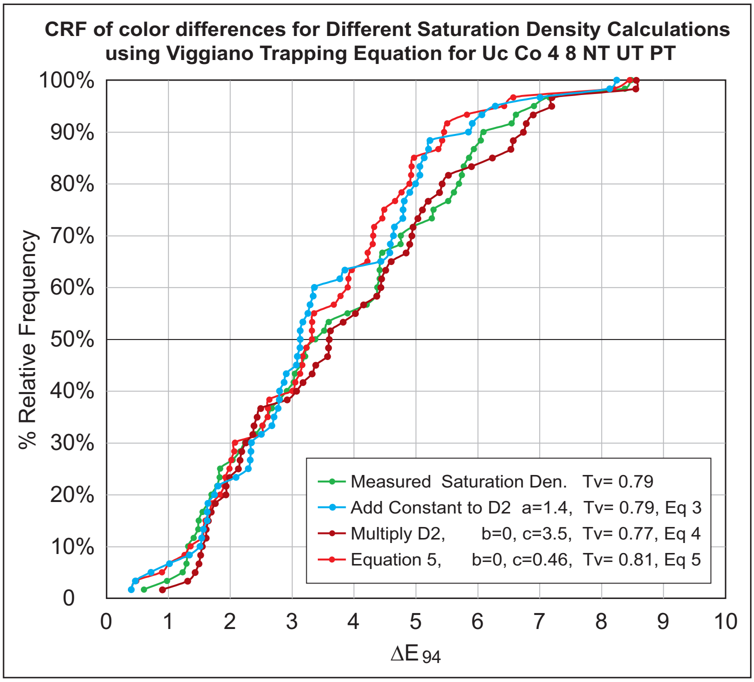


Figure 6. Comparison of different Saturation Densities.

Now that the basic procedures have been determined, the question whether it is possible to reduce the minimum common color difference value is considered. The following is a discussion of different possible strategies.

Trap and Tack

Because tack is one of the major variables that affects trap, it might be possible to improve the performance of the trapping model prediction by making the trap value in the equation a function of the tack of the inks. If this is the case, then there should be a relationship between tack difference and the optimized trap of the incremented values. Figure 7a shows that the correlation is very poor; the trendline for the tack values has a slope of only 0.014. When tack values are compensated for press speed and for printing unit difference (as discussed in connection with Figure 3), the slope of the trend line is a little better: 0.019 as shown in Figure 7b. This means that using compensated tack does make an improvement, but not enough to be significant.

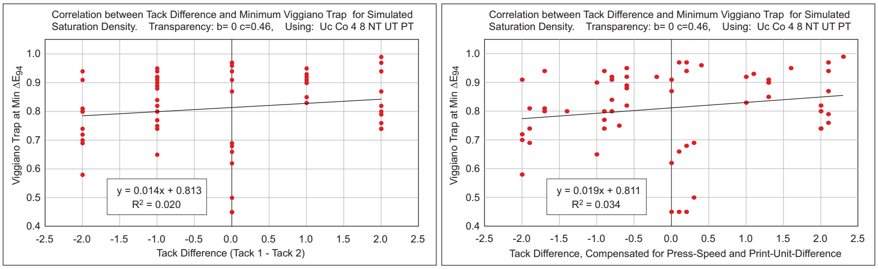


Figure 7a and 7b. Correlation between tack and minimum Viggiano Trap.

From this we can conclude that the cost-benefit ratio of using tack information to improve the predictive quality of the trapping model is very unfavorable. The benefit is very small, but the organizational cost of obtaining and using the tack info, and possibly ink sequence and press speed info, is very high. Therefore, tack information can be ignored when using the trapping models to predict overprint color, at least for the data that was used in this experiment.

Reducing Color Differences by Excluding Some of the Printing Conditions

One way to reduce the color difference at optimum trap could be to calculate the parameters for a limited set of printing conditions, such as having separate values for coated or uncoated paper, or for positive or negative tack sequences. Table 1 shows some tested printing conditions and the results obtained.

