CMIC SUMMIT 2014
ROCHESTER INSTITUTE OF TECHNOLOGY

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CROSS-MEDIA INNOVATION CENTER at RIT

AGENDA

2:15 - 2:45 PM   GRAY BALANCE: A CALIBRATION AIM OR A PROCESS
                        CONTROL AIM?
                        Dr. Bruce Myers & Dr. Bob Chung
                        RIT School of Media Sciences

2:45 - 3:15 PM   MEASUREMENT AND ANALYSIS FRAMEWORK
                        Saleh Abdel Motaal
                        RIT School of Media Sciences

3:15 - 3:45 PM   RESEARCH HOT TOPIC DISCUSSION
                        Matthew Bernius
                        RIT School of Media Sciences

3:45 - 4:00 PM   CMIC 2014 WRAP-UP
                        Chris Bondy
                        Frank E. Gannet Distinguished Professor
                        RIT School of Media Sciences

4:00 PM   ADJOURNED

in the Polymer Chemistry Division of the ACS [past Program Chair, Alternate Councilor, Webmaster, symposia organizer].

Sarah Mannone

Sarah Mannone is Vice President of Client Services at Trekk, a multi-channel marketing communications agency. She works with Trekk clients to develop strategic marketing plans and craft measurable programs that that span print, web, social and mobile. As part of the Trekk management team, Sarah is involved in the decisions and strategy around new technologies and applications to meet the current and future needs of Trekk clients. She leverages an expansive knowledge of marketing tactics and technologies to lead creative and technical teams and create communications programs that help marketers meet their business objectives. Sarah holds a Bachelor's Degree from Northern Illinois University and a Master's Degree in Communications from the University of Illinois.

Sarah is a frequent speaker at marketing industry events. Recent engagements include MarketingProfs' Annual B2B Forum; Direct Marketing Association and Target Marketing Webinars; Xploration 14; IPN Global Summit; Product Camp NYC; and Direct Marketing Day @ Your Desk.

Ivan Mironchuk

Ivan Mironchuk is Solutions Account Manager, North America for the Adobe Digital Publishing Suite. Specializing in editorial workflow systems and digital asset management, Ivan is an Adobe Certified Expert in InDesign and InCopy.

A known publishing technology specialist, Ivan is a consultant and a co-author of Hand of a Master: Advancements in the Graphic Arts.

Ivan holds a B.S. in New Media Publishing and a M.S. in Printing Technology and Digital Publishing from RIT.

Bruce Leigh Myers

Bruce Leigh Myers, Ph.D. is an earned Doctorate in Graphic Communications with over twenty-five years of extensive industry experience currently serving as Assistant Professor in RIT's School of Media Sciences.

Bruce worked as a resident professor in Graphic Communications at a New Jersey State University from 2000 – 2004, and served over twelve years as an Adjunct Instructor teaching theoretically based Graphic Communications concepts at New York University. Industry experience includes over fourteen years in various sales, training and management positions at X-Rite, Incorporated and eleven years in technical, sales and management positions at Agfa.

Dr. Myers' areas of specific technical expertise include color management, statistical process control, quality management, quantitative research design and analysis.

SESSIONS

GRAY BALANCE: A CALIBRATION AIM OR A PROCESS CONTROL AIM?

THURSDAY OCTOBER, 16

2:15 - 2:45 PM

Dr. Bruce Myers & Dr. Robert Chung • Professor/Professor
Rochester Institute of Technology

EXECUTIVE SUMMARY

In recent years, printers have increasingly utilized gray balance to ensure quality in process color printing. Gray balance targets comprised of overprinted dot percentages of cyan, magenta and yellow will indicate a myriad of issues related to consistent color quality: due to the idiosyncrasies of the human vision system color shifts are apparent in these near-neutrals before they are manifest in other metrics.

It is no wonder specification committees have recommended their use in establishing calibration aims for process printing workflows. For example, using near-neutral three color gray patches is a cornerstone of the calibration process in setting plate curves for printers adopting G7 methodologies. Using near-neutral grays for process control applications, however, is less clearly defined.

Based upon recent research in the RIT School of Media Sciences and the published literature, the effectiveness of using near-neutrals for process control applications is discussed. A greater understanding of the terms, uses and limitations here is relevant for those interested in both quality and productivity in graphic reproduction.

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Gray Balance: a Calibration Aim or a Process Control Aim?

Professors **Bruce Myers and Bob Chung**

RIT School of Media Sciences

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CMIC Summit 2014

Industry Challenge

- In process color printing, gray balance has different operational meanings.
  - When gray balance is the press calibartion aim, ink, paper, and printing are held as constants and plates are variables.
  - When gray balance is the process control aim, paper, and plates are held as constants and ink is the variable.
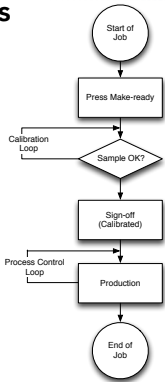
Intended Audience

- The information presented will be relevant to media producers and buyers alike.
  - Those involved with digital color reproduction together with ink-on-paper technologies including offset lithography, flexography and gravure can likely benefit from a more comprehensive understanding of the material presented.

