COLOR '16

Process Control for Digital Presses

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#Color2016

Advancing Graphic Communications
PRINTING INDUSTRIES OF AMERICA

CONTROL COLOR

Outline

- What's different about digital: the need for color management
- Digital press types and challenges for process control
- Types of color drift: short- v long-term
- Establishing the target condition
- The 4 types of color control software, pros/cons
- Advice and conclusions

Not in this presentation:

- Detailed look at sampling and statistics, databases, etc.
- Detailed instructions on building profiles
- Evaluation of commercial PC or CM solutions

Why talk about digital presses at all?

- Fastest growing print sector
- Poorly understood by traditional printers
- Requires a different approach to color control

Digital press types

I. **Dry toner electrographic presses**

- Examples: Xerox, Canon, Ricoh, etc.
- Approximately gray-balanced
- Fast warmup
- Not particularly stable

Digital press types

II. Liquid toner electrographic presses

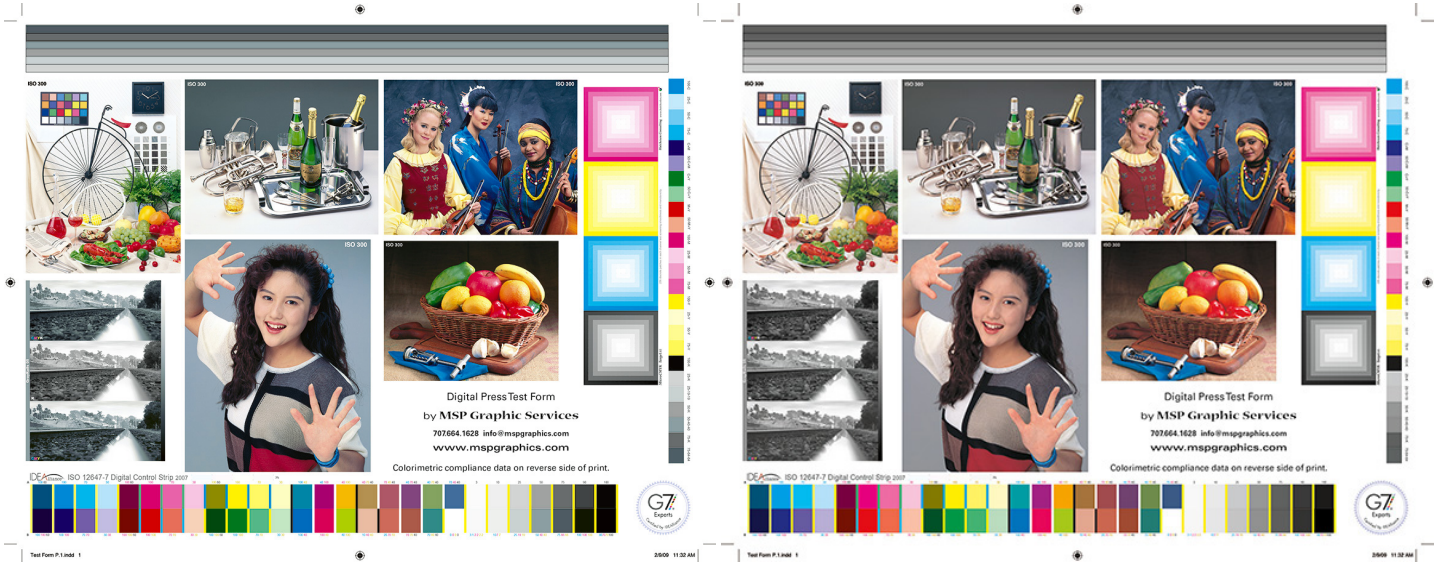
- Example: HP Indigo
- Natively the most “offset-like”
- Large output gamut with up to 7 colors
- Fast warmup
- Requires frequent calibration

Digital press types

III. Inkjet (UV, aqueous, solvent)

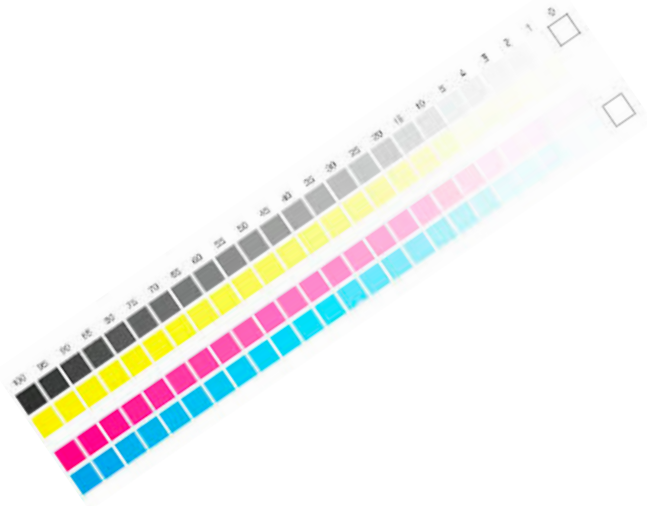
- Example: EFI Jetrion, VUTEk, Agfa Sherpa, Fuji Acuity, many, many others
- No warmup
- Stable output
- No user hardware calibration
- Large output gamut
- Natively not gray balanced (not even close!)

