The Optimal Method

Solution for Print Calibration

Print Experience

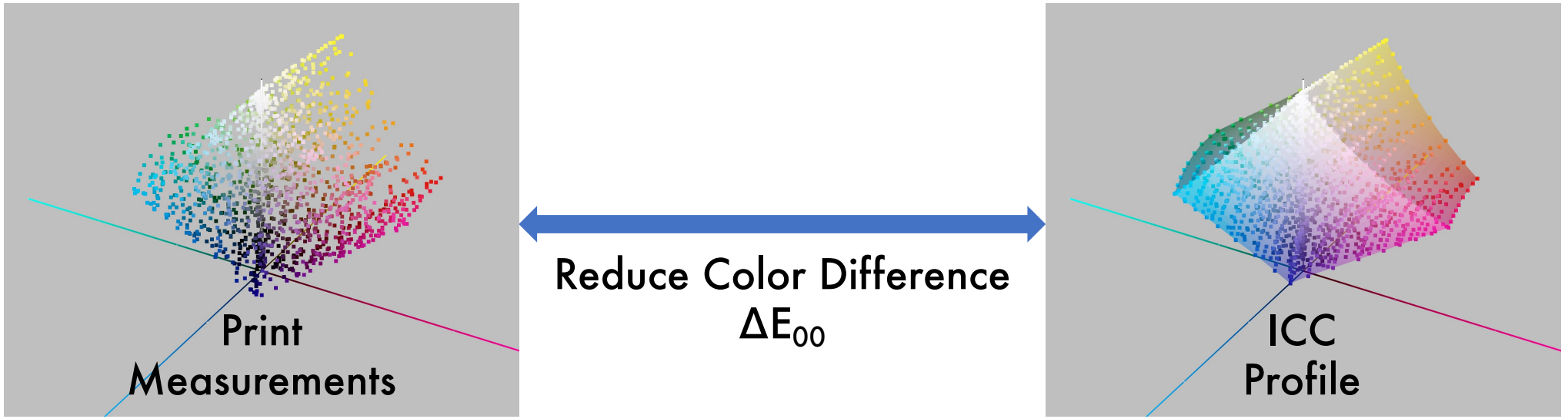
- **Charles (Chuck) Spontelli**
  Professor Emeritus BGSU, RIT School of Printing
  Taught print and color for 35 years
  Print color consultant for 5 years
- **William (Bill) Birkett**
  Engineer, University of Michigan
  Owned a prepress company for 32 years
  Print color consultant for 17 years

Calibration Methods

- TVI/SCTV
  - Use Curves to match prescribed tonality of process colors
- Near Neutral
  - Use Curves to match prescribed gray balance and tonality
- Color Management
  - Use Color Management to match an ICC Profile
- Optimal Method
  - Use Curves to match an ICC Profile

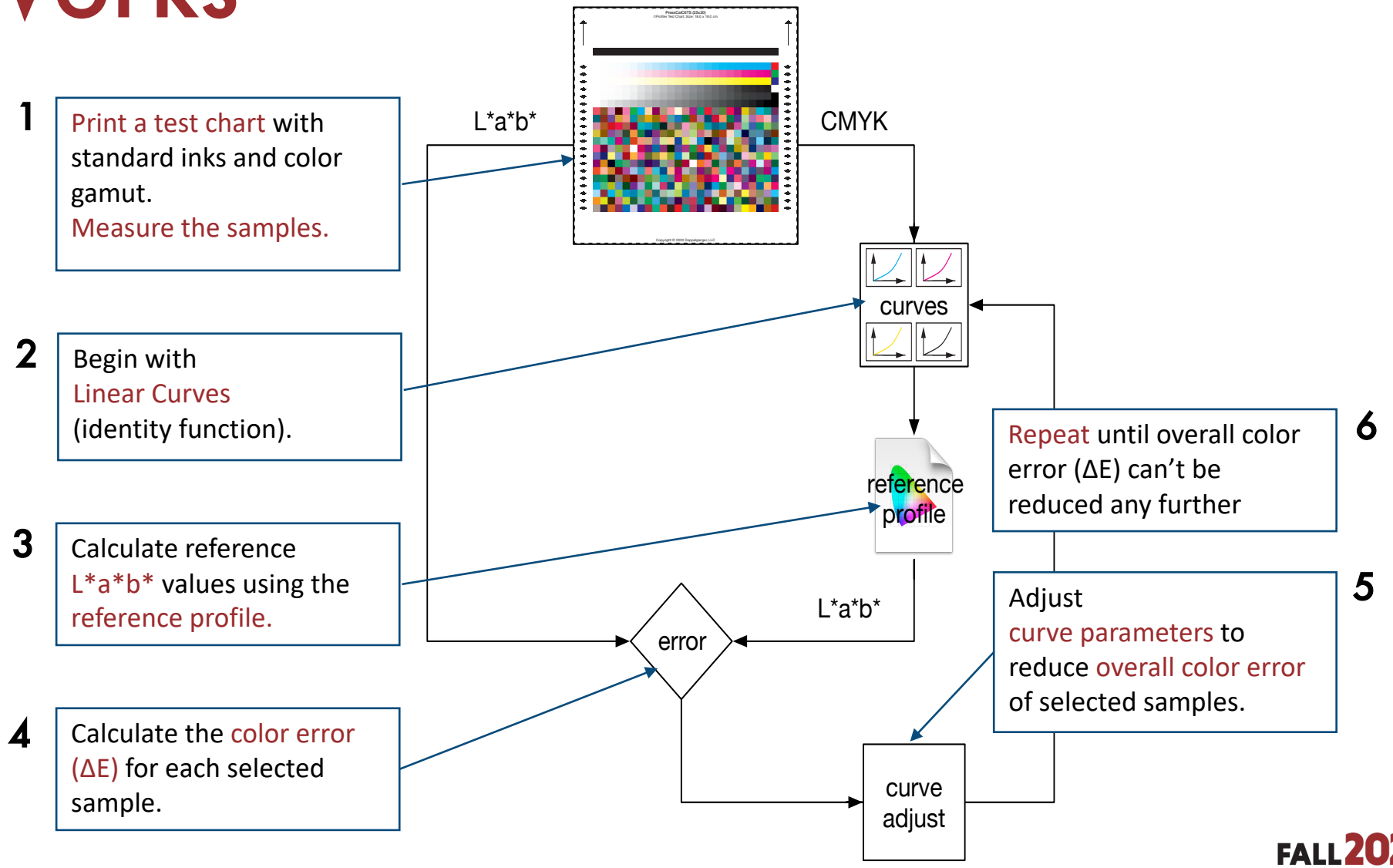
How It Works

- Reduce overall **color difference (ΔE)** between **printing** and an **ICC Profile**



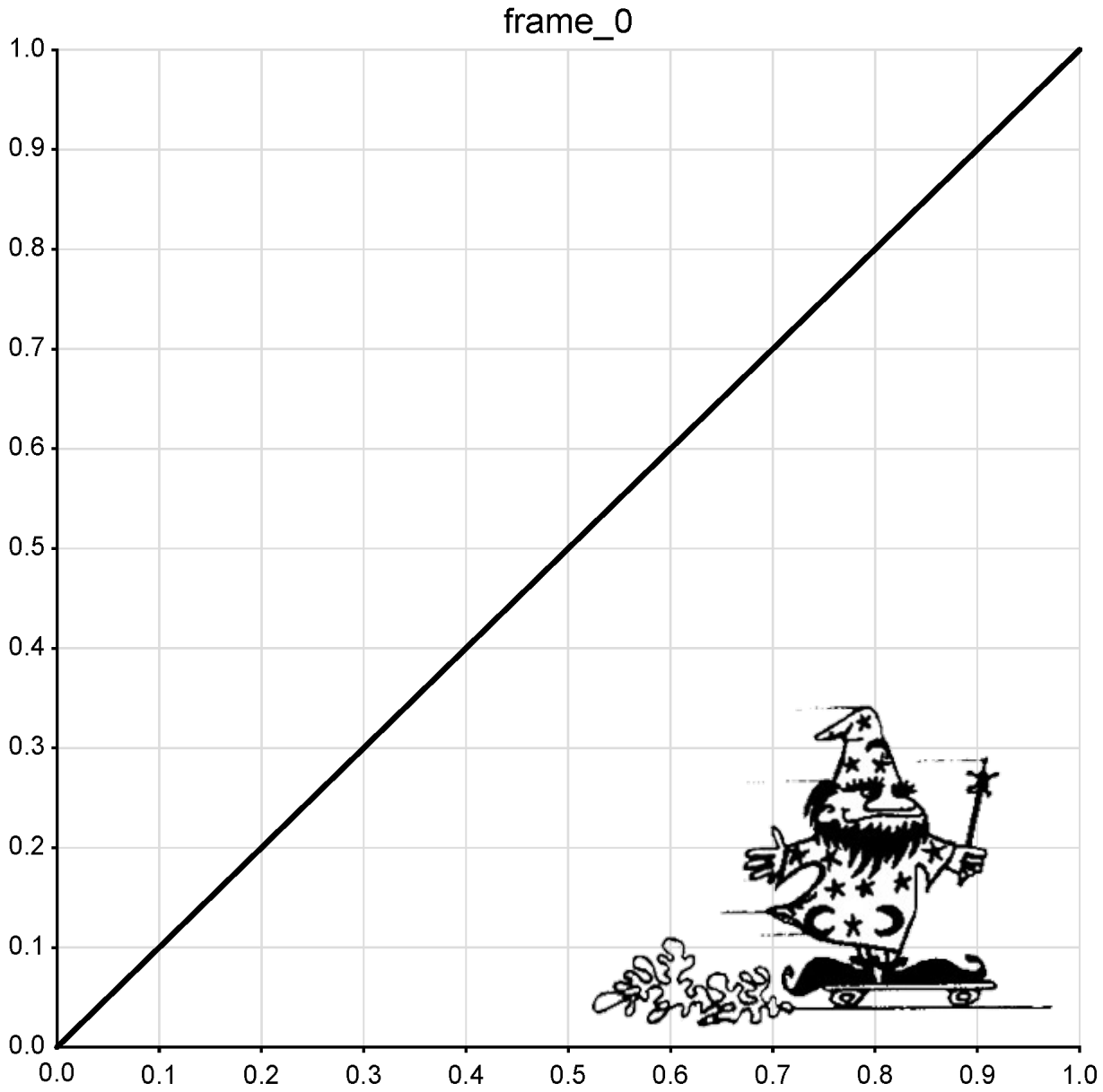
How It Works

- Iterative software loop
- Stops when the overall color error (ΔE) can't be reduced any further



Animation

- Each frame shows an iteration
- Stops when color difference Lowest OPTIMAL
- That took 145 iterations for this example



