ICC/HP Digital Print Day, Sant Cugat, Spain

Predicting the colorimetry of spot colour overprints

Kiran Deshpande, Phil Green
London College of Communication London

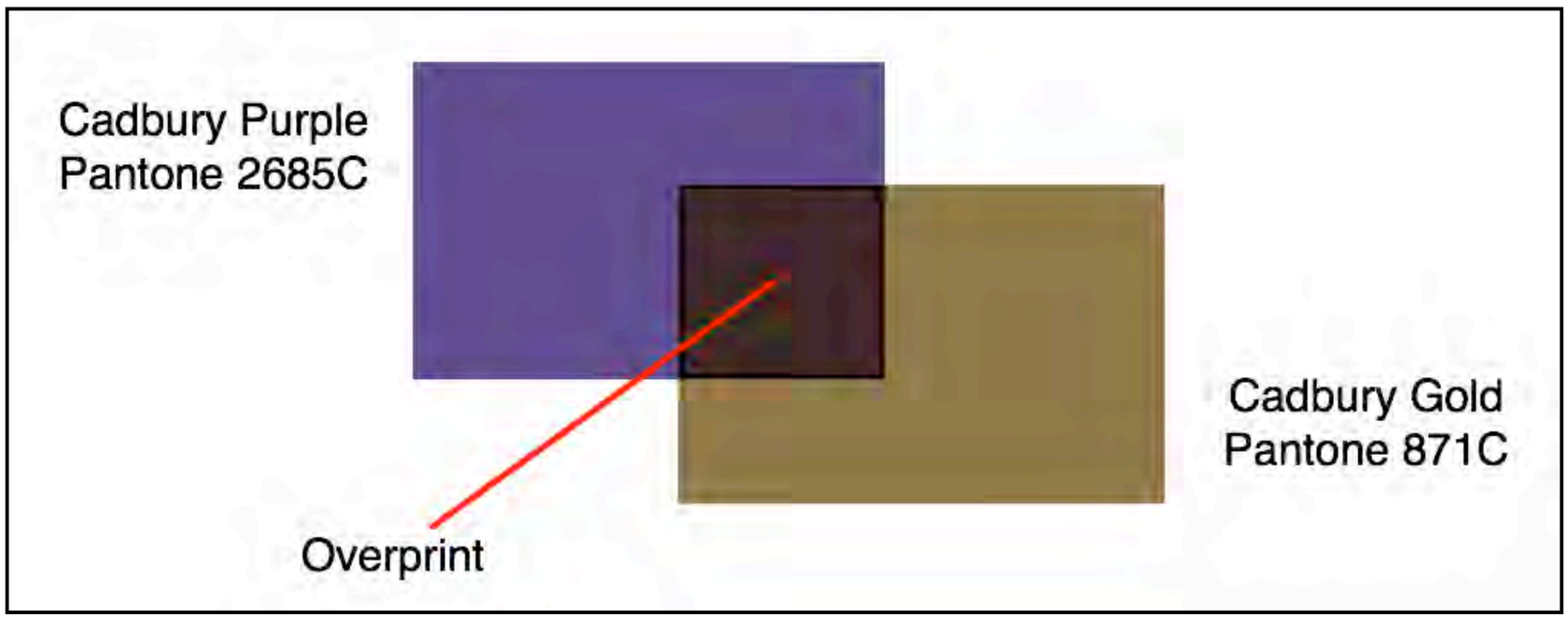
Outline

- Introduction
- Overprint model
- Evaluation method
- Results
- Implementation
- Summary

University of the Arts London
London College of Communication

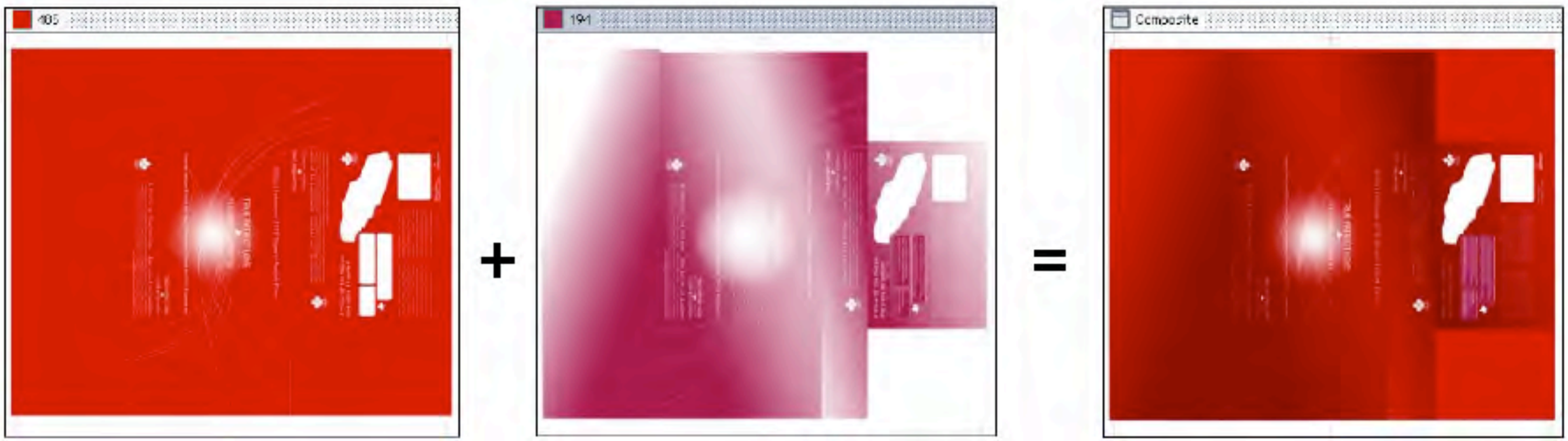
Introduction

- Spot colour overprints - widely used in packaging
- Challenges - communicating spot colours across workflow, preview of spot colour overprints (Chung, 2008) (Viggiano, 2008)