Data for different printing conditions Viggiano Trapping Model Simulated Saturation Density = $D_{2,\infty,\lambda} = D_{P,\lambda} + b + (c \cdot (D_{2,\lambda} - D_{P,\lambda}))$ b=1.4, c=1	Min. Common Incremen-ted Trap= optimum	ΔE at Min. Common Trap	ΔE, Average of values above 50 percentile, at optimum Trap
#1 T = 1.4, 1, Uc Co 4 8 NT UT PT	79	8.2	4.9
#2 T = 1.4, 1, Co 4 8 NT UT PT	79	8.2	4.4
#3 T = 1.4, 1, Uc 8 NT UT PT	83	5.5	4.5
#4 T = 1.4, 1, Co 8 NT UT PT	75	6.8	4.6
#5 T = 1.4, 1, Co 4 NT UT PT	88	4.3	3.7
#6 T = 1.4, 1, Co 4 8 PT	89	2.7	2.6
#7 T = 1.4, 1, Co 4 8 NT	74	6.4	4.6
#8 T = 1.4, 1, Co 4 8 UT	89	3.8	3.6
#9 T = 1.4, 1, Uc Co 8 NT UT PT	78	7.9	5.0

The abbreviations describing the printing conditions mean the following:

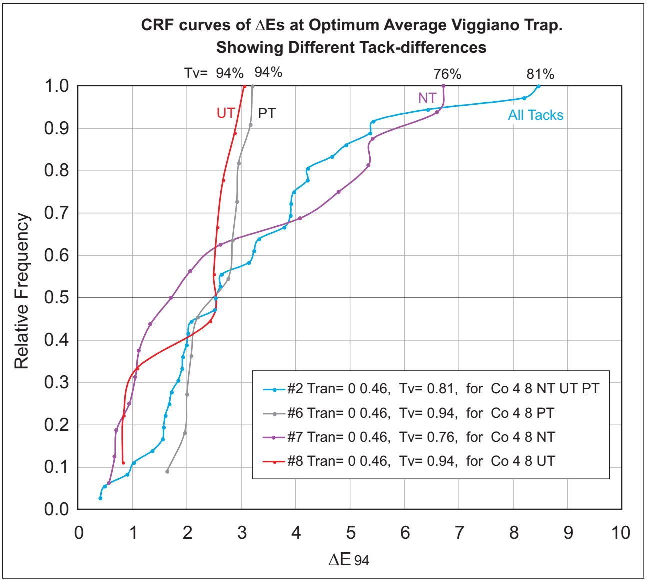
T	= Constants in the saturation density equation
Uc	= Uncoated paper
Co	= Coated paper
4	= Press speed is 4000 impressions per hour
8	= Press speed is 8000 impressions per hour
NT	= Negative tack difference for the two inks
UT	= Unitack, less than ± 0.5 Tack difference between inks
PT	= Positive tack difference

Table 1. Optimum incremented Viggiano Trap and color differences for various data sets.

The data in Table 1 was obtained from graphs that are similar to the graphs of Figure 4, but using less than the full set of printing conditions. The minimum common color difference can be reduced, by limiting the range of printing conditions, for instance when only positive or negative tack differences are used as shown in Figure 8. Reducing press speed also reduces color differences as shown in Figure 9. In general, a slower press speed results in smaller color difference values. This is expected since the first printed ink has more setting time where tack is increased. This results in better trap values. This effect is most pronounced for the unitack inks. Note: the more data is excluded from the data set, the smaller and less representative is the sample on which the results are based.

The curves of Figure 7 show that positive tack differences result in small color difference values. This is as expected, it means that the first ink has a higher tack than the second ink. When using CMYK inks, ink tacks are adjusted so that the first ink printed has the highest tack and the following inks have progressively lower tack. This is possible because ink sequence is standardized for process color printing. Having a higher tack for the first printed ink helps to better transfer the second ink, resulting in relatively high trap values. On the other hand, when using spot color inks, ink sequence could be anything. Therefore, unitack inks are often used for spot colors, relying on tack increase right after ink transfer due to the absorption of the ink into the paper surface.

However, at the time a designer would need to know the colors of overprints, printing ink sequence or press speed are not known and therefore we cannot take advantage of specifying such values to obtain smaller errors.



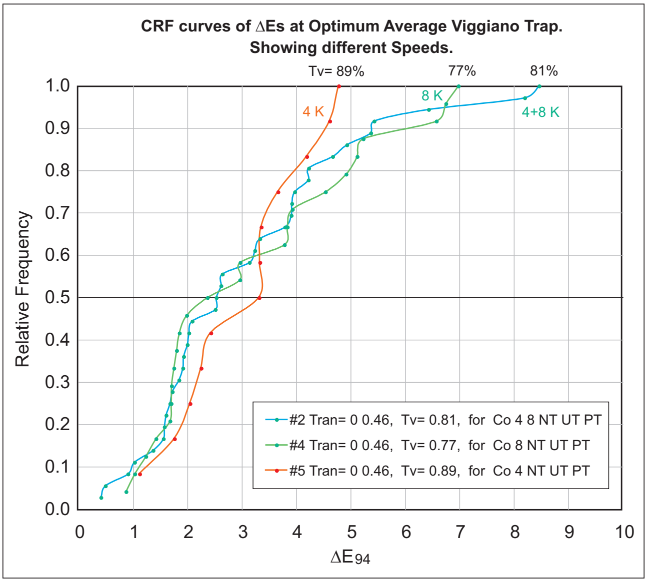


Figure 8 (top). CRF curves for different tack and ink sequences.
Figure 9 (bottom). CRF curves for press speed differences.