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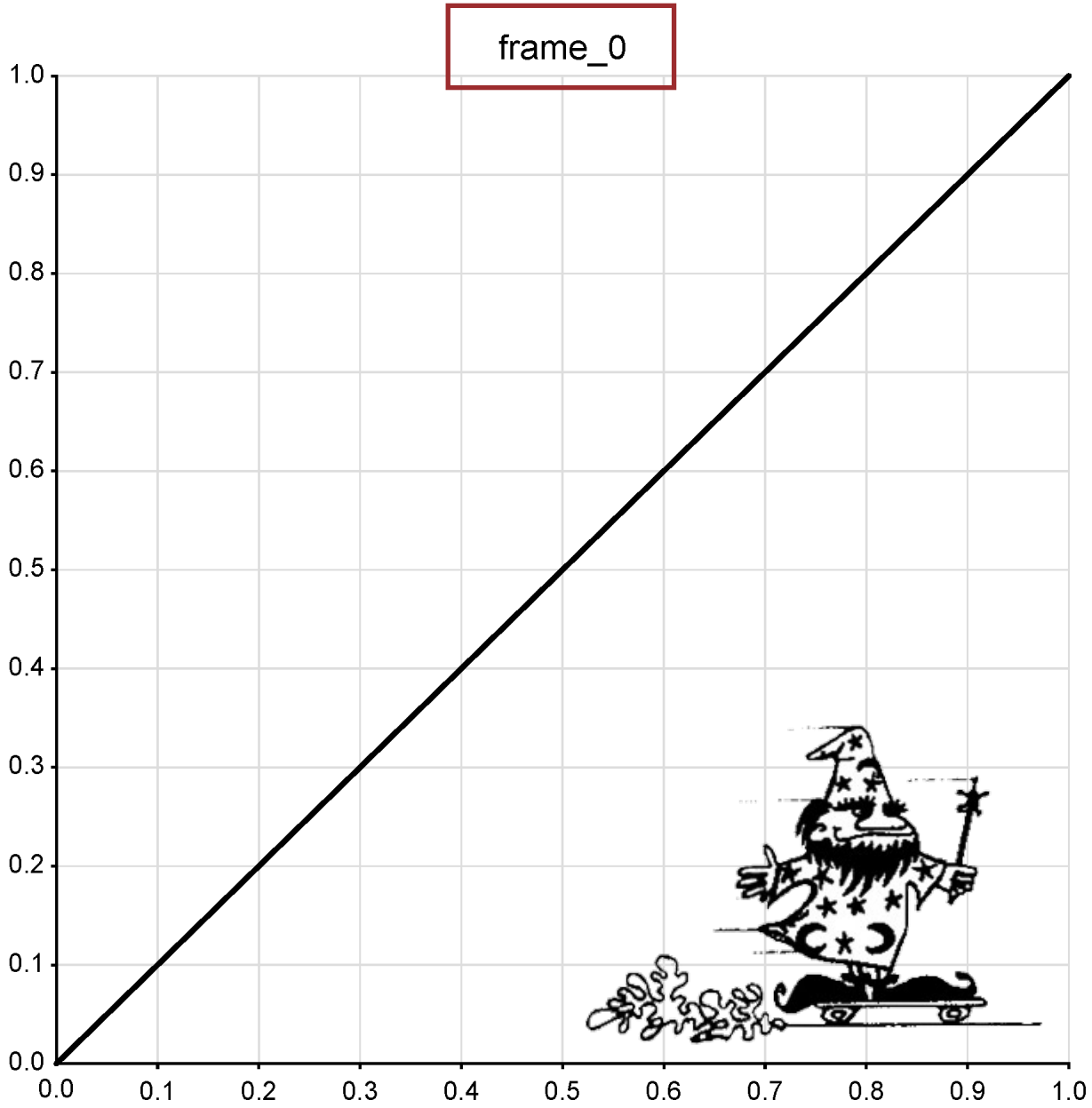

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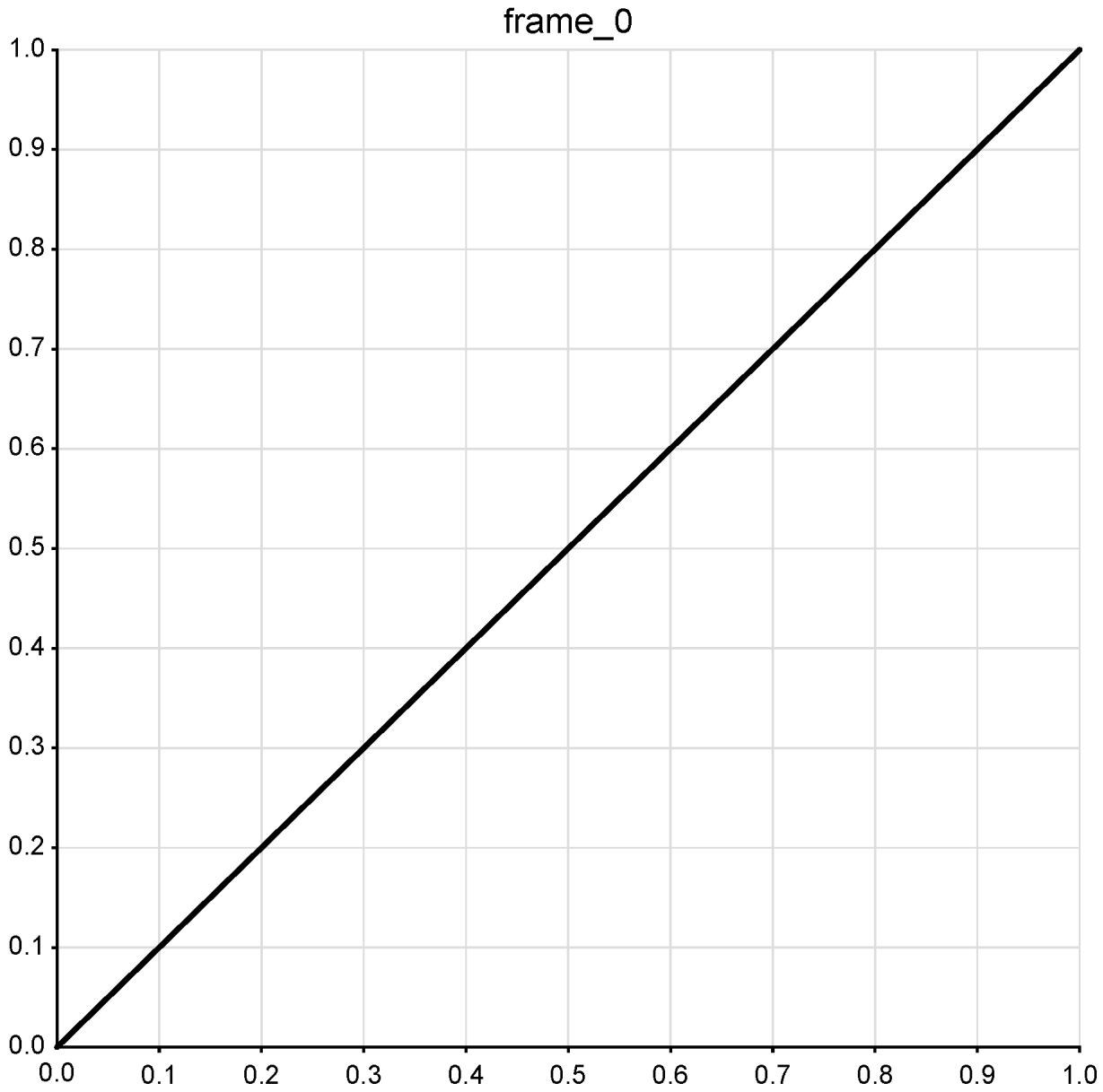
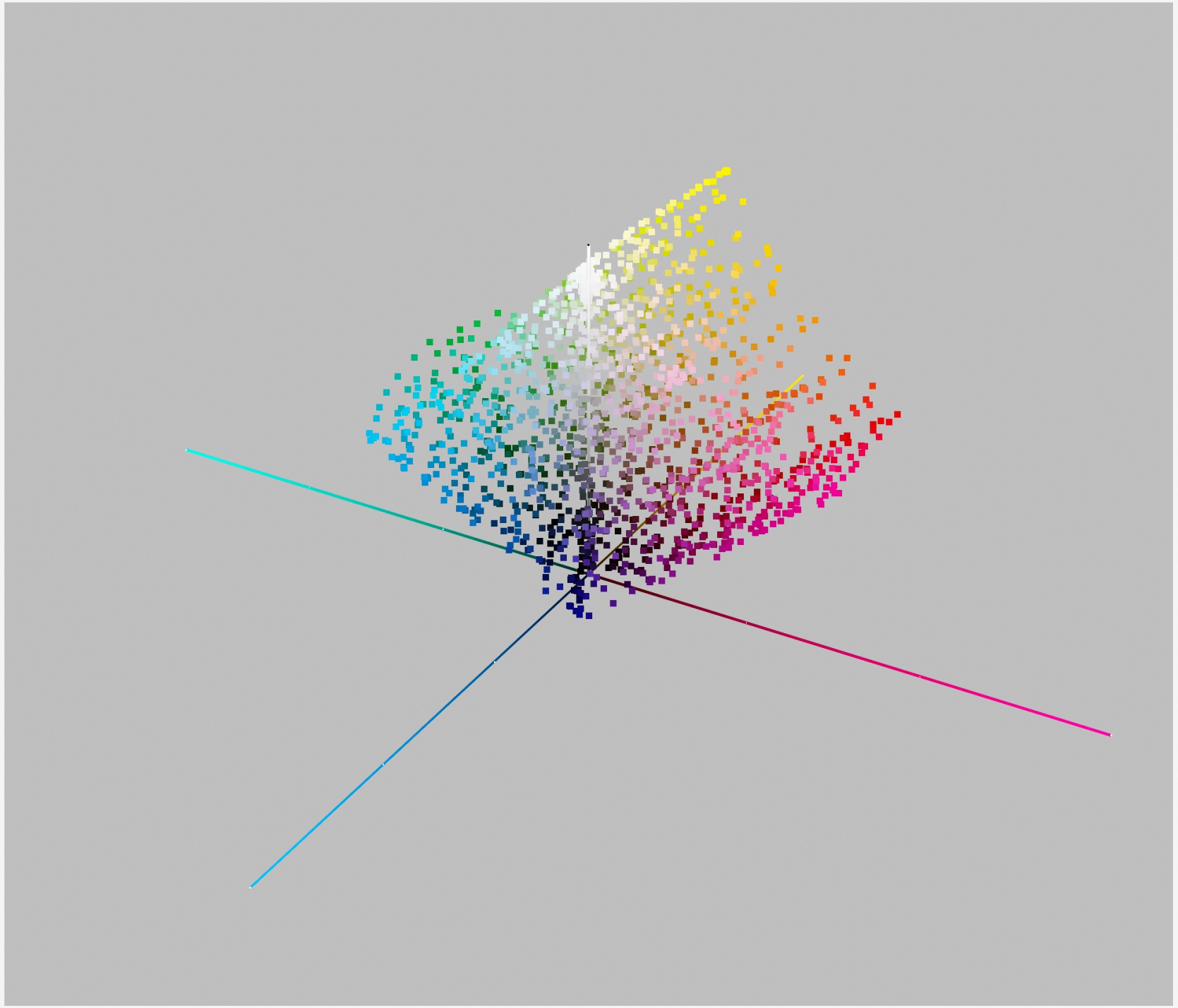


Sample Sets

- TVI/SCTV
  CMYK Ramps
- Near Neutral
  Gray/K Ramps
- Optimal
  Any or ALL
  Colors



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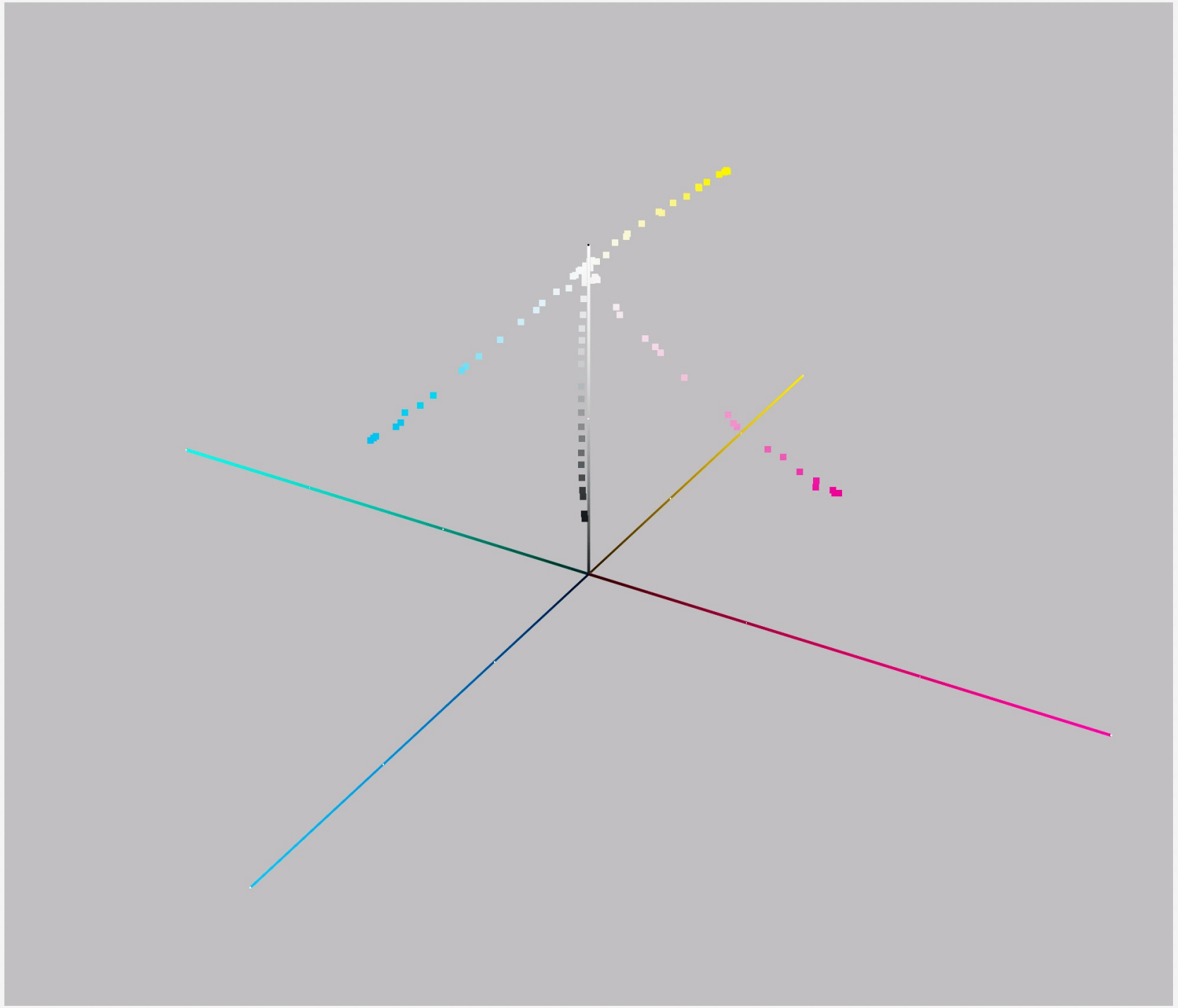