Introduction

- Spot colour overprints with tints



Pantone 485C + Pantone 194C = Overprint of Pantone 485C and 194C

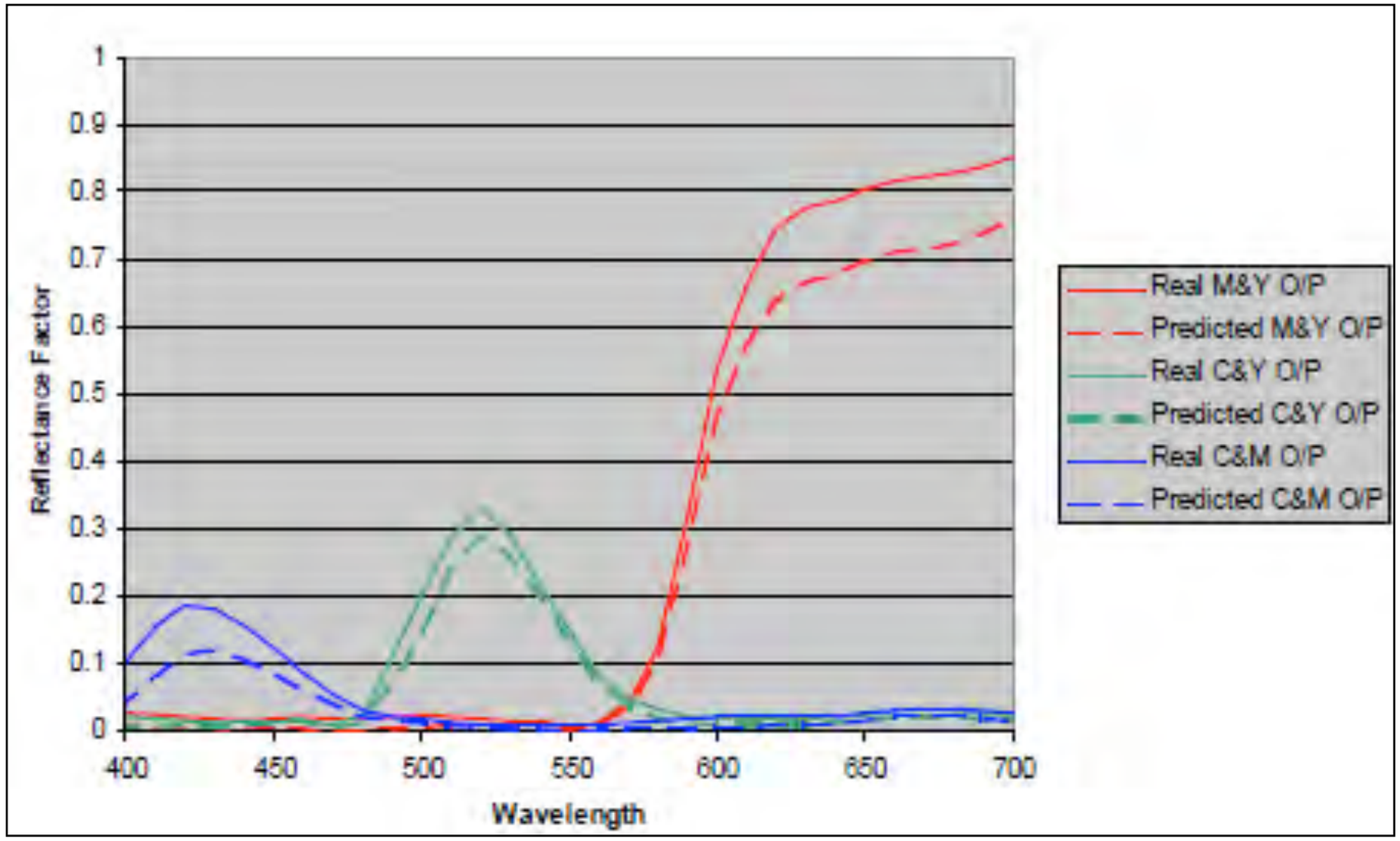
Objectives

- Predict the colorimetry of spot colour overprints
- Simple numerical method - easy to implement within ICC or PDF/X workflow
- Free of intellectual property
- Application - previewing overprints of spot colours on-the-fly using pre-media software

Overprint model

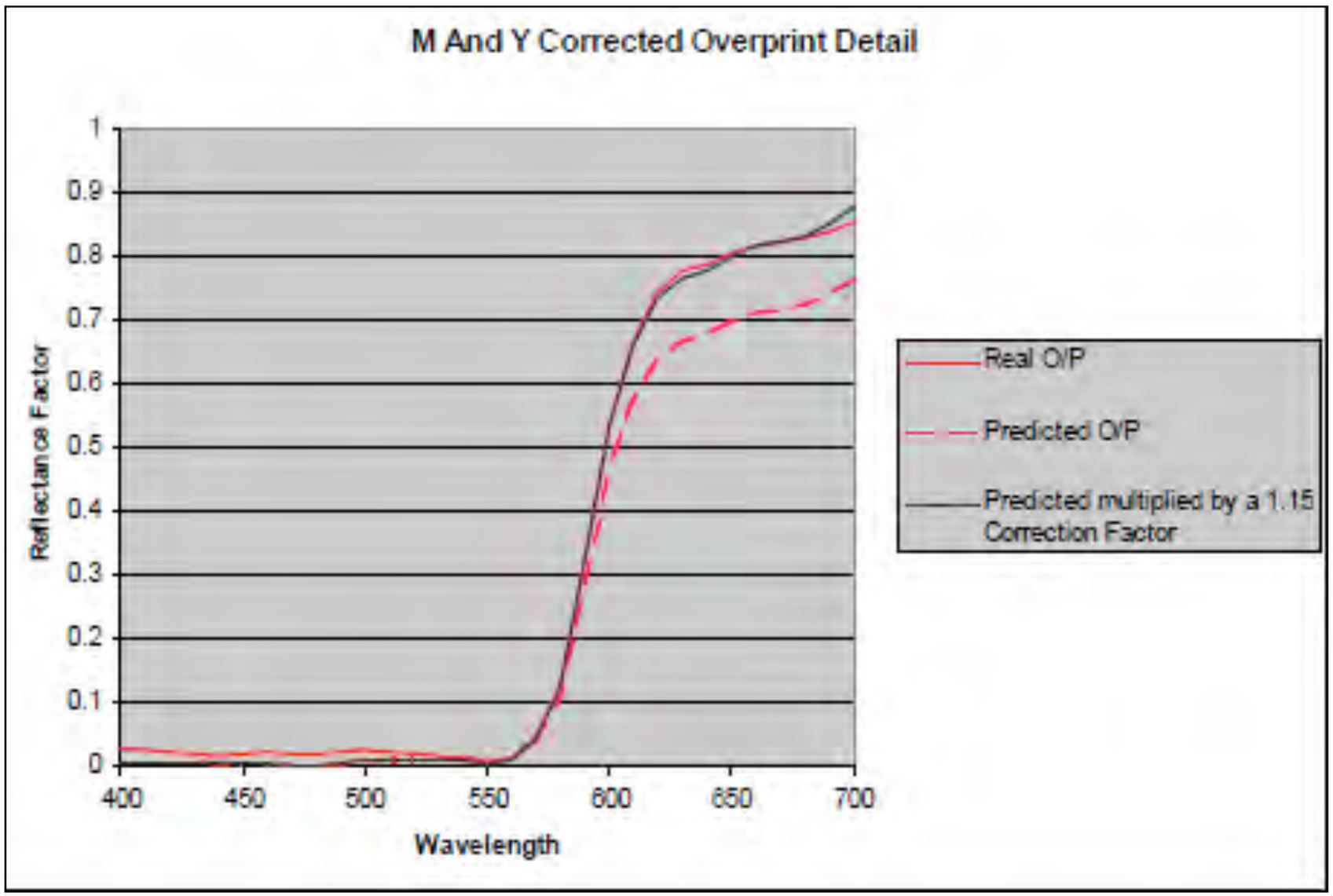
- Reflectance of overprint ≈ product of the reflectances of two inks measured independently