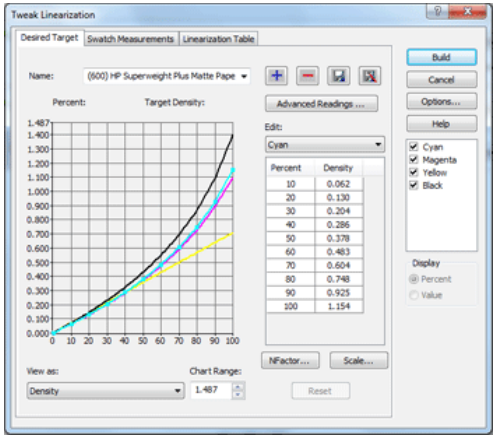
Digital presses must be profiled



First Steps

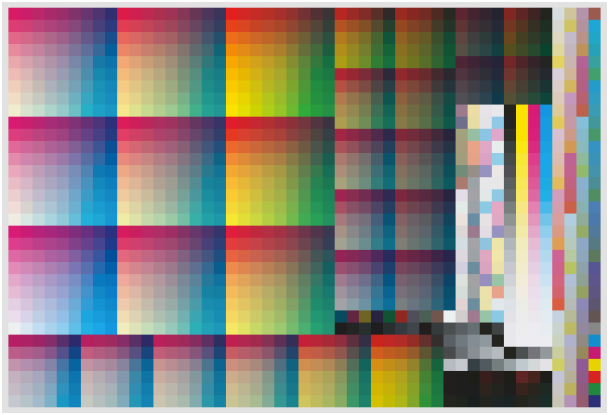
- Device Calibration/system maintenance

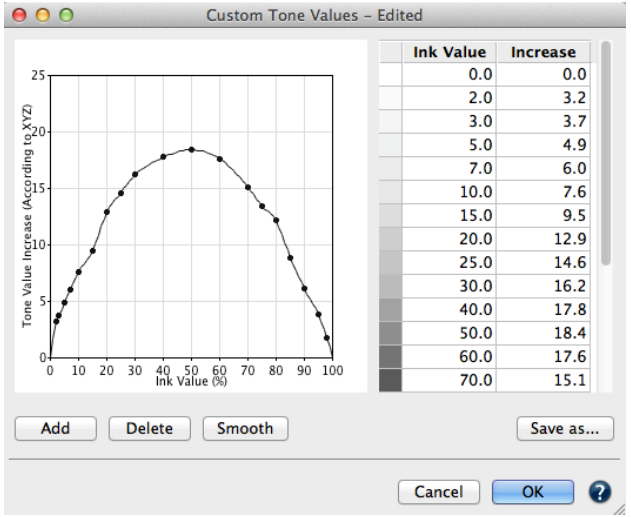




First Steps

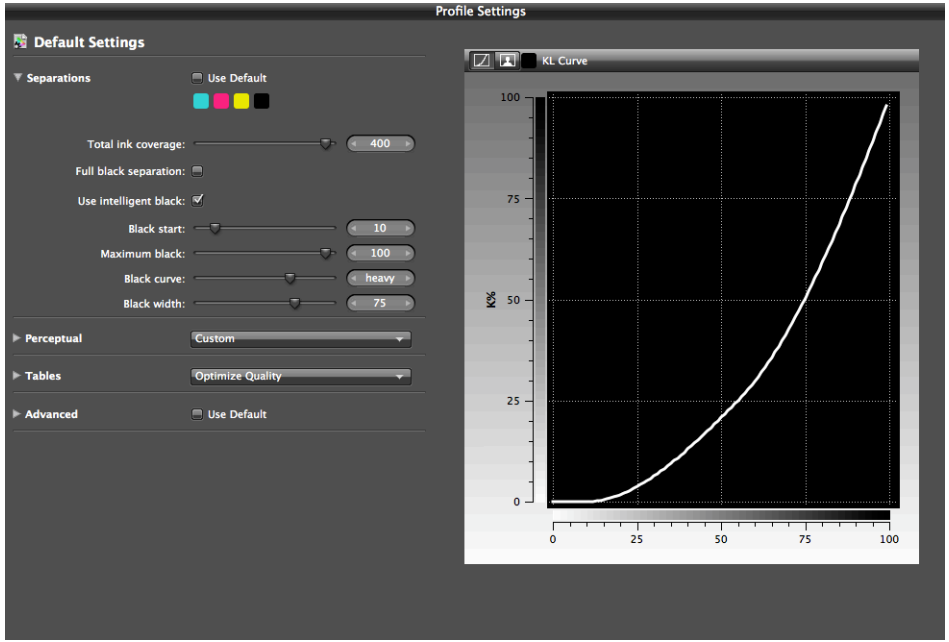
- Gather good, *typical* output data

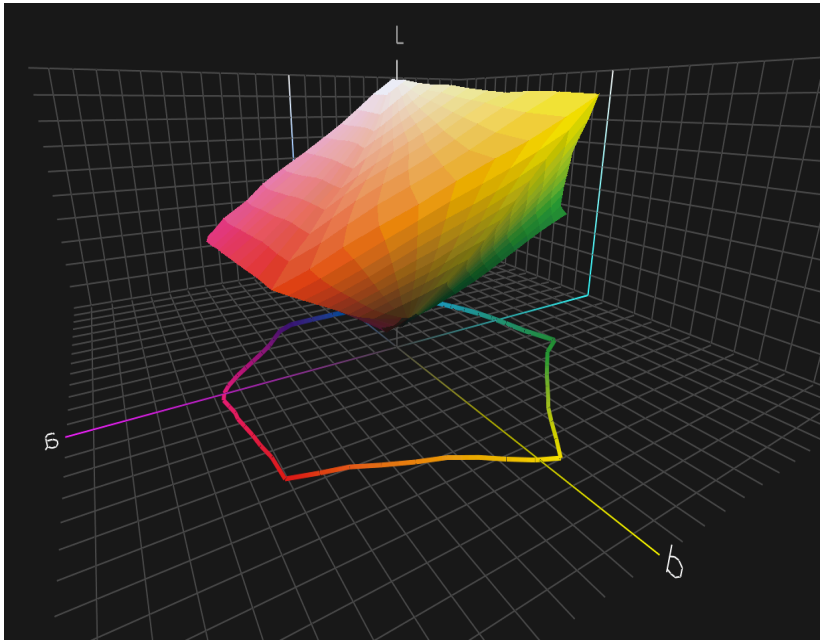




First Steps

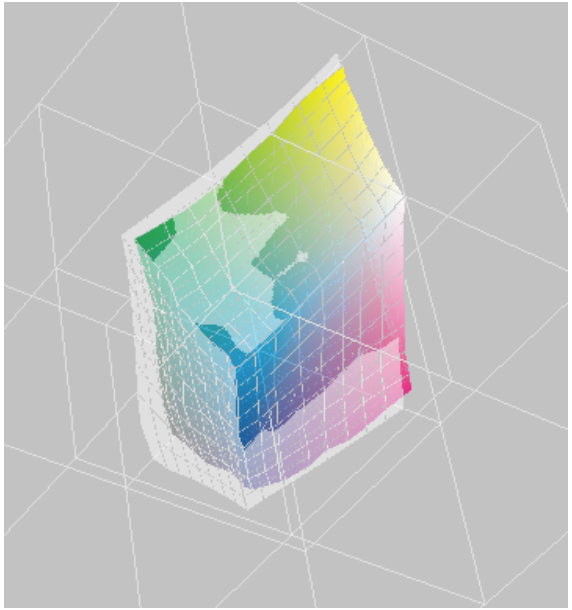
Make the Profile



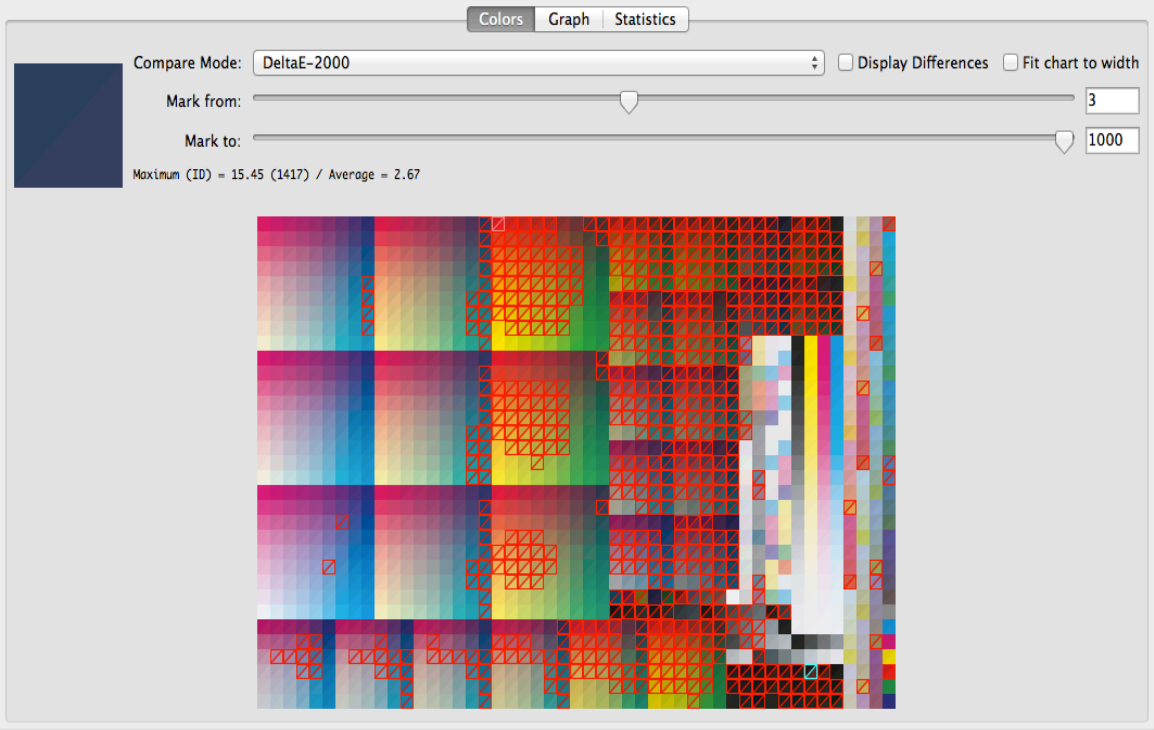


Setting Expectations

Can you reach the target?



Look at the numbers!



- Maximum = 15.45 (1417)
- Average = 2.67
- Sigma = 1.63
- Median = 2.37
- Coeff of Variation = 0.61

- Worst Patches:
- 15.45 (1417)
- 11.97 (1450)
- 11.15 (1354)
- 11.02 (1219)
- 10.78 (1418)
- 10.41 (1082)
- 10.35 (1252)
- 9.87 (1285)
- 9.75 (1355)
- 9.39 (1057)

- Distribution:
- 10% Patches <= 1.0
- 20% Patches <= 1.3
- 30% Patches <= 1.6
- 40% Patches <= 2.0
- 50% Patches <= 2.4
- 60% Patches <= 2.8
- 70% Patches <= 3.3
- 80% Patches <= 3.9
- 90% Patches <= 4.6
- 95% Patches <= 5.5
- 100% Patches <= 15.4

Look at the numbers!

(Spot colors)

Configuration: GRACoL2006_to_Indigo_CalGloss_CMYK_M1
Target Profile: Indigo_CalGloss_CMYK_4500_062116_M1-WhiteOrigBacking_300-300.icc