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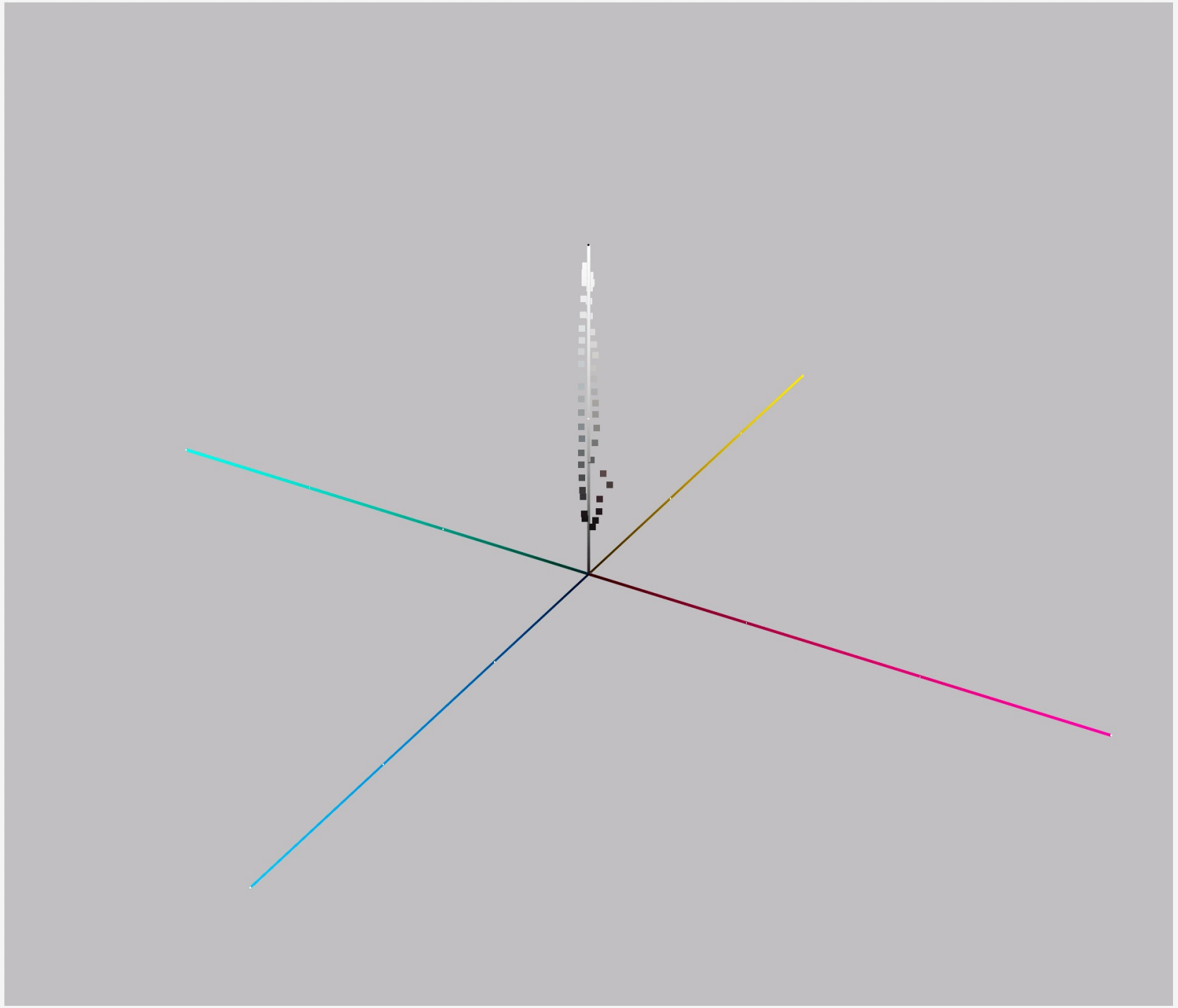

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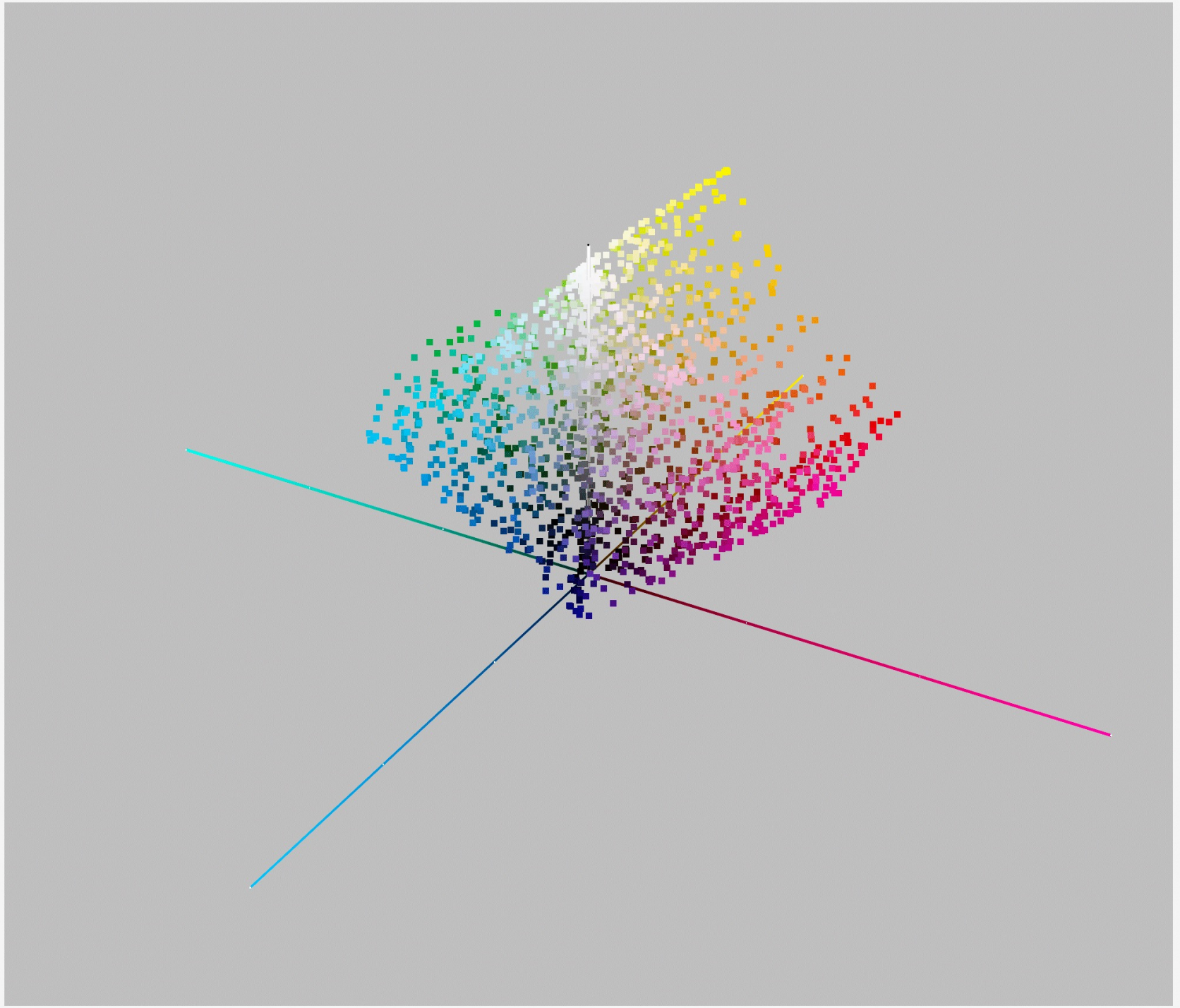
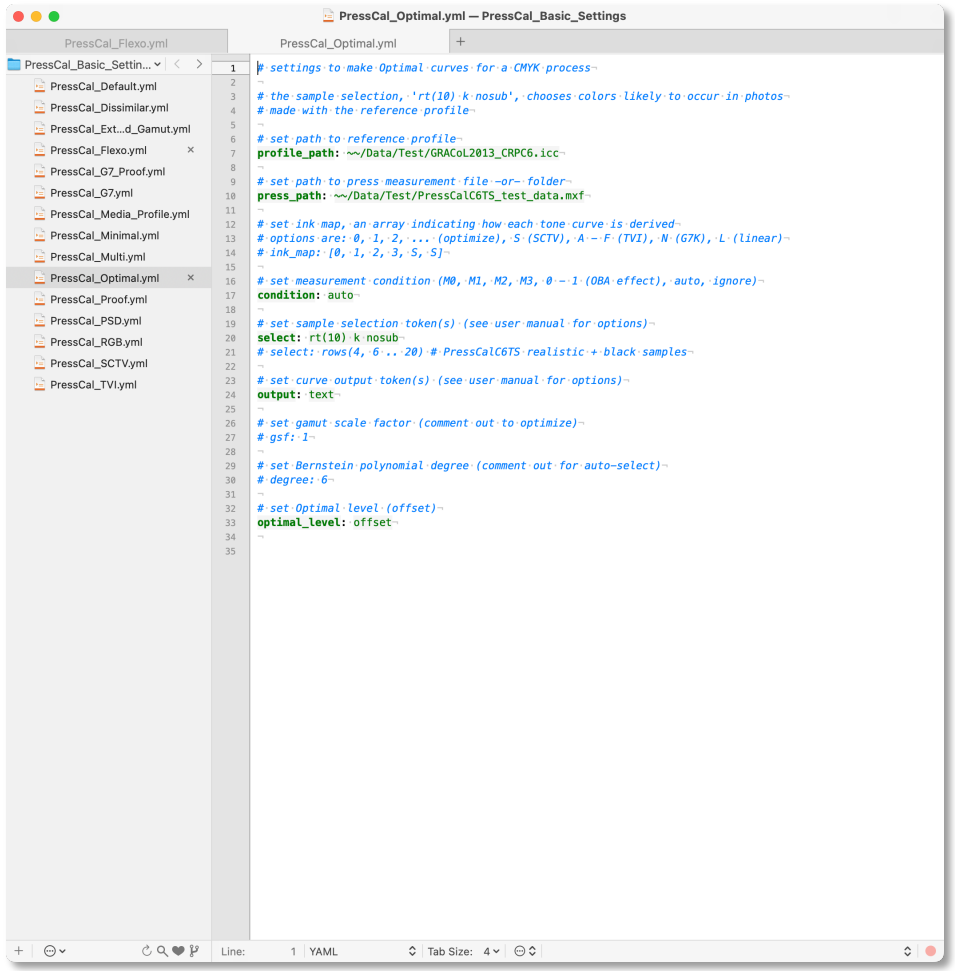


PressCal

- Free software implementing the Optimal Method
- Open source, GPL license, actively developed and maintained
- Powerful optimization engine to perform the complex calculations



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Levenberg-Marquardt algorithm levmar C/C++ library linked to macOS Accelerate framework

General Features

- Color reference is an ICC profile
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- Sample selection by list of properties (tokens)