- Error is typically a linear underestimate of the reflectance



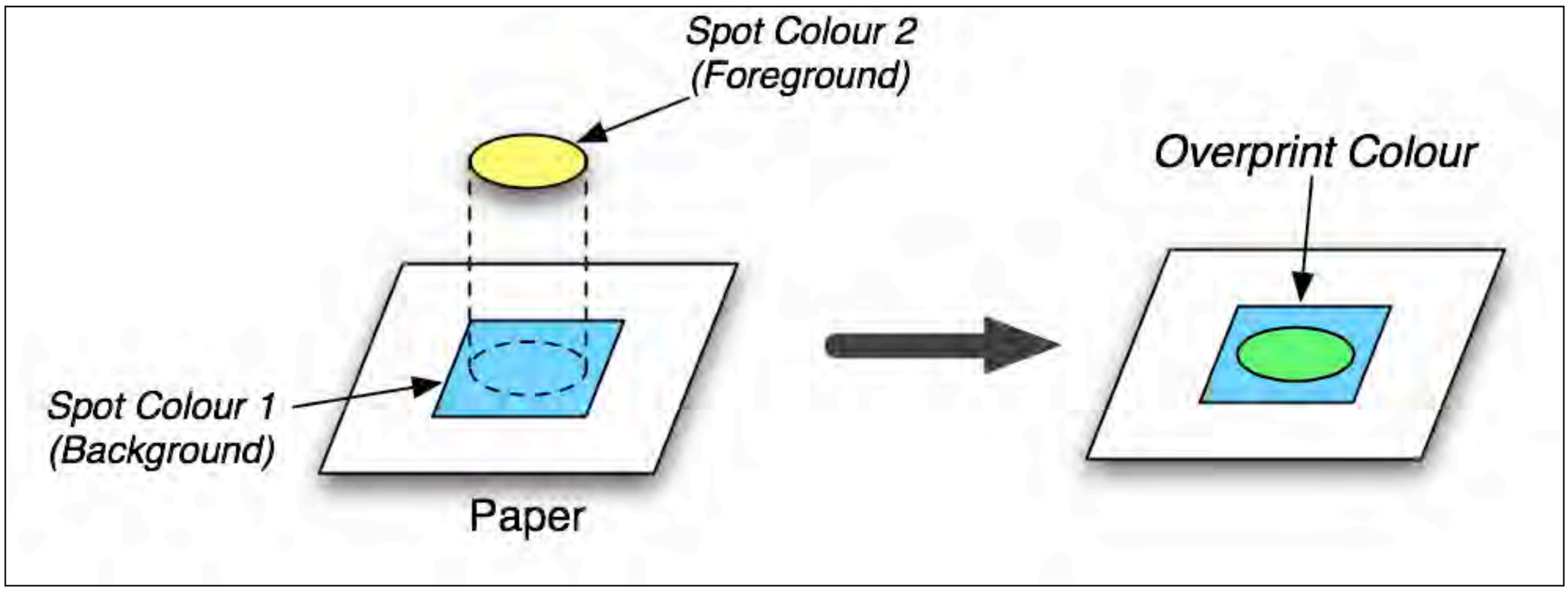
Overprint model

- Reflectance product is modified numerically by a scaling factor
- Scaling factor depends on colorant opacity, ink sequence and dot area



Overprint model

- Underlying colour = Background colour
- Overprinted colour = Foreground colour



Overprint model

- Overprint colour correlated to the product of background and foreground colours using regression analysis

- Refinement of linear model (Deshpande, 2010) to improve accuracy

$$X = j_x \times (X_b \times X_f)^{k_x}$$

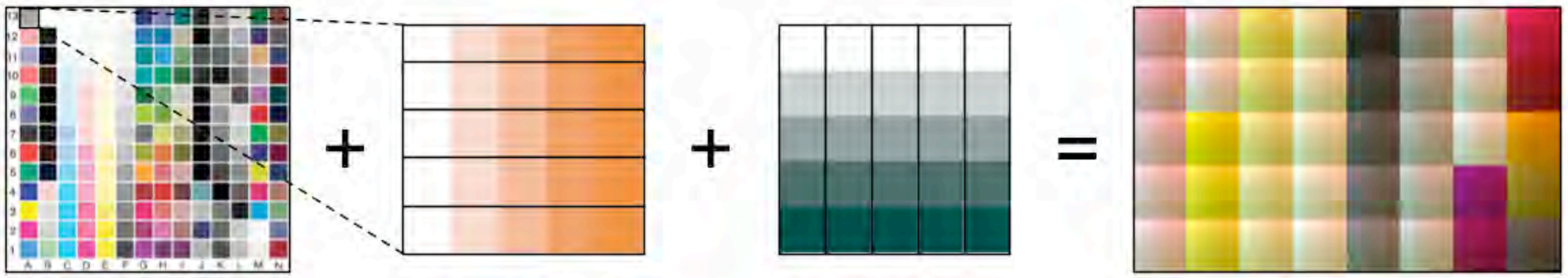
$$Y = j_y \times (Y_b \times Y_f)^{k_y}$$

$$Z = j_z \times (Z_b \times Z_f)^{k_z}$$

X, Y, Z : predicted tristimulus values of the overprint colour
X_b, Y_b, Z_b : measured tristimulus values of the background colour
X_f, Y_f, Z_f : measured tristimulus values of the foreground colour
j_x, j_y, j_z : scaling factors of the foreground colour depending on dot area
k_x, k_y, k_z : exponents of the foreground colour depending on dot area

Evaluation method

- Design of the test chart



CMYK
182 patches

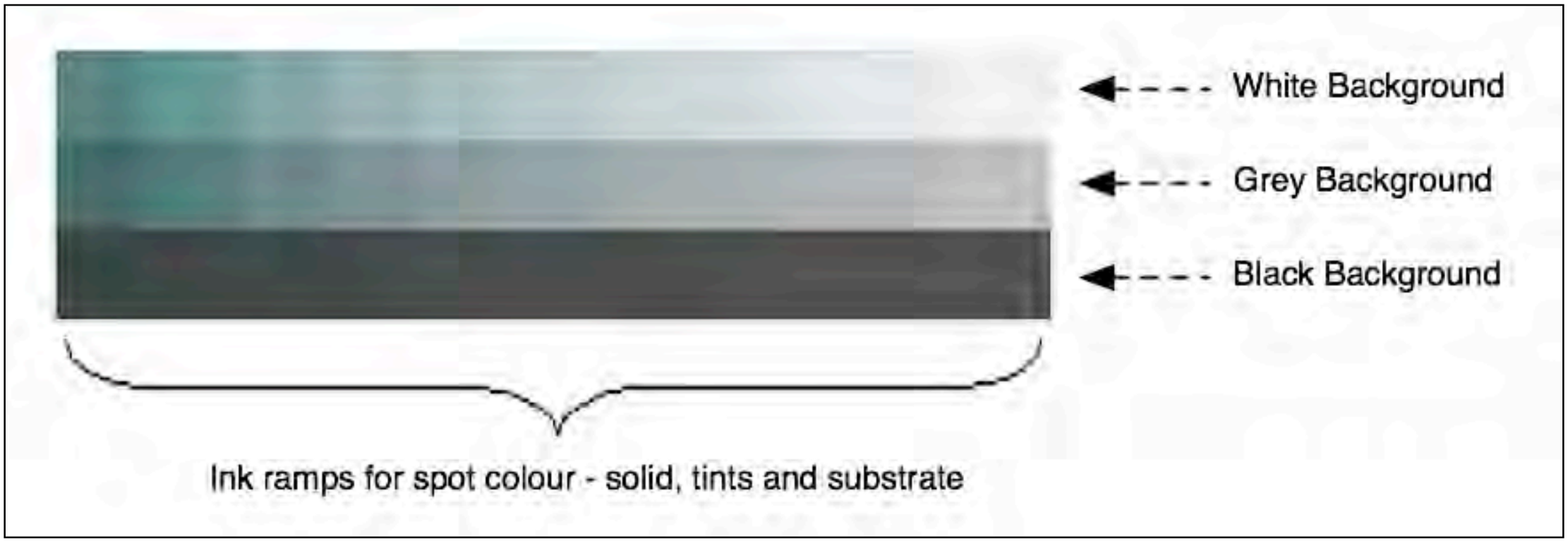
Pantone157C
25 patches over
every basic color
[0, 25, 50, 75, 100]

Pantone330C
25 patches over
every basic color
[0, 25, 50, 75, 100]

6-Color Test Chart
(CMYK + 2 Spot)
Total 4550 patches

Evaluation method

- Calibrate the model-coefficients using the ink step-wedge chart
- Ink ramps of 0% to 100% over three different backgrounds