Name	Conversion:	Target Lab	CMYK	Lab	dE00	DeltaE-76
PANTONE 100 C	PANTONE+ Solid Coated-V3	92.04 -7.56 65.78	2.1 0.0 78.1 0.0	90.23 -6.12 65.88	1.4	2.3
PANTONE 101 C	PANTONE+ Solid Coated-V3	91.76 -7.51 75.12	2.1 0.0 86.3 0.0	90.39 -6.10 75.00	1.2	2.0
PANTONE 102 C	PANTONE+ Solid Coated-V3	90.24 -4.87 106.30	0.0 0.0 100.0 0.0	90.48 -4.76 93.67	2.3	12.6
PANTONE 103 C	PANTONE+ Solid Coated-V3	70.15 0.46 83.74	0.0 10.7 100.0 19.5	73.08 1.07 74.54	3.0	9.7
PANTONE 104 C	PANTONE+ Solid Coated-V3	63.55 -0.29 70.66	0.0 12.1 100.0 36.3	64.86 -0.12 65.45	1.7	5.4
PANTONE 105 C	PANTONE+ Solid Coated-V3	51.58 -0.75 45.50	0.0 15.2 94.7 60.1	51.61 -0.72 45.66	0.1	0.2
PANTONE 106 C	PANTONE+ Solid Coated-V3	90.66 -4.13 74.71	0.0 1.2 85.4 0.0	90.74 -4.22 74.64	0.1	0.1
PANTONE 107 C	PANTONE+ Solid Coated-V3	89.83 -2.47 84.14	0.0 3.4 94.4 0.0	89.28 -2.91 84.02	0.4	0.7
PANTONE 108 C	PANTONE+ Solid Coated-V3	88.45 0.62 94.52	0.0 7.3 100.0 0.0	87.98 -0.33 91.91	0.8	2.8
PANTONE 109 C	PANTONE+ Solid Coated-V3	86.28 5.99 98.56	0.0 11.3 100.0 0.0	86.10 2.52 90.10	2.3	9.1
PANTONE 110 C	PANTONE+ Solid Coated-V3	72.59 9.31 88.89	0.0 23.2 100.0 8.4	76.19 8.96 78.76	3.4	10.8
PANTONE 111 C	PANTONE+ Solid Coated-V3	59.30 4.69 68.12	0.0 23.8 100.0 38.5	60.90 4.55 61.44	2.2	6.9
PANTONE 112 C	PANTONE+ Solid Coated-V3	56.17 2.49 57.21	0.0 23.0 100.0 48.9	56.39 2.48 56.29	0.3	0.9
PANTONE 113 C	PANTONE+ Solid Coated-V3	89.72 -1.34 69.52	0.0 4.9 82.4 0.0	89.19 -1.76 69.56	0.4	0.7