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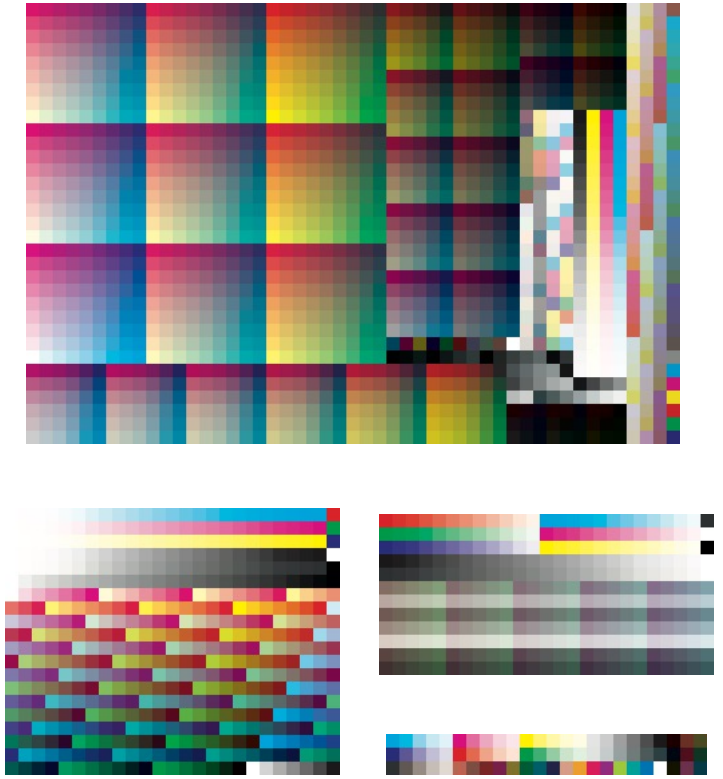

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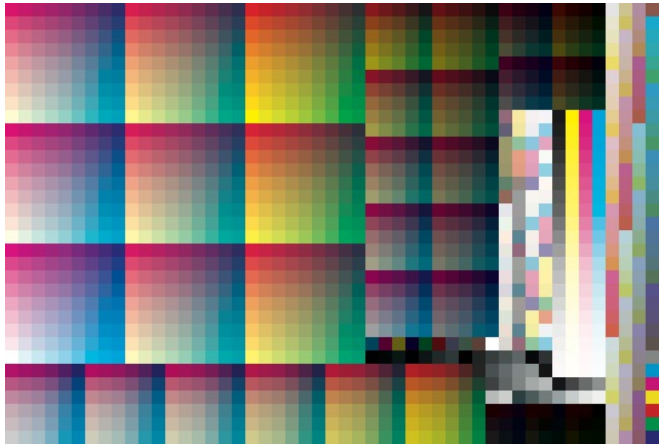

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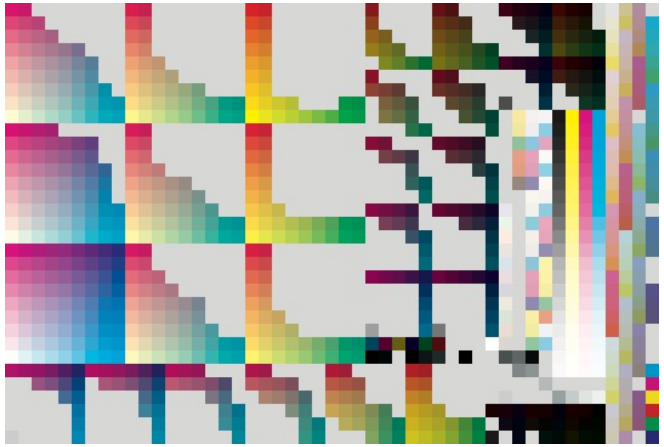

select: rt(10) k

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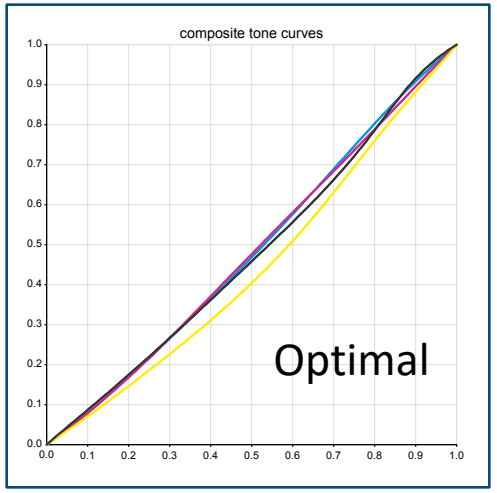
- Also implements the traditional methods (TVI, G7, SCTV)
- Makes vector curves of adjustable complexity
- Outputs curve formats for most common DFEs



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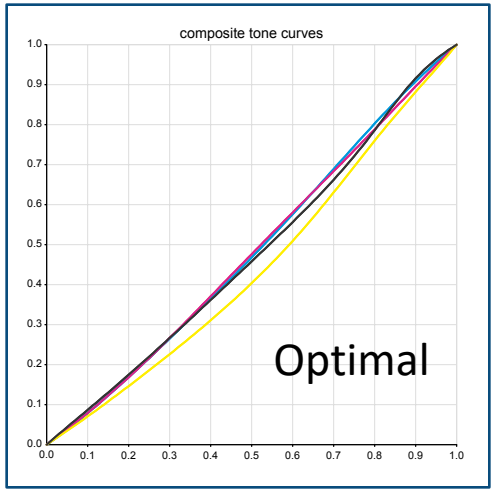

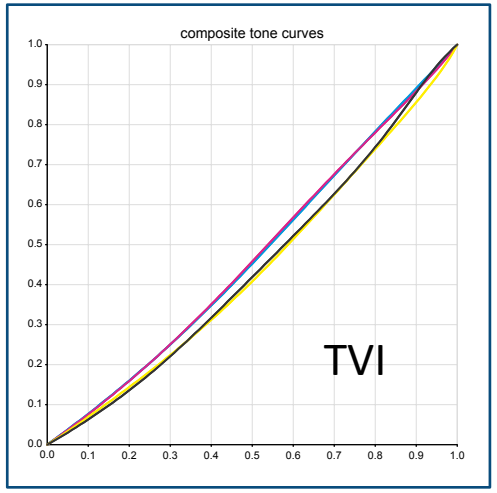

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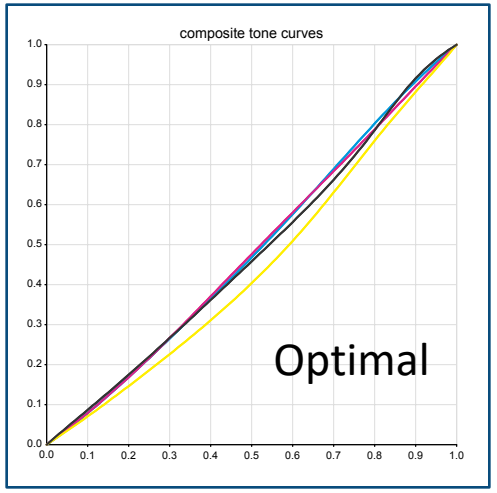

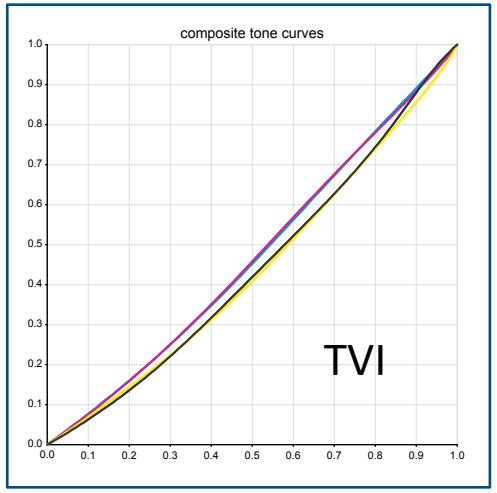

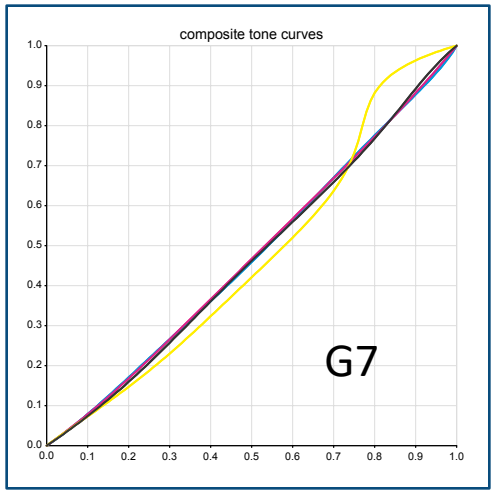

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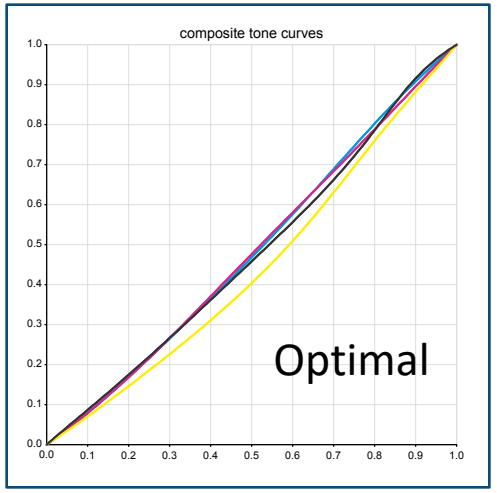