Ink step-wedge chart - Pantone 330C spot colour

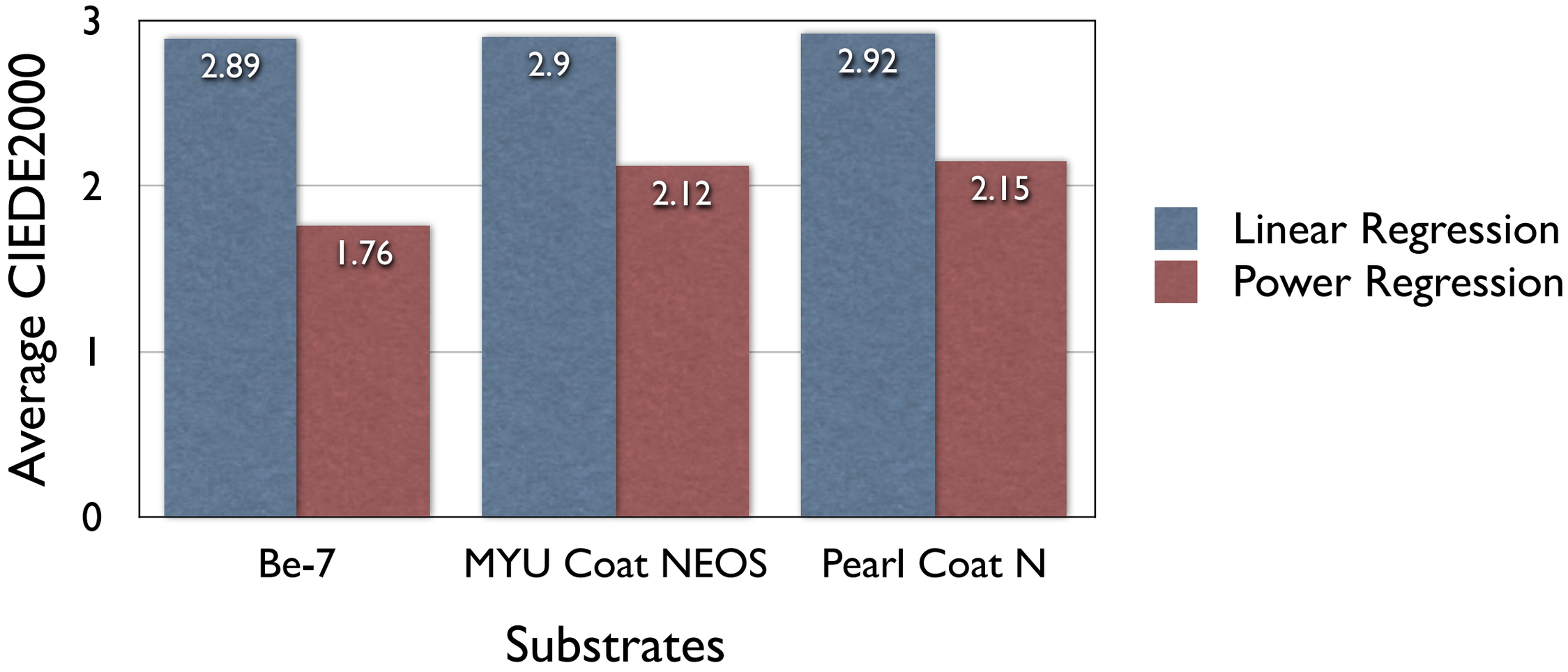
Evaluation method

- Specifications

Printing Process	Offset
Substrates	1. Mitsubishi MYU Coat NEOS 2. Hokuetsu Pearl Coat N 3. Nihon Be-7
Ink Sequence	K - C - M - Y - PMS157C (*Spot1*) - PMS330C (*Spot2*)
Measurements	X-Rite SpectroScan

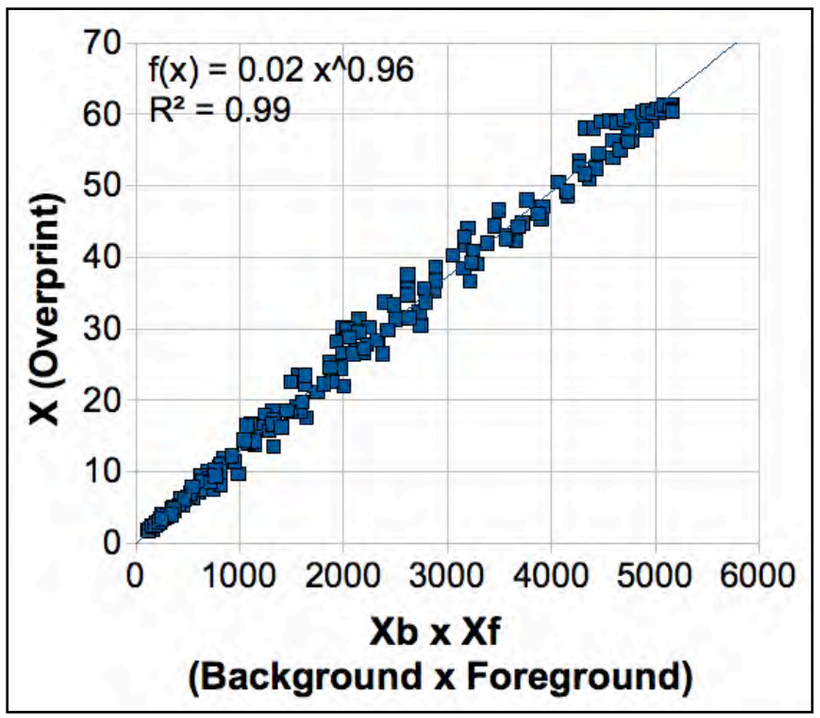
Results

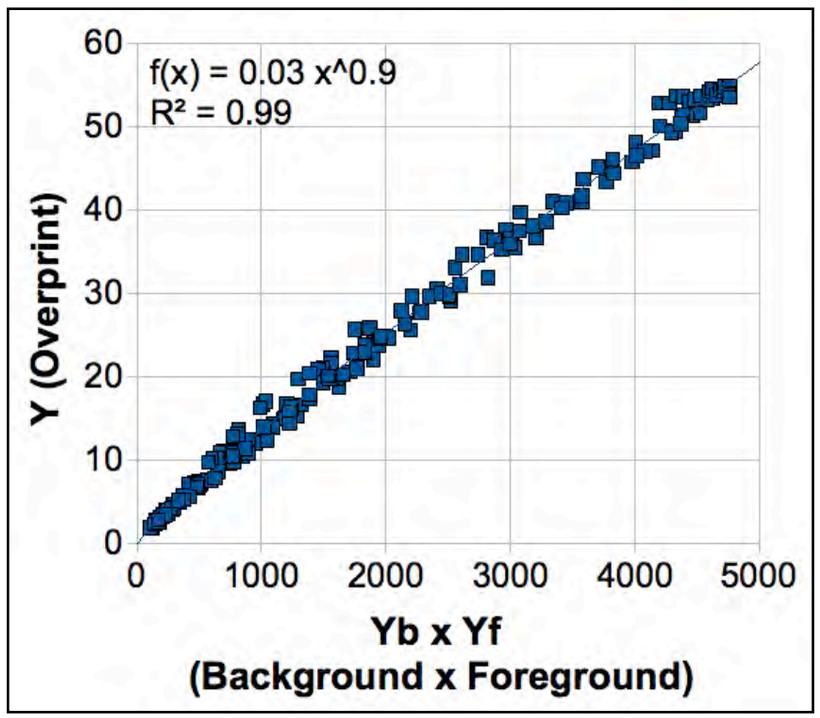
- Regression analysis - linear and power