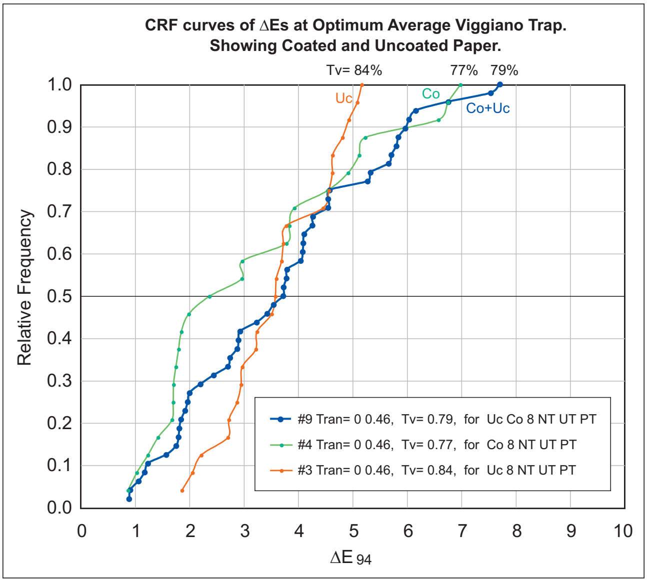


Figure 10. CRF curves for coated and uncoated paper.

Paper quality might be known. But the comparison of the values for data sets #3 and #4 shows too small a difference to make it worth while. The reason why paper was not found to be a strong factor for the predictive quality of the equation is because the spectral measurements of the single ink samples are made on the respective coated or uncoated paper, and therefore the most important effects of paper are incorporated into the mathematical model.

The results shown in this report may not be fully achieved in practice because the printing conditions for the printing of a Pantone sample book, from which the spectral curves of the two inks are taken, may not match the printing conditions (such as paper or ink density) for a given print job.

Unfortunately, when the press sheets were printed, we forgot to print the uncoated sheets at 4000 iph. Therefore there are less uncoated samples than coated samples which has an effect on the shape of the CRF curves. Figure 10 therefore only shows the data for the press speed with 8000 iph.

The conclusion from the analysis of the offset prints is that excluding data from the data set, in order to improve the predictive quality of the equation, is not improving the results enough to make it worth while. The advantage of including all data is that the trap and transparency parameters are universal and do not need to be reset for different applications.

Results for HP Indigo prints

Offset printing has wet ink trapping. Therefore trap values are lower than if the second ink were only printed on previously dried ink. It would be interesting to see whether the trapping models give higher trap values in a case of dry trapping, such as when printing on an HP Indigo press.

The same testform that was used for offset printing was also printed on the Indigo 7000 press at the Printing Applications Lab at Rochester Institute of Technology. There were 4 press runs, each one using CMYK inks and one spot color. For each ink setup, ink sequence was changed under software control. All inks, including the overprints with the CMY colors were evaluated. 72 Sample conditions were evaluated, but many of them were replicates of CMY overprints from the different press runs. Figure 11 shows the trap curves of the Indigo prints, and Figure 12 shows the CRF curve at minimum common trap. It is reassuring to see that the minimum common trap value is much higher than for offset, as expected, and there is less variability.

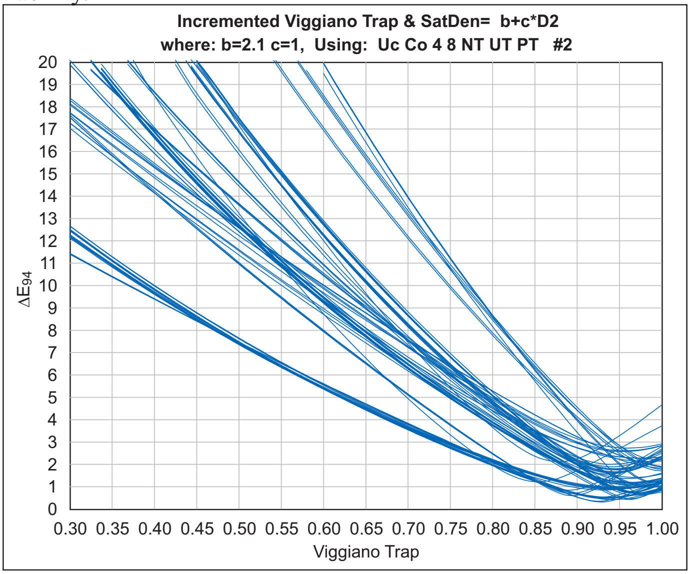


Figure 11. Trapping curves for prints on HP Indigo 7000.