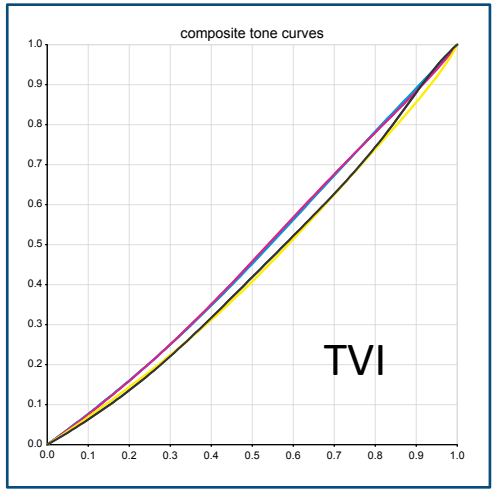

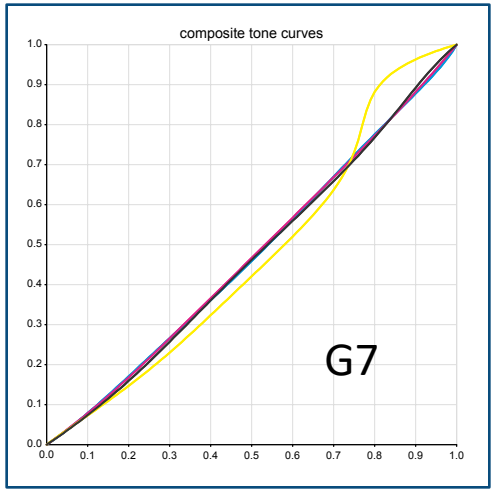

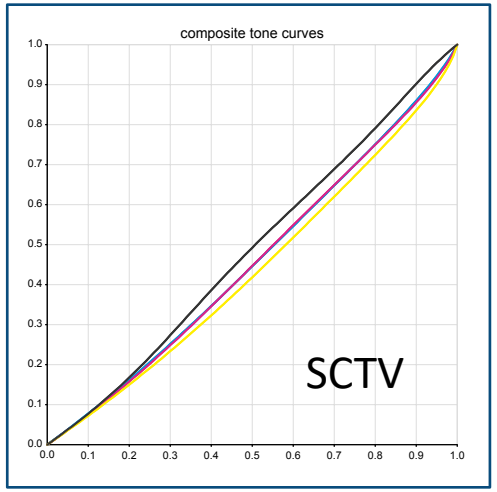

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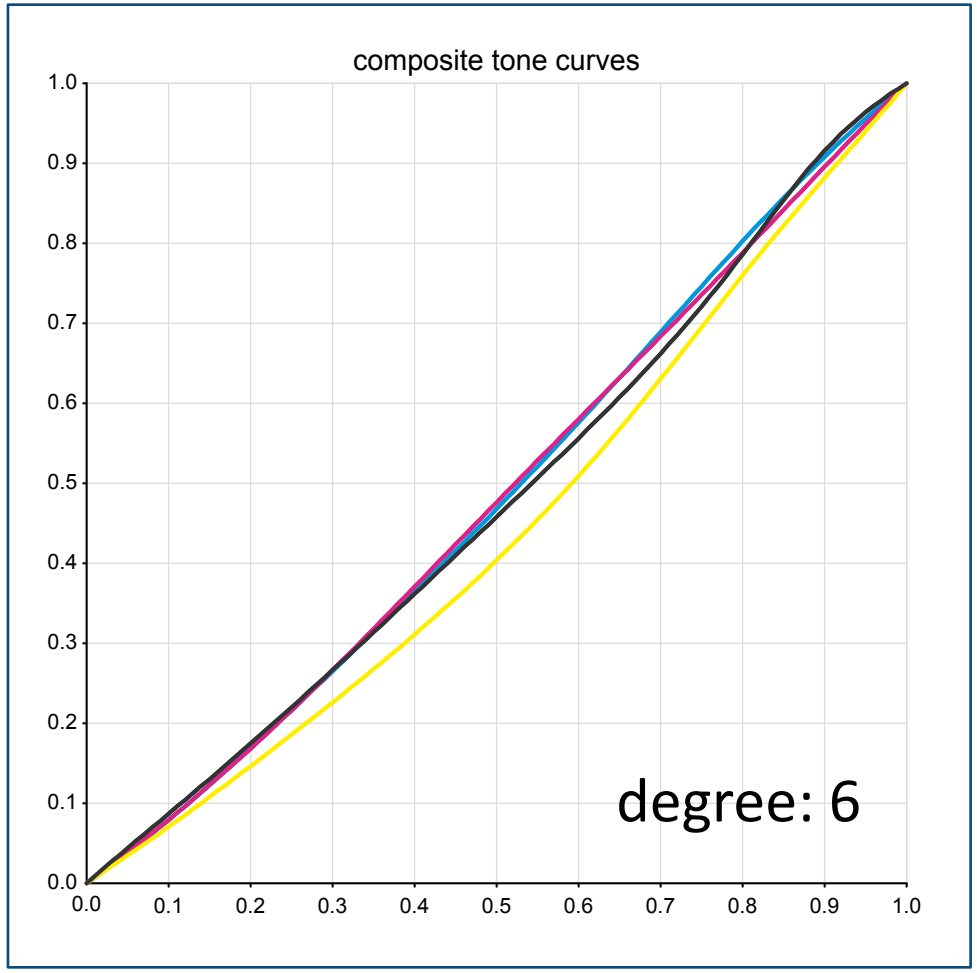

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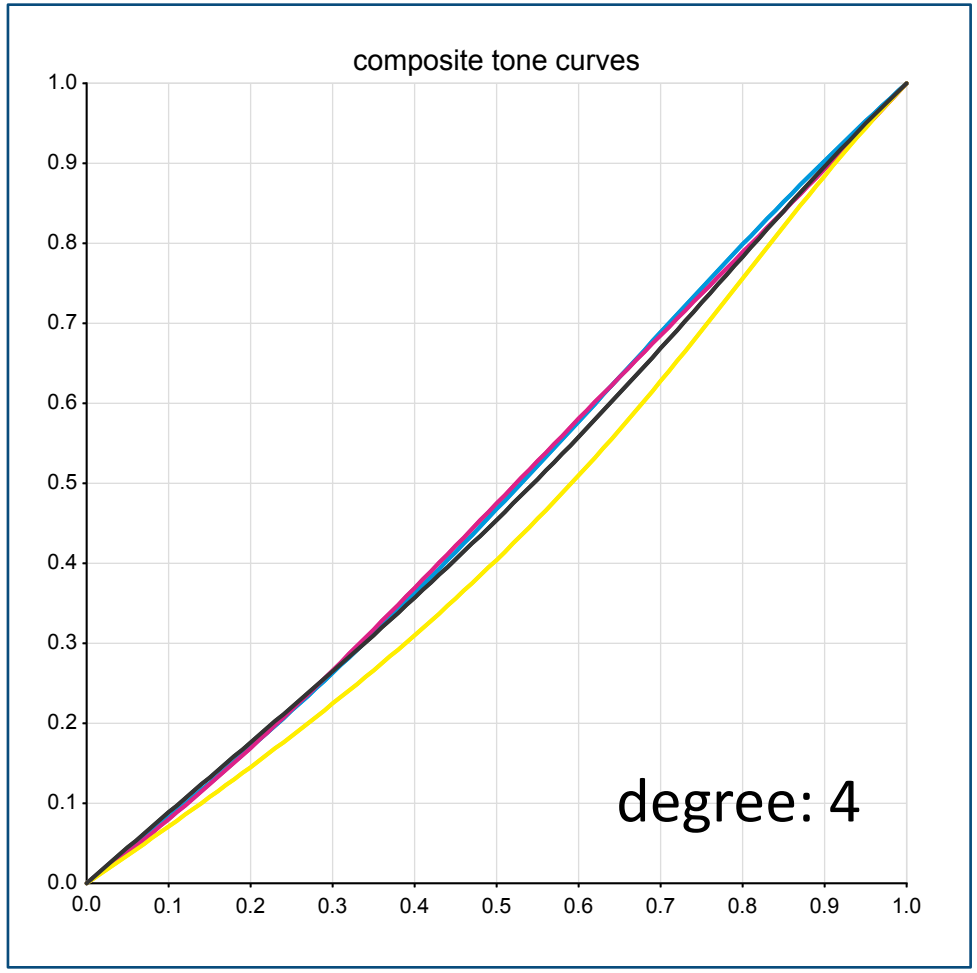

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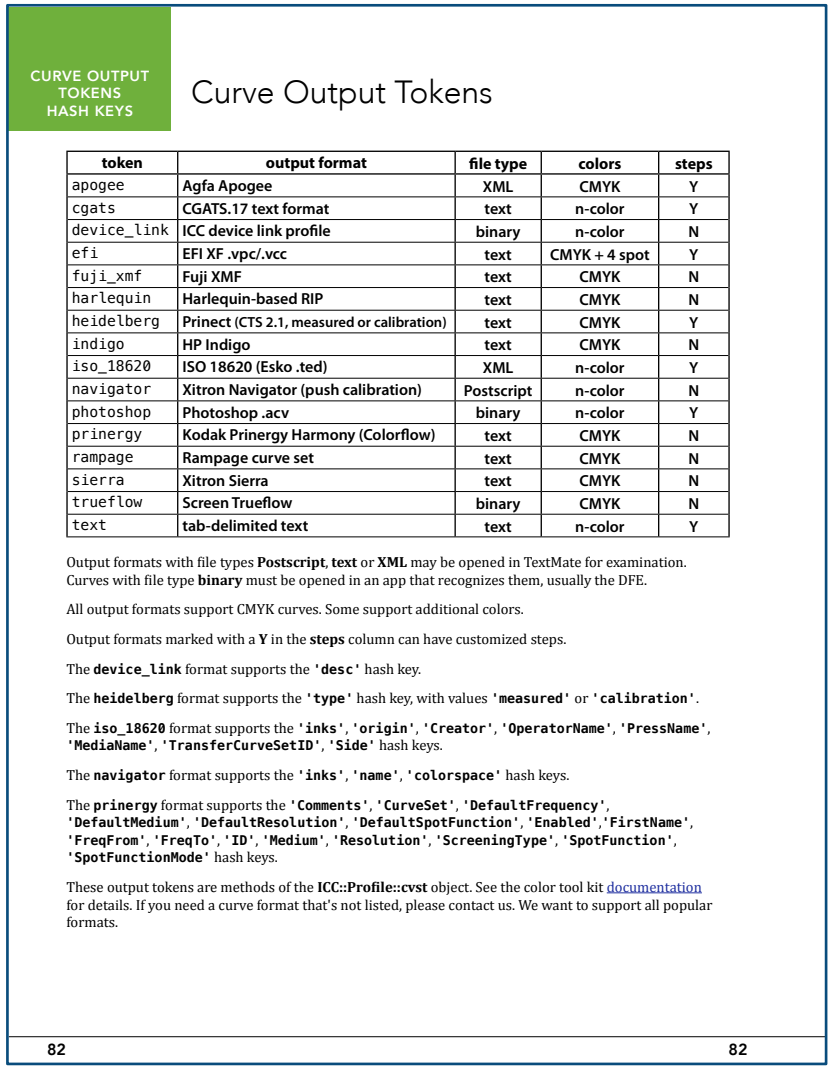

CURVE OUTPUT TOKENS HASH KEYS

Curve Output Tokens

token	output format	file type	colors	steps
apogee	Agfa Apogee	XML	CMYK	Y
cgats	CGATS.17 text format	text	n-color	Y
device_link	ICC device link profile	binary	n-color	N
efi	EFI XF .vpc/.vcc	text	CMYK + 4 spot	Y
fuji_xmf	Fuji XMF	text	CMYK	N
harlequin	Harlequin-based RIP	text	CMYK	N
heidelberg	Prinect (CTS 2.1, measured or calibration)	text	CMYK	Y
indigo	HP Indigo	text	CMYK	N
iso_18620	ISO 18620 (Esko .ted)	XML	n-color	Y
navigator	Xitron Navigator (push calibration)	Postscript	n-color	N
photoshop	Photoshop .acv	binary	n-color	Y
prinergy	Kodak Prinergy Harmony (Colorflow)	text	CMYK	N
rampage	Rampage curve set	text	CMYK	N
sierra	Xitron Sierra	text	CMYK	N
trueflow	Screen Trueflow	binary	CMYK	N
text	tab-delimited text	text	n-color	Y

Output formats with file types **Postscript**, **text** or **XML** may be opened in TextMate for examination. Curves with file type **binary** must be opened in an app that recognizes them, usually the DFE.

All output formats support CMYK curves. Some support additional colors.

Output formats marked with a **Y** in the **steps** column can have customized steps.

The **device_link** format supports the **'desc'** hash key.

The **heidelberg** format supports the **'type'** hash key, with values **'measured'** or **'calibration'**.

The **iso_18620** format supports the **'inks'**, **'origin'**, **'Creator'**, **'OperatorName'**, **'PressName'**, **'MediaName'**, **'TransferCurveSetID'**, **'Side'** hash keys.

The **navigator** format supports the **'inks'**, **'name'**, **'colorspace'** hash keys.

The **prinergy** format supports the **'Comments'**, **'CurveSet'**, **'DefaultFrequency'**, **'DefaultMedium'**, **'DefaultResolution'**, **'DefaultSpotFunction'**, **'Enabled'**,**'FirstName'**, **'FreqFrom'**, **'FreqTo'**, **'ID'**, **'Medium'**, **'Resolution'**, **'ScreeningType'**, **'SpotFunction'**, **'SpotFunctionMode'** hash keys.

These output tokens are methods of the **ICC::Profile::cvst** object. See the color tool kit documentation for details. If you need a curve format that's not listed, please contact us. We want to support all popular formats.