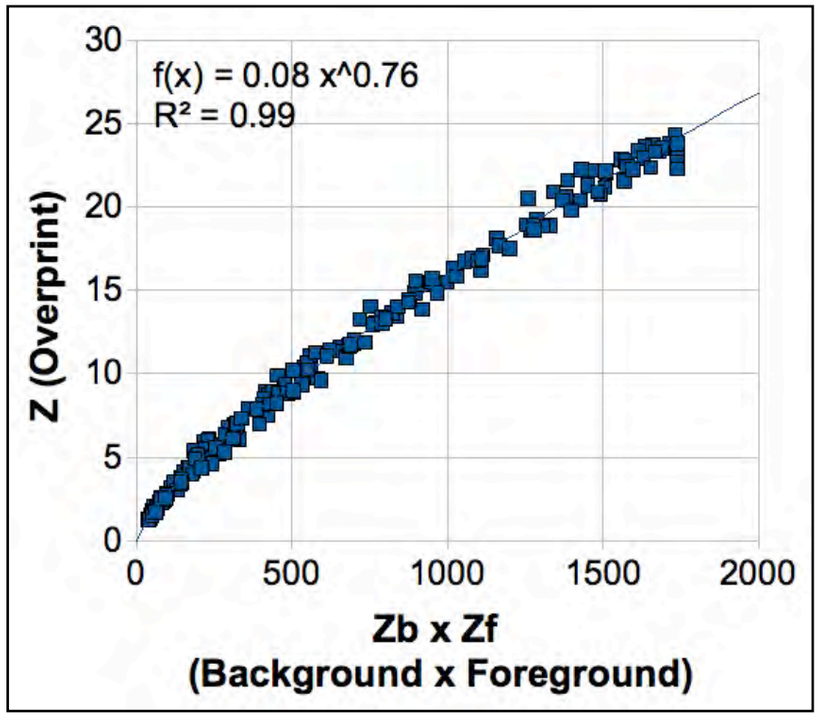


Results

- Data fitting - power regression



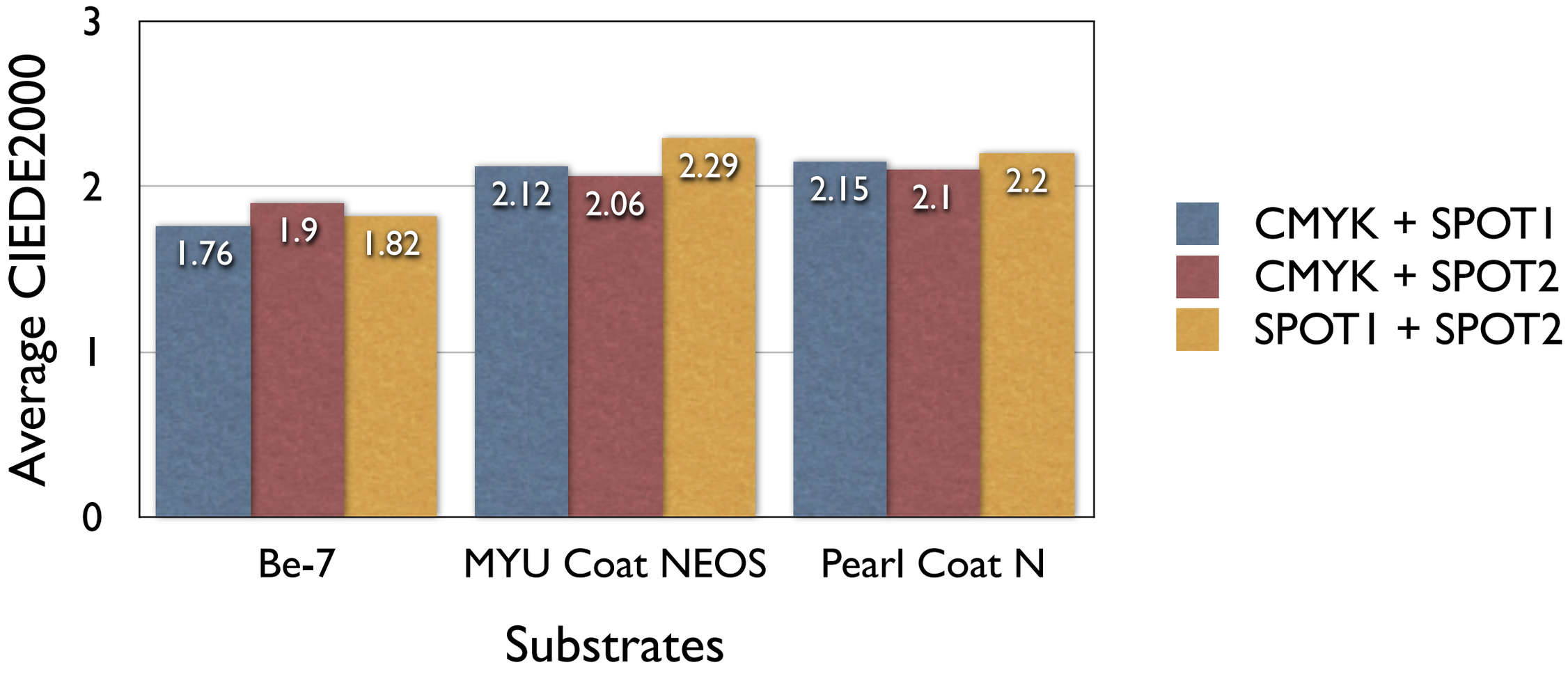




Measured overprint colour vs. product of the background and foreground colours

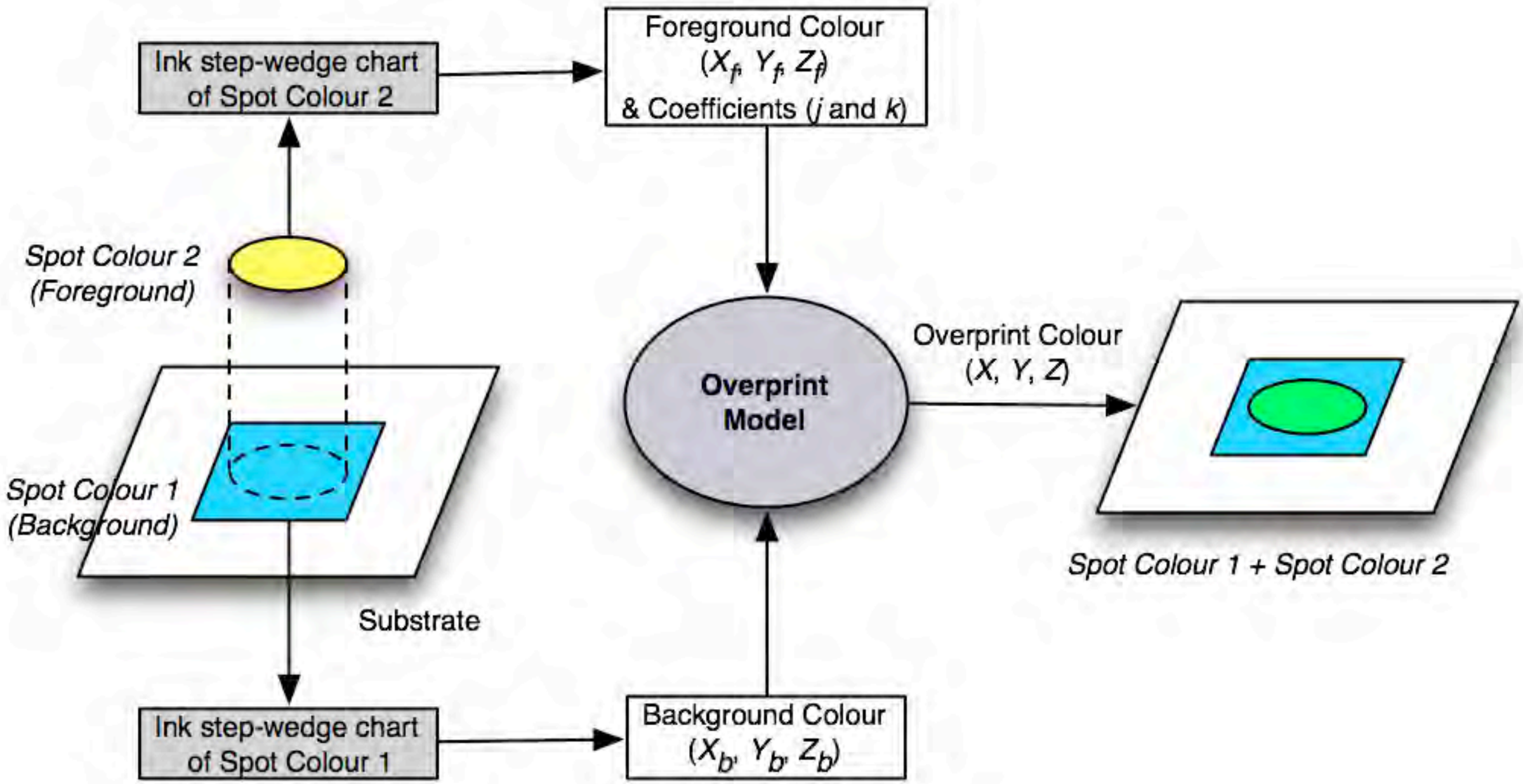
Results

- Overprint model - power regression



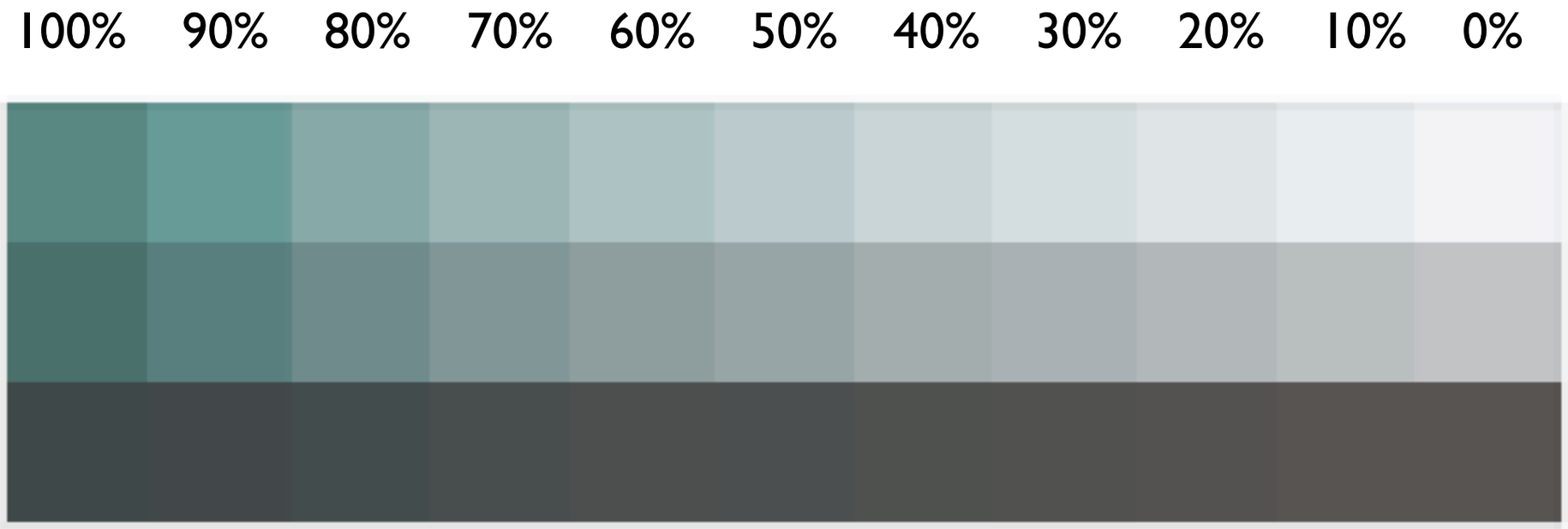
Implementation

- 2-inks combination



Implementation

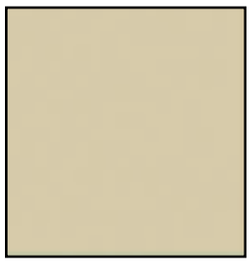
- Ink step-wedge chart