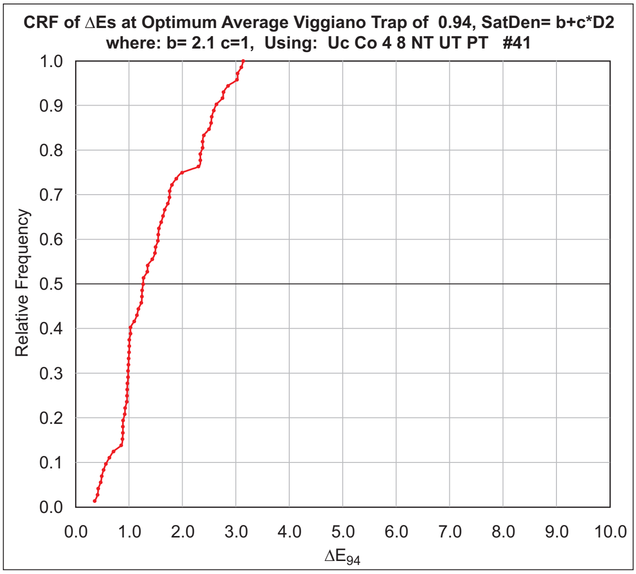


Figure 12. CRF Curve for prints on HP Indigo 7000.

It is reassuring to see that the minimum common trap value is much higher than for offset, as expected, and there is less variability. Interestingly, even if the constants optimized for offset were used on Indigo, the minimum color difference would still fall within the offset limit of less than 8.6 ΔE^*_{94}.

Summary and Conclusions

The Hamilton and Viggiano trapping models were used to predict the color of two spot color overprints for coated and uncoated offset printed press sheets, using 6 Pantone inks in various combinations and various tack differences, and for two press speeds. 60 samples with different printing conditions were analyzed. Although this is not necessarily representative for all possible Pantone colors, the sample size is large enough to give a preliminary indication of the potential predictive accuracy that can be achieved. In an additional test, the trapping models were also tested on two color overprints printed on a HP Indigo 7000 press.

Based on the results from these tests, the following conclusions can be drawn:
Both the Hamilton and Viggiano trapping models work quite well, the predicted color of two color offset overprints does not deviate more than 8.6 ΔE^*94 from the actual prints tested in this experiment.

The methodology only uses spectral input data from single inks and paper, and an estimate of trapping and transparency constants of the second ink. This means that ink sequence also needs to be specified.

For the data tested in this experiment, for offset prints on paper (coated or uncoated), when using the following equation to simulate the saturation density: $D_{2,\infty,\lambda} = D_{P,\lambda} + b + c \cdot (D_{2,\lambda} - D_{P,\lambda})$, the following constants resulted in color differences relative to actual prints of less than 8.6 ΔE^*_{94} for 100 % of samples, and less than 5 ΔE^*_{94} for 80% of the samples:
For the Hamilton trapping model (Eq. 1), Th = 76%, b = 2.0, c = 1, (Figure 4a).
For the Viggiano trapping model (Eq. 2), Tv = 79%, b = 1.4, c = 1, (Figure 4b, Table 1).

Simulation of the saturation density of the second ink can be achieved by adding a constant or by using a constant multiplication factor for each spectral density value of the second ink. The results are as good or better than measurements of saturation density.

The difference between the Hamilton and the Viggiano trapping models is very small. When the variables for them are incremented, both find essentially the same lowest common color difference, but may require slightly different trapping and transparancy constants.

Predictions of overprint colors for a limited sample of prints made on an HP Indigo press were even more accurate, less than 3.3 ΔE^*_{94} at a Tv of 94%.

Future Work

Once the color of a two color overprint is known, then the models such as described in Viggiano (2010) can be used to also calculate the tints of the single colors and all combinations of tint overprints. This means that it would be possible to calculate the colors of a profiling target. Such a two dimensional target would look like one of the blocks shown in Figure 2. From such a profiling target it is possible to make a color profile which then can be used to render images on a monitor or print.

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