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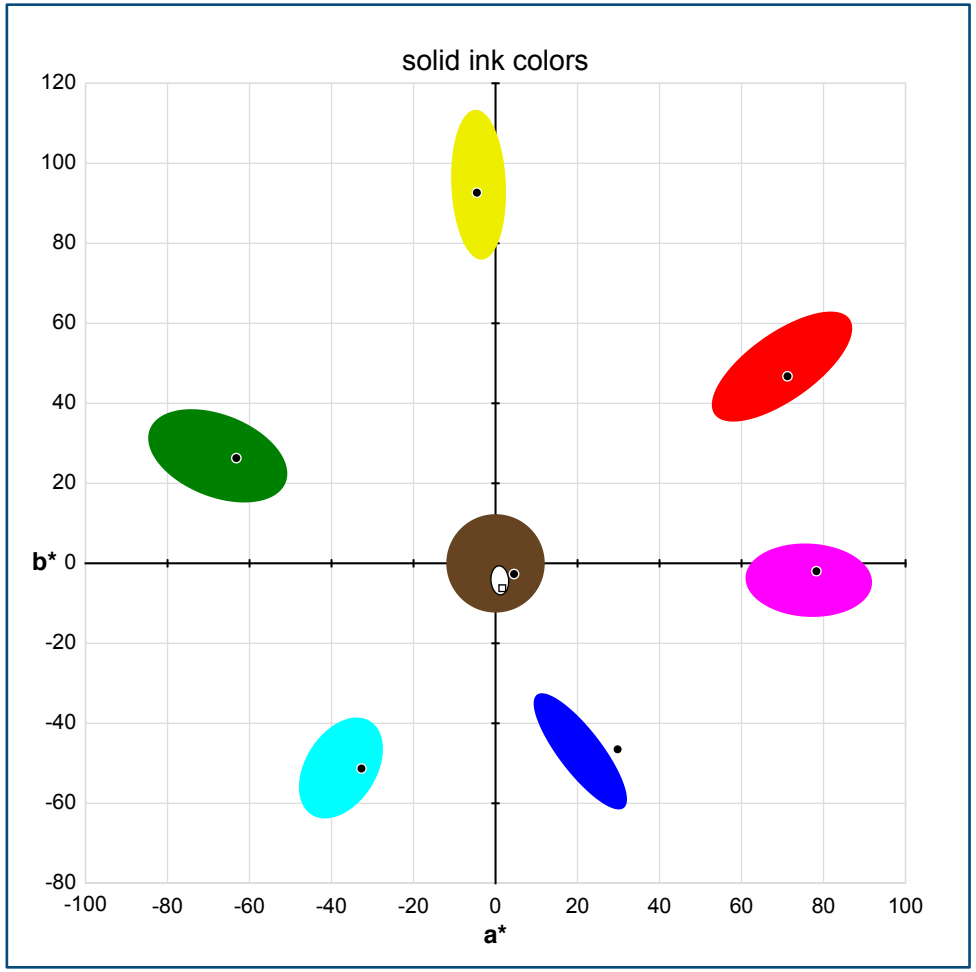
General Features

- Ink balance tool for setting solid ink densities
- Grading tool for verifying compliance with print standards
- Graphs to visualize curves and other important properties



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solid ink colors and errors (optimized):

	abs L*a*b* values			->	ref L*a*b* values			press
paper	97.0	0.3	0.4		97.5	0.4	0.5	97.5
cyan	51.3	-32.5	-61.3		51.6	-32.6	-61.5	51.6
magenta	52.5	81.1	-3.3		52.8	81.4	-3.3	52.7
yellow	91.8	-5.2	109.6		92.2	-5.2	110.1	91.8
red	51.2	73.1	66.2		51.5	73.4	66.5	51.2
green	40.2	-70.6	31.9		40.5	-70.9	32.1	40.5
blue	13.6	44.1	-63.2		13.8	44.3	-63.4	13.8
iso	10.7	2.4	-2.0		10.9	2.4	-1.9	10.9
black	2.6	0.1	0.0		2.7	0.1	0.1	2.7
cmyk	5.7	-0.3	-2.3		5.7	-0.4	-2.4	sam
orange	63.3	66.9	98.2		63.7	67.3	98.7	63.6
green	68.0	-84.7	25.3		68.4	-85.1	25.4	68.3
violet	20.2	56.2	-66.6		20.4	56.4	-66.9	20.4

status T densities:

	nom	opt	change
cyan (R)	1.756	1.732	-0.02
magenta (G)	1.679	1.662	-0.02
yellow (B)	1.230	1.219	-0.01
black (V)	2.558	2.521	-0.04
orange (B)	2.177	2.137	-0.04
green (R)	1.369	1.351	-0.02
violet (G)	1.893	1.883	-0.01

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```
standard: optimal, version: 2020, level: offset

process solids color error

      cyan ΔE00: 0.30 ✔ [3.00]
   magenta ΔE00: 0.32 ✔ [3.00]
    yellow ΔE00: 0.31 ✔ [3.00]
     black ΔE00: 0.54 ✔ [5.00]
    orange ΔE00: 0.31 ℹ [3.00]
     green ΔE00: 0.32 ℹ [3.00]
    violet ΔE00: 0.15 ℹ [3.00]

RGB solids color error

       red ΔE00: 0.31 ✔ [3.00]
     green ΔE00: 0.25 ✔ [3.00]
      blue ΔE00: 0.13 ✔ [3.00]

gray axis color errors

    missing data to grade gray axis

round-trip samples (228)

    median ΔE00: 0.39 ✔ [2.50]
  95th pct ΔE00: 1.03 ✔ [5.00]
   maximum ΔE00: 1.60 ✔ [10.00]

skipped 4 tests
```

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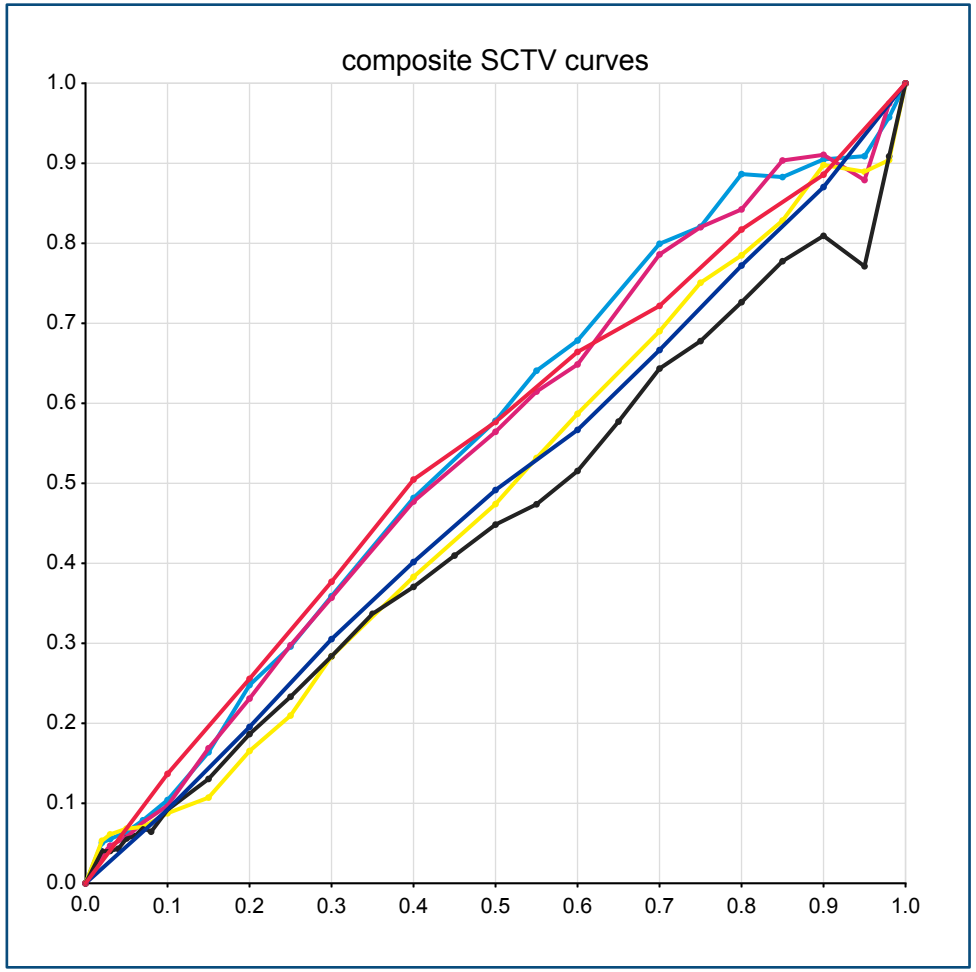

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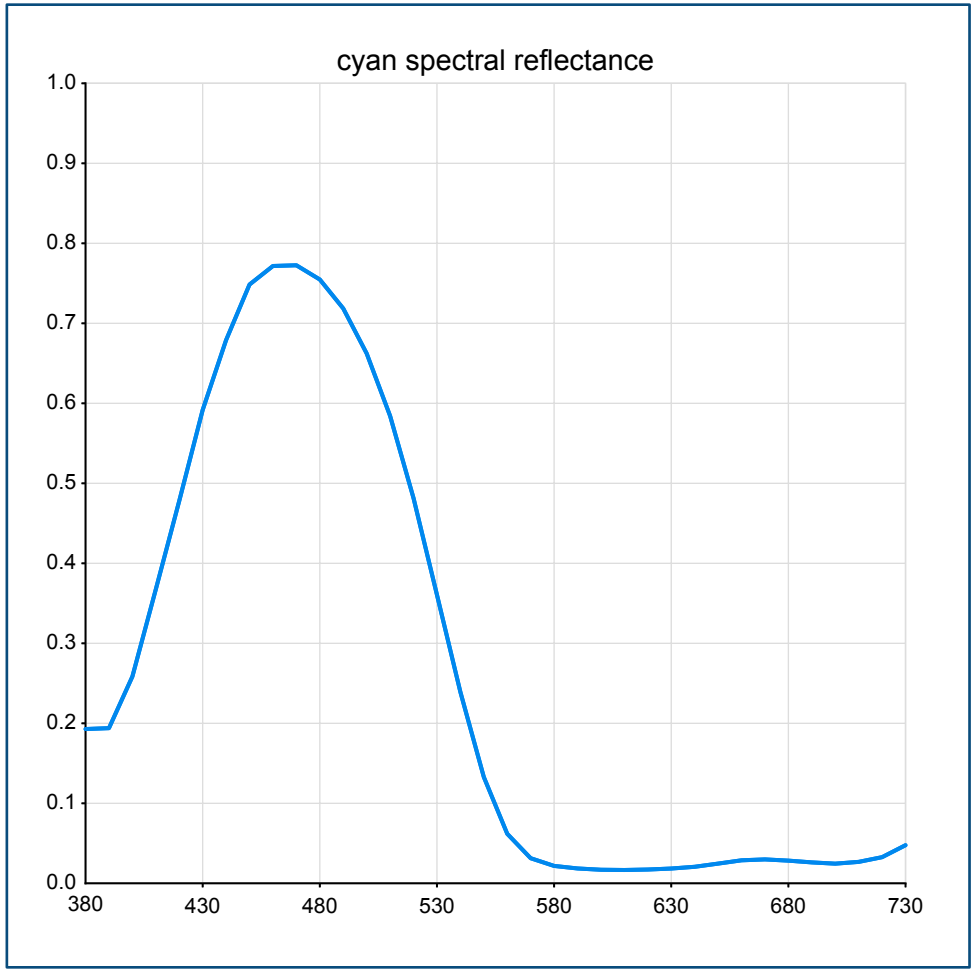

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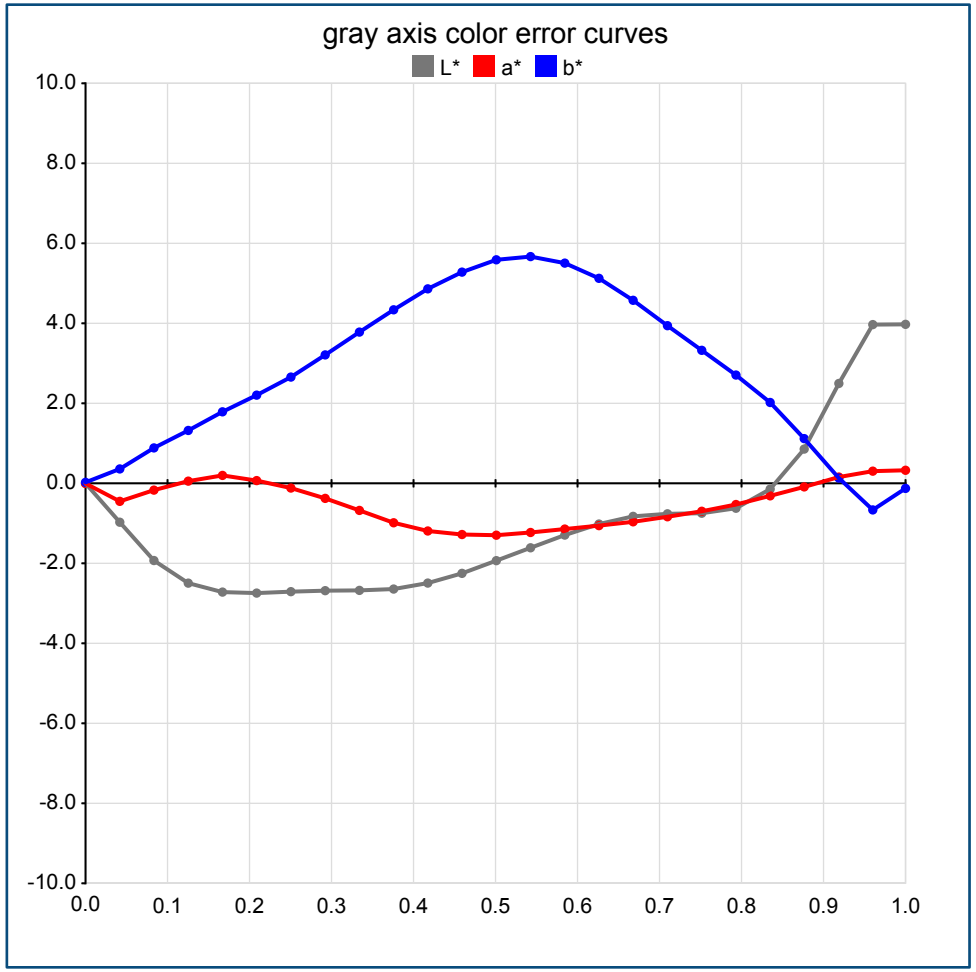

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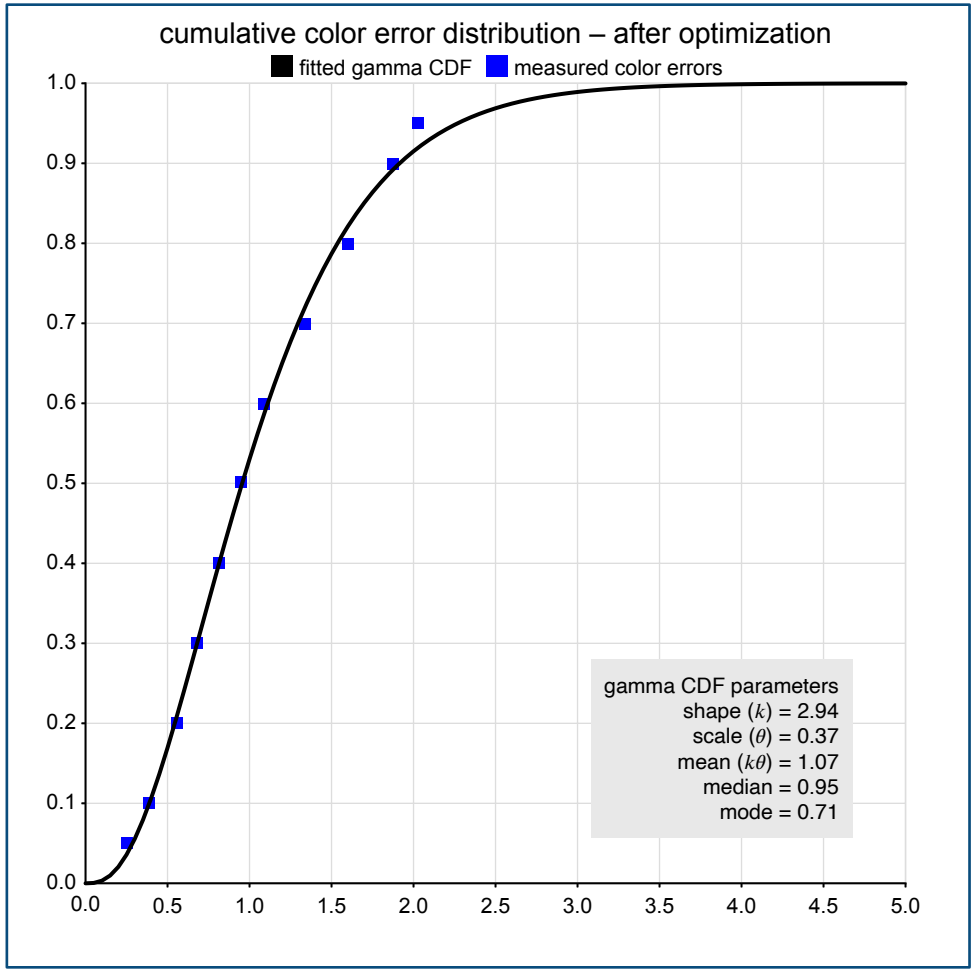

Flexo-Oriented Features

- Full support for spot colors (including CxF/X-4 files)
- Full support for ECG processes (e.g., CMYKOGV)
- Support for multiple profiles and measurement files
- Control of curve endpoints (alternative to bump curves)

PressCal_Flexo.yml — PressCal_Basic_Settings

PressCal_Flexo.yml | PressCal_G7.yml | PressCal_Optimal.yml