- Intermediate dot % - obtained by interpolation



Ink step-wedge chart - foreground (*Spot Colour2*)

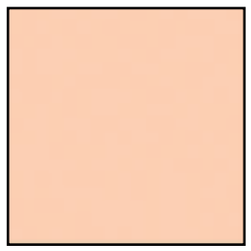
Implementation

Overprint



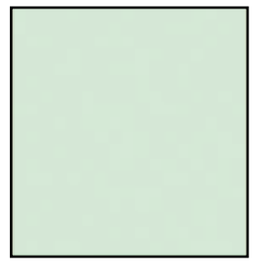
=

75% *Spot1*



+

50% *Spot2*

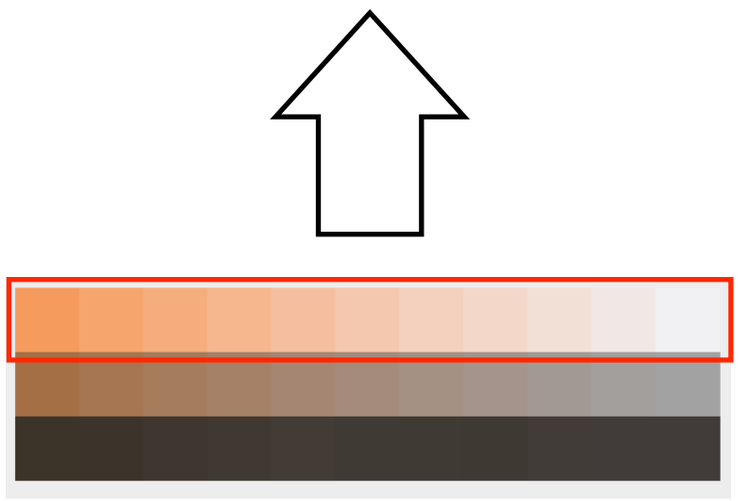


X, Y, Z

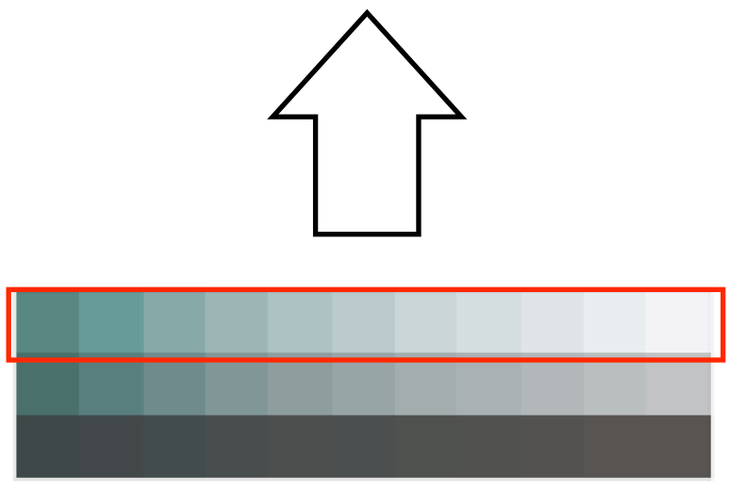
X_b, Y_b, Z_b

X_f, Y_f, Z_f

$$X = j_x \times (X_b \times X_f)^{k_x}$$
$$Y = j_y \times (Y_b \times Y_f)^{k_y}$$
$$Z = j_z \times (Z_b \times Z_f)^{k_z}$$