PANTONE 114 C	PANTONE+ Solid Coated-V3	89.06 -0.09 75.69	0.0 6.7 88.8 0.0	88.34 -0.68 75.61	0.6	0.9
PANTONE 115 C	PANTONE+ Solid Coated-V3	88.17 1.58 82.46	0.0 8.7 94.9 0.0	87.12 0.74 82.40	0.8	1.3
PANTONE 116 C	PANTONE+ Solid Coated-V3	85.45 8.25 89.48	0.0 16.3 100.0 0.0	83.77 5.93 87.76	1.7	3.3
PANTONE 117 C	PANTONE+ Solid Coated-V3	66.18 11.95 78.63	0.0 29.9 100.0 18.2	68.49 11.10 70.22	2.7	8.8
PANTONE 118 C	PANTONE+ Solid Coated-V3	58.13 8.99 66.32	0.0 31.3 100.0 36.1	59.62 8.55 60.16	2.1	6.4
PANTONE 119 C	PANTONE+ Solid Coated-V3	49.67 2.40 45.85	0.0 25.0 97.2 59.8	49.65 2.39 45.91	0.0	0.1
PANTONE 120 C	PANTONE+ Solid Coated-V3	88.57 2.65 61.10	0.0 10.4 75.9 0.0	87.38 1.90 60.73	0.9	1.5
PANTONE 1205 C	PANTONE+ Solid Coated-V3	89.97 1.42 43.30	0.0 7.9 53.0 0.0	88.83 0.86 43.04	0.8	1.3
PANTONE 121 C	PANTONE+ Solid Coated-V3	87.81 4.16 66.13	0.0 11.8 81.7 0.0	86.17 3.01 65.62	1.3	2.1
PANTONE 1215 C	PANTONE+ Solid Coated-V3	88.03 4.52 54.26	0.0 12.4 69.1 0.0	86.59 3.66 54.14	1.1	1.7
PANTONE 122 C	PANTONE+ Solid Coated-V3	86.43 7.04 73.19	0.0 15.3 90.1 0.0	84.28 5.27 72.95	1.8	2.8
PANTONE 1225 C	PANTONE+ Solid Coated-V3	84.38 12.12 69.90	0.0 22.8 89.5 0.0	81.36 9.71 69.38	2.5	3.9
PANTONE 123 C	PANTONE+ Solid Coated-V3	84.11 12.65 77.82	0.0 23.6 95.9 0.0	81.06 10.05 77.34	2.5	4.0
PANTONE 1235 C	PANTONE+ Solid Coated-V3	80.67 20.70 79.11	0.0 36.9 100.0 0.0	76.87 17.43 78.61	3.2	5.0

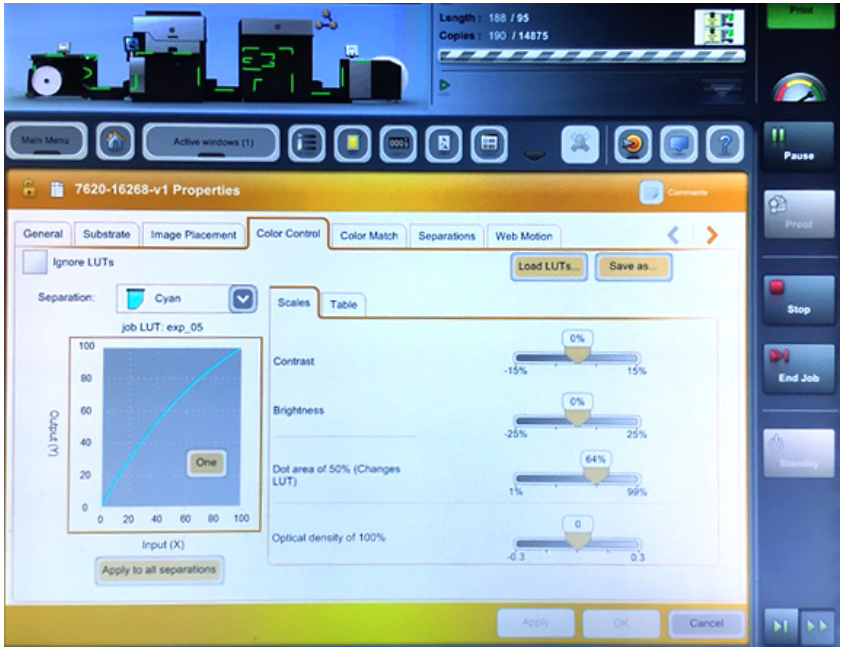
Setting the Target

Possible compliance goals:

- Color space (GRACoL2013, Fogra 51, et al)
- Adjusted color space (if target OOG)
- G7 “targeted,” “Grayscale”
- Adjusted spot color targets

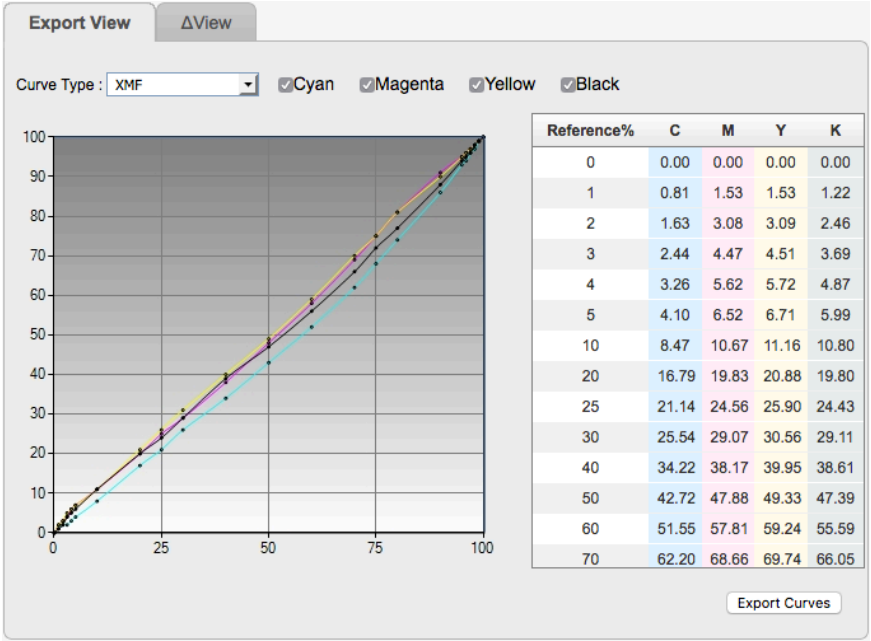
Four Approaches to Process Control

1. Simple density and linearity calibration



Four Approaches to Process Control

1. Simple density and linearity calibration



Reference%	C	M	Y	K
0	0.00	0.00	0.00	0.00
1	0.81	1.53	1.53	1.22
2	1.63	3.08	3.09	2.46
3	2.44	4.47	4.51	3.69
4	3.26	5.62	5.72	4.87
5	4.10	6.52	6.71	5.99
10	8.47	10.67	11.16	10.80
20	16.79	19.83	20.88	19.80
25	21.14	24.56	25.90	24.43
30	25.54	29.07	30.56	29.11
40	34.22	38.17	39.95	38.61
50	42.72	47.88	49.33	47.39
60	51.55	57.81	59.24	55.59
70	62.20	68.66	69.74	66.05

Types of Color Control Tools

1. Simple density and linearity calibration

Pros:

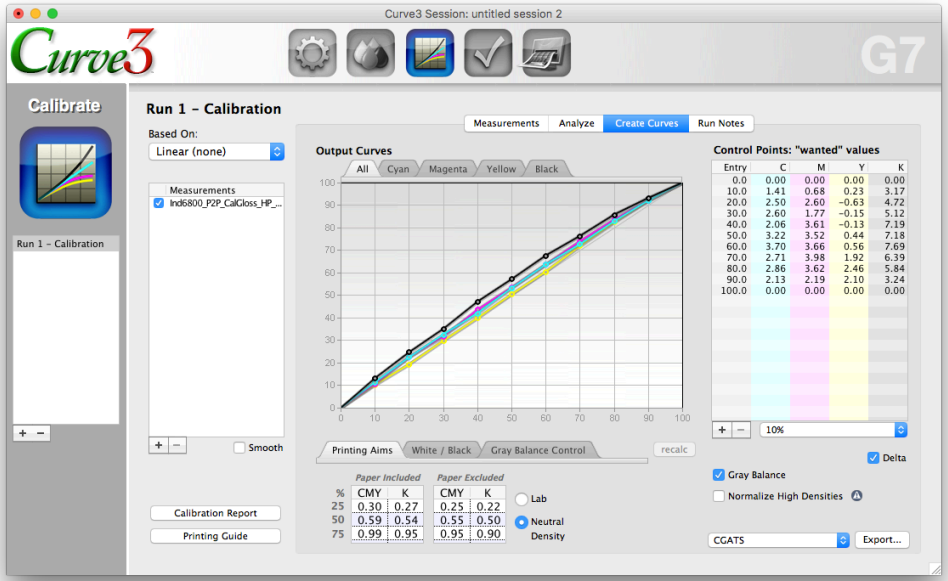
- Familiar to traditional press operators
- Adjusts both solids and TVI