Offset Printing Process

- 3 steps
  1. Press make-ready
     - Adjust registration and ink film thickness
  2. Achieve calibration
     - Deviation conformity or sign-off by customer
  3. Implement process control
     - Achieve repeatable color

Start of Job → Press Make-ready → Calibration Loop → Sample OK? → Sign-off (Calibrated) → Process Control Loop → Production → End of Job

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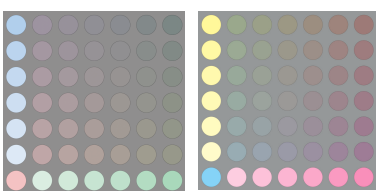
Calibration vs. Process Control

- **Calibration is like launching the stone, it focuses on the initial aiming of the target.**
- **Process control is like the sweeping in *curling*, it focuses on the efforts of guiding and correcting the process.**

Gray Balance

- In the most liberal sense, gray balance is paper, colorant, and tonal value dependent.
  - A combination of RGB colorant mixture can produce a gray sensation as much as a combination of CMY colorant mixture.

Pop Quiz

- Which image is reproduced by RGB colorants, and why?

Hint: RGB subtractive primaries have greener greens, but no yellows.

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Press Calibration Methodology

- ISO/TS 10128 (2009) Graphic technology — Methods of adjustment of the colour reproduction of a printing system to match a set of characterization data, defines three press calibration methods
  - Match dataset via tonal values
  - Match dataset via near-neutral tonal scale (gray balance)
  - Match dataset via device link

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What is Characterization Data?

- FOGRA 39L

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Grey (Gray) Balance

- ISO 12647-1 (2012), Clause 3.11, defines grey balance as "set of tone values of the characetrization dataset that appears as an achromatic colour under specified viewing conditions and specified printing conditions."
  - The specified printing conditions are according to paper, color of the CMYK solids, TVI of the CMYK tints, and the midtone spread.
  - Gray balance is the results of calibrating to solids, TVIs, and the midtone spread.

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Press Calibration by TVI Method

1) Match the correct process colour solids and two-colour solid overprints.
2) Match the tone value curve to the reference tone value curve for each printing primary.

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Press Calibration by Gray Balance Method

- ANSI/CGATS/IDEAlliance TR015 (2013), Clause 3.3, Graphic technology — Methodology for Establishing Printing Aims Based on a Shared Near-neutral Gray-scale, defines gray balance as "a range of tones from full coverage to unprinted substrate in which the measured value of each tone is that of an achromatic."
  - Near-neutral gray-scale aims (a set of pre-defined CMY triplets) are built into characterization datasets.

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Press Calibration by Gray Balance Method

- Starting with a predefined near-neutral (3-color CMY) tone scale

Before calibration → After calibration

G7

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Press Calibration by Gray Balance Method

- Key benefits
  - The ability to produce images with the similar visual appearance at various locations worldwide, which enhances global supply-chain initiatives.
  - The ability to achieve the similar visual appearance with disparate substrates and processes, which expands the flexibility of brand equity and image repurposing.

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Printing Process Control

- Process control is taking corrective action to produce conforming products by comparing sample measurement to specifications during the production.

Disturbance
ink, paper

Manipulated Variables

material transport
PROCESS
printing nip

PRINTED PRODUCT

targets, registration
CONTROLLER
IFT, color LUT

Feedback Signal
color measurement deviation variation

Reference
aims, OK sheet, control limits

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Process Control Methodology

- A series of press runs under controlled conditions was conducted by varying two variables to ascertain the benefits of two control methods (Ray Prince, Chuck Koehler, etc., TAGA Proceedings, 2008)
  - Controlling solid ink films and controlling gray balance
- Results — Controlling solid ink density results in less waste and less color variation than controlling gray balance.
  - The causal relationship in controlling solid ink density is explicit.
  - The causal relationship between dependent variable (gray balance) and independent variables (CMY ink films) is not explicit.
    - TVI may change intermittently due to dot slur/doubling, and adjusting solid ink is the wrong thing to do.

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Process Control, RIT Case Study

  - We developed press calibration tools.
    - Input: Substrate-corrected solid aims, spectral reflectance values of paper and a sample solid
    - Output: Status T density that predicts the best match (smallest ΔE_{00})

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Process Control, RIT Case Study

  - We also developed process control tools to monitor printing consistency during the production run.
    - Input: CIELAB values of press sheet samples, and substrate-corrected aims
    - Output: Time charts indicating time-dependent variation of CMYK solids, CMYK tints, and gray balance with tolerances superimposed

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Conclusion

- Presss calibration is a pre-requisite of printing process control.
  - Press calibration by solid ink and TVI works well and is widely adopted in Europe and Asia.
  - Press calibration by gray balance also works well and is adopted in North America.
- Printing process control by solid ink density works far more effectively than controlling gray balance by varying solid ink density in the press room.

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Future Research Questions

- Is a gray balance control strip, consisted of repeating patches of CMY triplets and matching K tints, useful for printing process control?

We discussed press calibration and process control in traditional printing. How different are these issues in digital printing?

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Literature Cited

- ISO 12467-1 (2002), Graphic technology — Process control for the production of half-tone colour separations, proof and production prints — Part 1: Parameters and measurement methods
- ISO/TS 10128 (2009), Graphic technology — Methods of adjustment of the colour reproduction of a printing system to match a set of characterization data
- ANSI/CGATS/IDEAlliance TR015 (2013), Graphic technology — Methodology for Establishing Printing Aims Based on a Shared Near-neutral Gray-scale
- Prince, Ray, Koehler, Chuck, et al., TAGA Proceedings (2008) "Controlling Ink Color during the Press Run - Solid Ink or Gray Balance," pp. 117-135
- Chung, Robert, Test Targets 8.0, RIT (2008), "Non-CMYK Pictorial Color Image Reproduction,", pp. 44-48
- Chung, Robert, TAGA Proceedings (2012), "Grey Reproduction & Its Conformity Assessment," pp. 342-352

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Thank You!
Q & A

Professors Bruce Myers and Bob Chung
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