Ink chart - *Spot1*

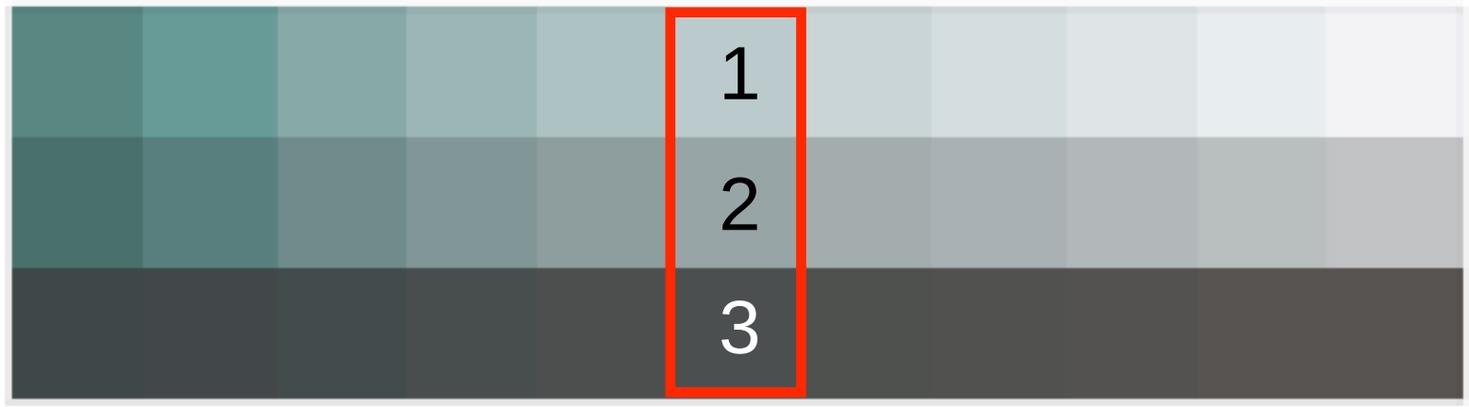


Ink chart - *Spot2*

Implementation

- Calculate the coefficients for the foreground colour (50% *Spot2*)

50% *Spot2*



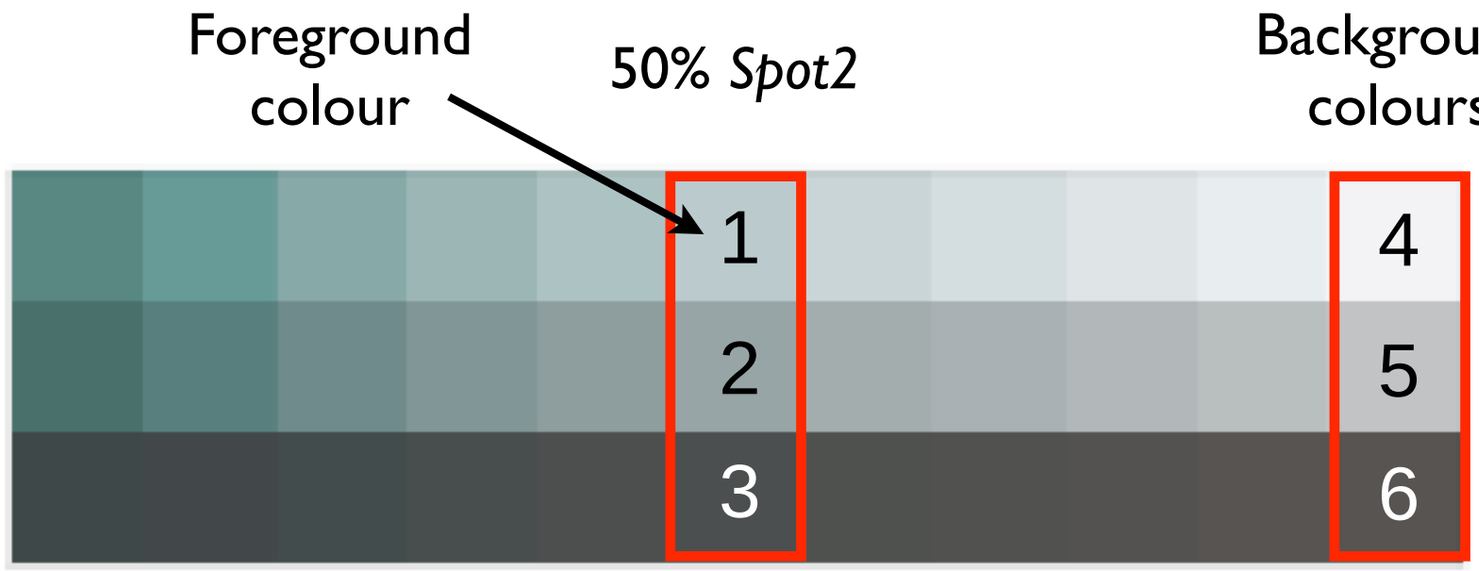
$$X = j_x \times (X_b \times X_f)^{k_x}$$

$$Y = j_y \times (Y_b \times Y_f)^{k_y}$$

$$Z = j_z \times (Z_b \times Z_f)^{k_z}$$

Implementation

- Calculate the coefficients for the foreground colour (*Spot2*)