Cons:

- Could be time-consuming
- Cannot adjust gray balance
- Cannot adjust overprints
- May not be accurate enough

Types of Color Control Tools

2. Gray-balancing curves



Types of Color Control Tools

2. Gray-balancing curves

Pros:

- Adjusts both tonality and gray balance
- Excellent method for removing obvious color error in images

Cons:

- Does not adjust solids and overprints
- Has little or no impact on strong colors
- May require third-party software and offline measuring

Types of Color Control Tools

3. “3D,” or reprofiling approaches

Types of Color Control Tools

3. “3D,” or reprofiling approaches

Pros:

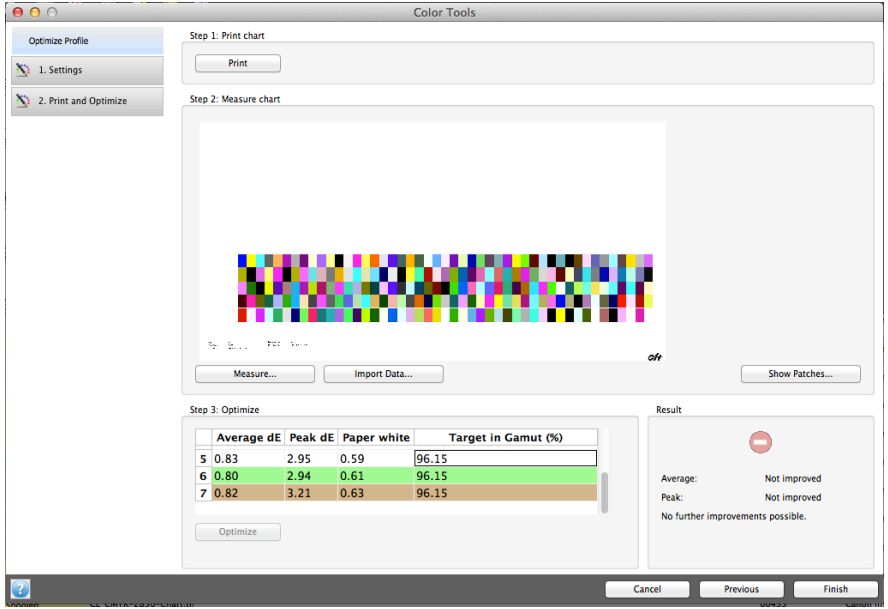
- Overall best accuracy; adjusts tonality, gray balance, overprints, and solids*
- Easy

Cons:

- May require third-party software, offline measurements
- Can be time-consuming
- Most apps limited to 4 output channels

Types of Color Control Tools

4. Lab Optimization



Types of Color Control Tools

4. Lab Optimization

Pros:

- Best way to improve match to a reference
- Easy--integrated in a DFE
- Can use a small chart

Cons:

- Iterative procedure can be time-consuming
- Specific to one reference print condition
- Not available as standalone application

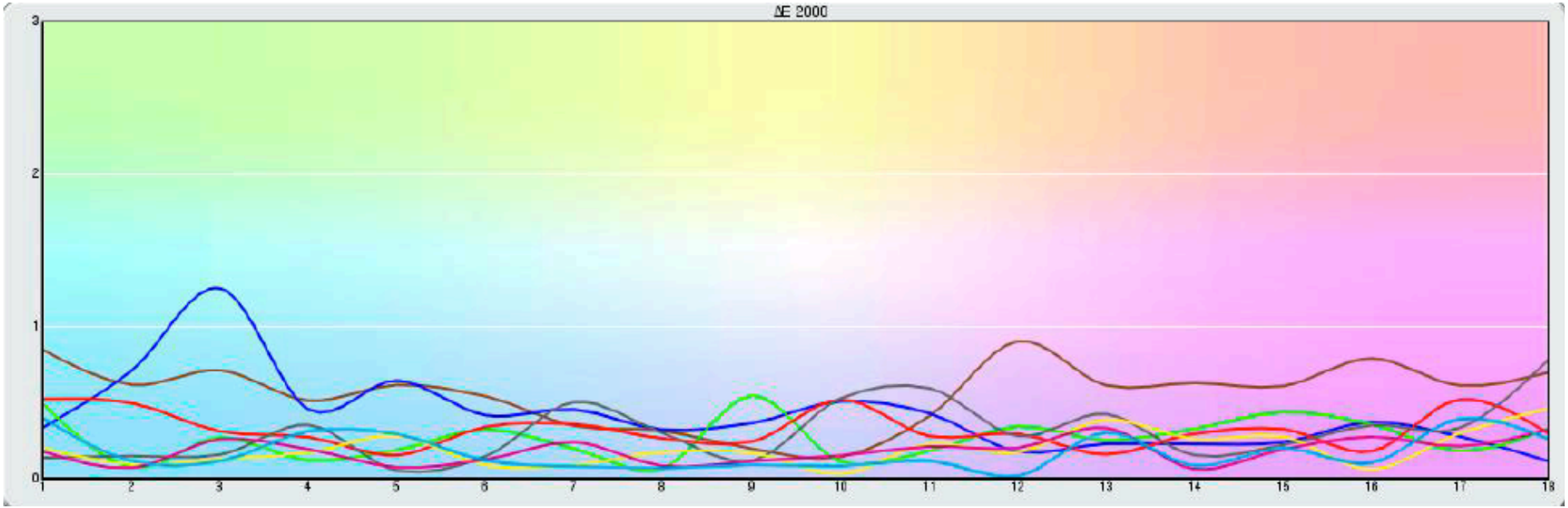
What about more than 4 channels?