```
# Flexo settings

# set path to reference profile
profile_path: ~~/Data/Test/GRACoL2013_CRPC6.icc

# set path to press measurement file -or- folder
press_path: [['~~/Data/FTA/TC1617x_CMYK.txt', 0, 1, 2, 3, N],
['~~/Data/FTA/FTA_Blue.cxf', 4], ['~~/Data/FTA/FTA_Red.cxf', 5]]

# set ink map, an array indicating how each tone curve is derived
# options are: 0, 1, 2, ... (optimize), S (SCTV), A - F (TVI), N (G7K),
  L (linear)
ink_map: [0, 1, 2, 3, S, S]

# set sctv reference curves
sctv_reference: [['~~/Data/FTA/FTA_Blue.cxf', 4],
    ['~~/Data/FTA/FTA_Red.cxf', 5]] # CxF/X-4 files

# set measurement condition (M0, M1, M2, M3, 0 - 1 (OBA effect), auto,
  ignore)
condition: ignore

# set sample selection token(s) (see user manual for options)
select: rt(10) k nosub

```

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PressCal_Multi.yml — PressCal_Basic_Settings

PressCal_Multi.yml | PressCal_Optimal.yml

```
# set path to reference profile
profile_path: [['~~/Data/FTA/FTA_CMYK.icc', 0, 1, 2, 3],
['~~/Data/FTA/FTA_Omyk.icc', 4, 1, 2, 3], ['~~/Data/FTA/FTA_cGyk.icc',
0, 5, 2, 3], ['~~/Data/FTA/FTA_cmVk.icc', 0, 1, 6, 3]]

# set path to press measurement file -or- folder
press_path: [['~~/Data/FTA/TC1617x_CMYK.txt', 0, 1, 2, 3],
['~~/Data/FTA/TC1617x_Omyk.txt', 4, 1, 2, 3],
['~~/Data/FTA/TC1617x_cGyk.txt', 0, 5, 2, 3],
['~~/Data/FTA/TC1617x_cmVK.txt', 0, 1, 6, 3]]

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  L (linear)
# ink_map: [0, 1, 2, 3, S, S, S]

# set measurement condition (M0, M1, M2, M3, 0 - 1 (OBA effect), auto,
  ignore)
# condition: M1

# set sample selection token(s) (see user manual for options)
select: all

# set curve output token(s) (see user manual for options)
output: text
```

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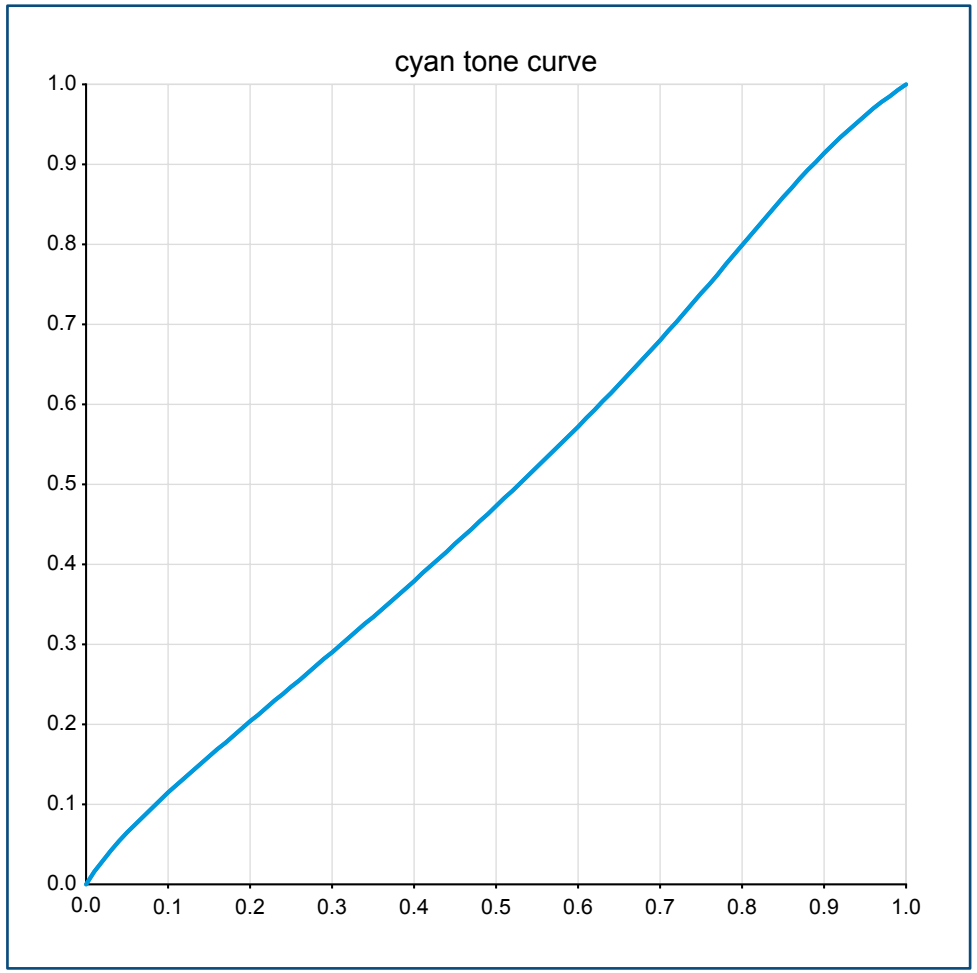
- Full support for ECG processes (e.g., CMYKOGV)
- Support for multiple profiles and measurement files
- Control of curve endpoints (alternative to bump curves)

```
PressCal version 16.3U modified 2022-09-08

reference profile(s):

        ~~/Data/FTA/FTA_CMYK.icc mapped to [0, 1, 2, 3]
        ~~/Data/FTA/FTA_Omyk.icc mapped to [4, 1, 2, 3]
        ~~/Data/FTA/FTA_cGyk.icc mapped to [0, 5, 2, 3]
        ~~/Data/FTA/FTA_cmVk.icc mapped to [0, 1, 6, 3]

press chart(s):

        ~~/Data/FTA/TC1617x_CMYK.txt mapped to [0, 1, 2, 3]
        ~~/Data/FTA/TC1617x_Omyk.txt mapped to [4, 1, 2, 3]
        ~~/Data/FTA/TC1617x_cGyk.txt mapped to [0, 5, 2, 3]
        ~~/Data/FTA/TC1617x_cmVK.txt mapped to [0, 1, 6, 3]

file contains M0 measurement condition

chart type: unknown, nominal samples: 6468, colorspace: CMYKOGV, types: PPPP

solid ink cluster size: 28.2

solid ink colors and errors:

                abs L*a*b* values   ->   ref L*a*b* values      press L*a*b
      paper    92.0   -0.3    2.1        92.4   -0.4    2.2       92.4   -0.
       cyan    55.4  -33.7  -49.1        55.6  -33.9  -49.3       55.6  -33.
    magenta    51.2   69.7    3.1        51.5   69.9    3.2       51.3   69.
     yellow    89.7   -8.5   99.6        90.1   -8.7  100.0       89.8   -8.
        red    49.6   66.9   58.5        49.9   67.1   58.8       49.5   67.
      green    49.8  -71.1   37.2        50.0  -71.4   37.4       49.7  -71.
       blue    25.2    9.2  -38.2        25.3    9.1  -38.3       24.9   10.
```

Flexo-Oriented Features

- Full support for spot colors (including CxF/X-4 files)
- Full support for ECG processes (e.g., CMYKOGV)
- Support for multiple profiles and measurement files
- Control of curve endpoints (alternative to bump curves)



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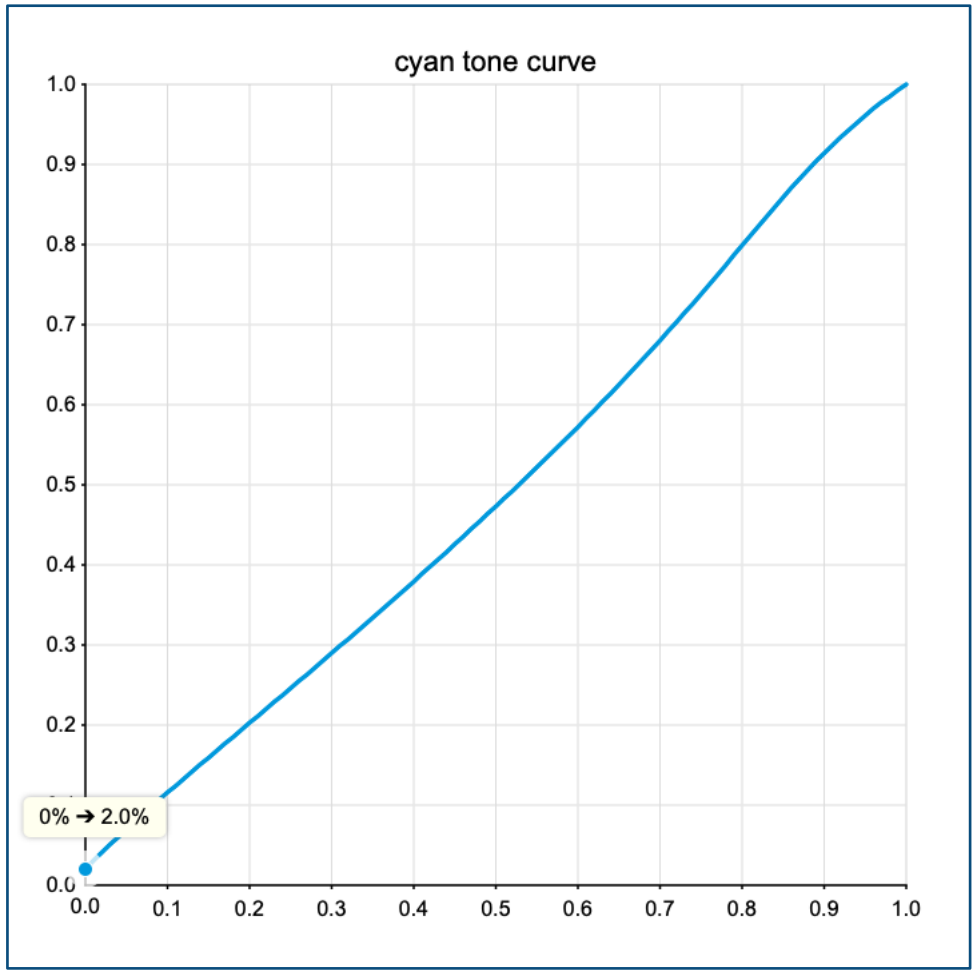
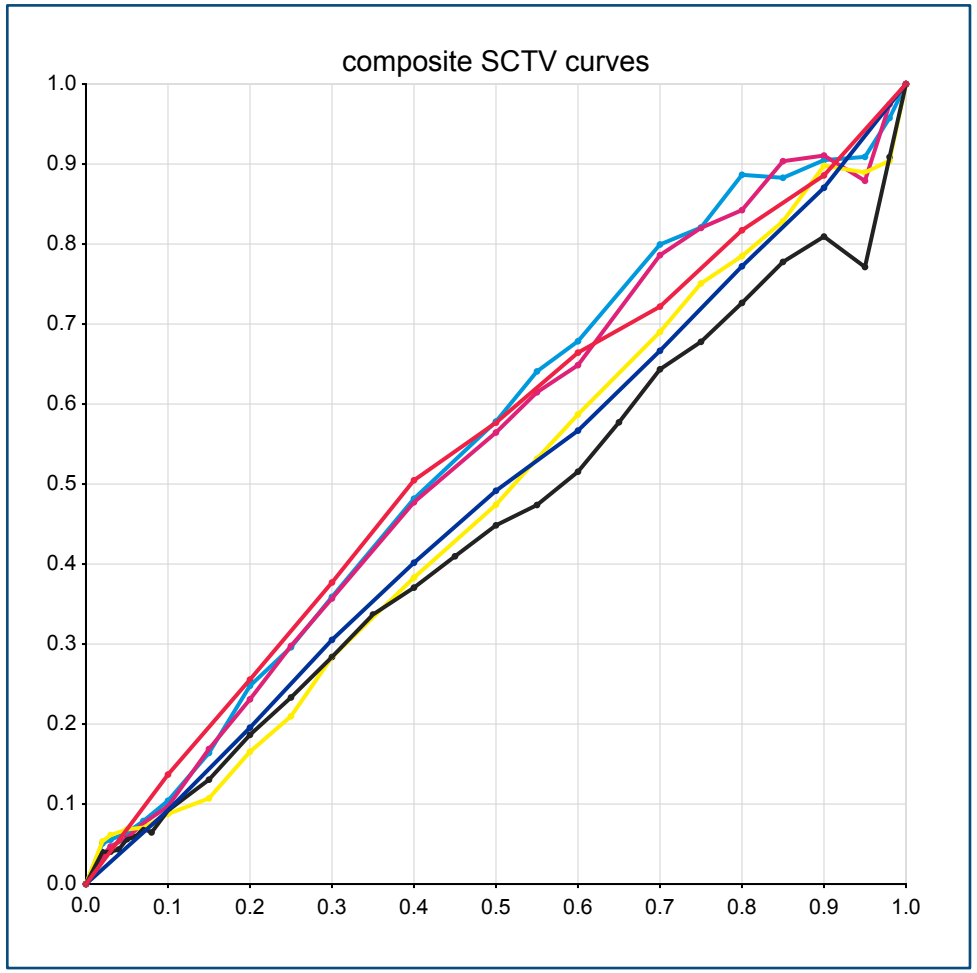


Flexo-Oriented Features

- Good calibrations from rough or flawed data
- Calibrate re-runs to custom reference profile
- Calibrate multiple presses to custom reference profile



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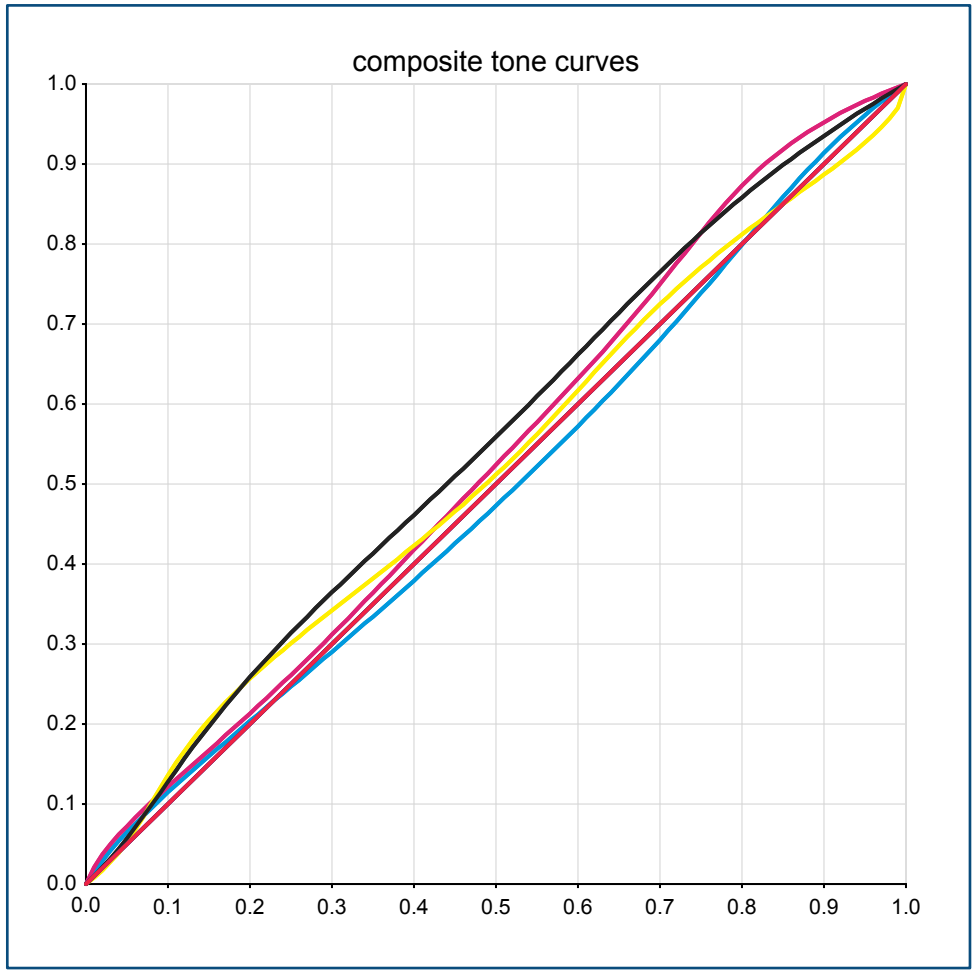

Flexo-Oriented Features

- Good calibrations from rough or flawed data
- Calibrate re-runs to custom reference profile
- Calibrate multiple presses to custom reference profile

Supports *FIRST*

Using measurements from the fingerprinting press run, PressCal will generate:

- Tone curves to calibrate against a reference profile
- Process control data (L*a*b*, SCTV, density, M-D, TVI)
- Curve-adjusted data set to build a characterization profile

This could save time and money

(For more info, see appendix H of *FIRST* 7.0)

Thank You

(grazie to Stefano d'Andrea 🇮🇹)

(thanks to Mark Samworth 🇺🇸)

- Chuck Spontelli
  chuck.spontelli@colortuneup.com
- Bill Birkett
  wbirkett@doplganger.com
- Optimal Method Website
  https://optimalmethod.org
- FLEXO Magazine Article (September 2022 Issue)
  https://www.flexography.org/news/the-optimal-method-for-press-calibration/

Questions and Comments

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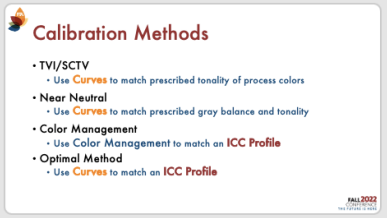

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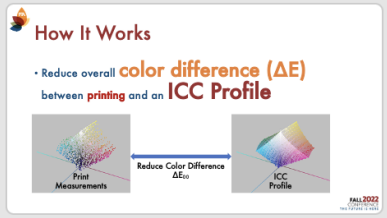

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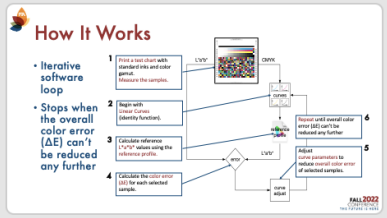

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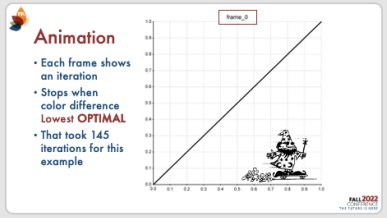

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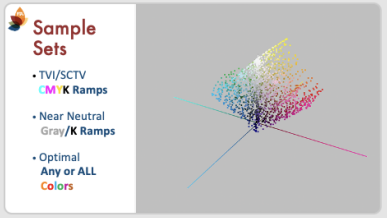

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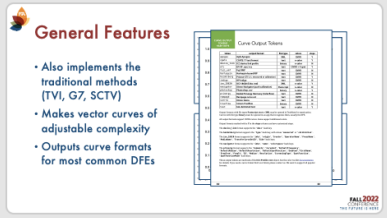

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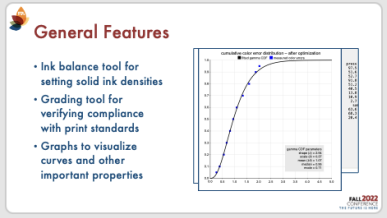

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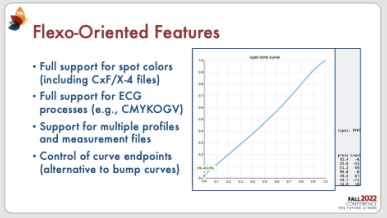

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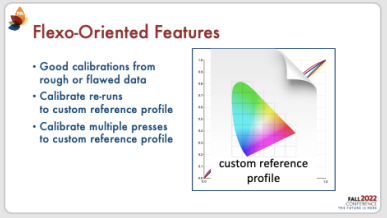

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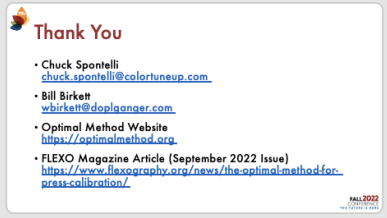

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