$$X = j_x \times (X_b \times X_f)^{k_x}$$

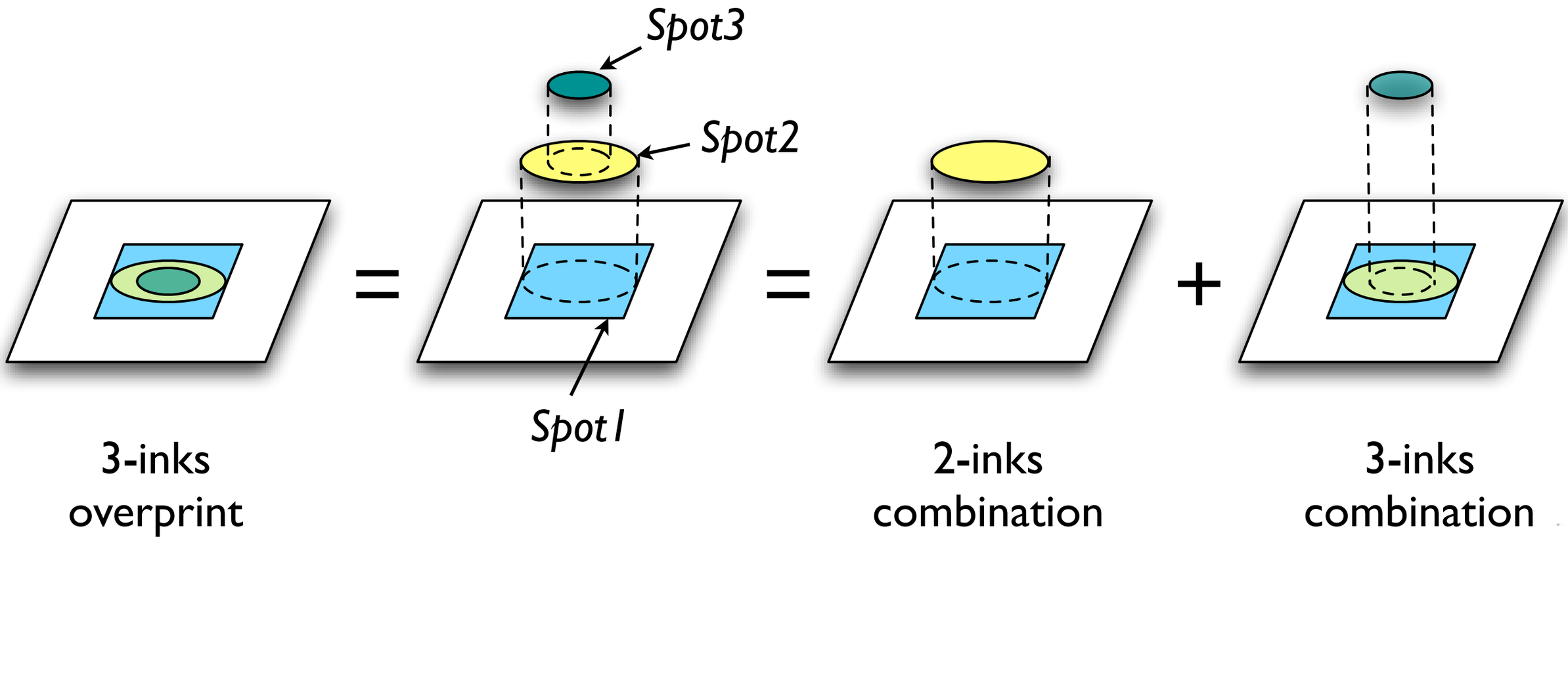
$$Y = j_y \times (Y_b \times Y_f)^{k_y}$$

$$Z = j_z \times (Z_b \times Z_f)^{k_z}$$

Overprint colour (X, Y, Z)	Background (X_b, Y_b, Z_b)	Foreground (X_f, Y_f, Z_f)
Patch 1	Patch 4	Patch 1
Patch 2	Patch 5	Patch 1
Patch 3	Patch 5	Patch 1

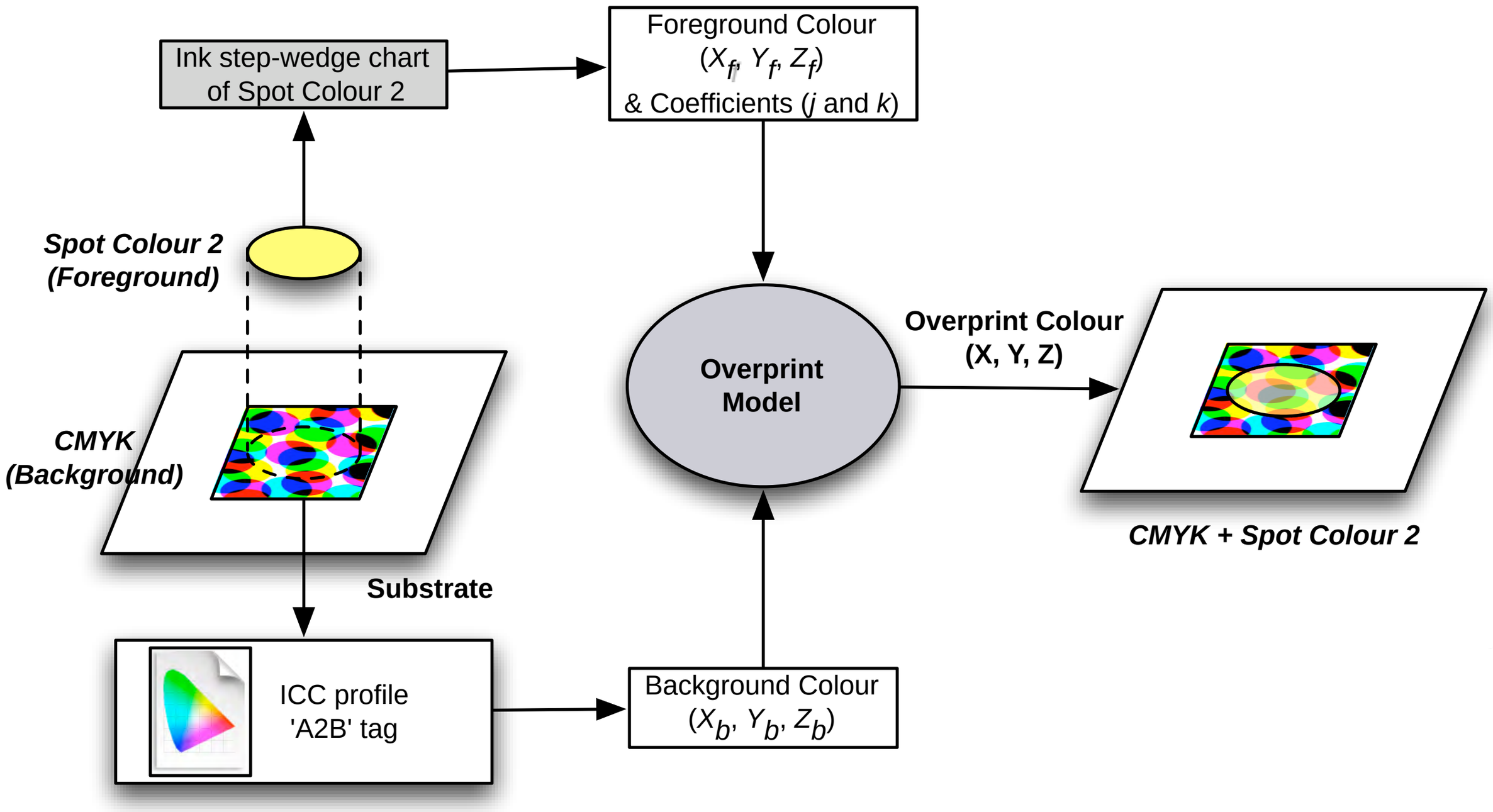
Implementation

- Multiple-inks combination: 3-inks, 4-inks and more
- Apply the model recursively



Implementation

- Process inks (*CMYK*) + Spot colour combination



Summary

- Proposed model - predicts solid and halftone overprints
- Simple and computationally inexpensive - based on CIEXYZ
- Accuracy is acceptable for the overprint preview

- Implementation for different scenarios
- Applications
  - previewing overprints in pre-media software
  - matching spot colour overprints on digital printing systems
  - N-colour printing

References

- Chung, R., Riordan, M. and Prakhya S. (2008) *Predictability of spot colour overprints*, Advances in Printing and Media Technology, VI. XXXV, p. 373-380

- Deshpande, K. and Green, P. (2010) *A simplified method of predicting the colorimetry of sot colour overprints*, Proc. 18th Color Imaging Conference: Color Science and Engineering Systems, Technologies, and Applications, p 213-216, San Antonio, Texas

- Viggiano, J.A.S. and Prakhya, S. (2008) *Prediction of overprint spectra using trapping models: A feasibility study*, TAGA 2008, Rochester, NY:2008 TAGA student chapter.

University of the Arts London
London College of Communication

Thank You!

University of the Arts London
London College of Communication