Options:

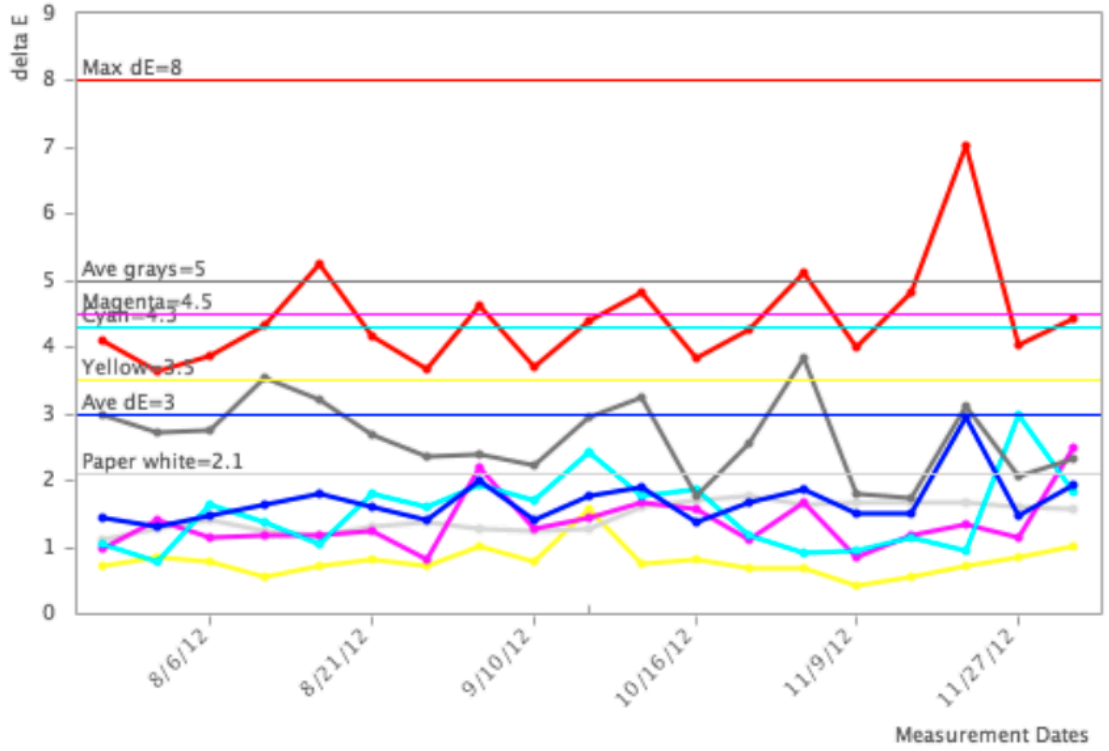
- Relinearization
- Full reprofiling
- Abbreviated reprofiling

Considerations for process control

Short-term variation: The “uncertainty floor”



Long-term color variation



Tolerances: Keep it real!

- Historical data for device, substrates
- Established industry specs (e.g., G7 pass-fail)
- Brand owner mandates

Conclusions

- Correct only for longer-cycle drift
- Set appropriate tolerances
- Know the 4 types of color adjustment
- Balance effectiveness and time required, inline v offline
- Consider the type of work: process Images v brand colors, and choose tools accordingly

Thanks

Alder Technology/Bruce Bayne
Canon USA
Chromix
ColorLogic GMBH
EFI
Fujifilm USA
Hewlett Packard
Onyx Graphics
Paragon Label
John Seymour
X-Rite