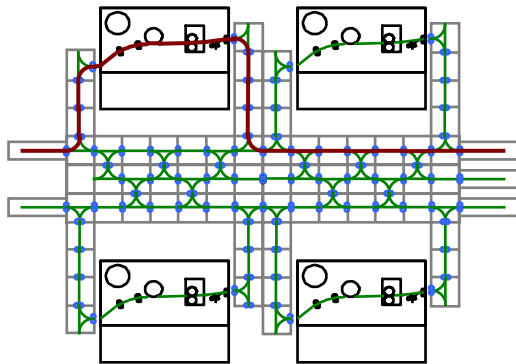
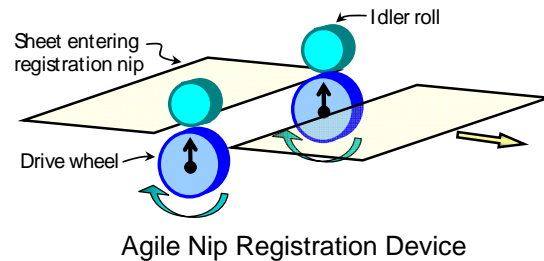


WeA02: Control in Modern Printing Systems: Modular Reconfigurable Media Paths, Color Consistency, Fuser Process, and Registration



Highly Modular, Reconfigurable Printer



Examples of Printing Systems Using Advanced Control Techniques

Modern high-end printers are some of the most sophisticated devices in use today. In particular, as a printer is essentially a “manufacturing system in a box,” control systems feature prominently in printing systems, and a truly remarkable range of control techniques are employed. This tutorial will cover real examples used in printing today and in the future, including: distributed control over networks with delays, hybrid systems, nonholonomic systems, time-optimal control, feedback and feedforward (two-degree-of-freedom) controllers, and Model Predictive Control (MPC).

Structure of the Tutorial Session

The tutorial session consists of four talks:

- **WeA02.1 (60 min): *Control in Printing Systems: Modular Reconfigurable Media Paths, Color Consistency, Fuser Process, and Registration***, by Haitham Hindi and Lara S. Crawford of the Palo Alto Research Center. This talk will present a novel highly modular, reconfigurable parallel printing system. We will describe its hierarchical, networked control architecture and the design of its distributed time-optimal reference tracking controllers. We will also discuss real-world implementation issues, such as time and state synchronization and integration with a discrete planner/scheduler, and share lessons learned.
- **WeA02.2 (20 min): *Feedback and Feedforward Issues in Media Path and Fuser Control***, by Eric S. Hamby, Faming Li, and Yongsoo Eun of the Xerox Corporation. This talk will review applications of feed-forward control in printing processes. We will then extend feed-forward control theory to make use of extra “look-ahead” time, when disturbance information is known well in advance, and show the advantages of this extended feed-forward strategy in a printing process example.
- **WeA02.3 (20 min): *Spot Color Rendition – A Feedback Control Problem***, by Alvaro Gil and Lalit K. Mestha of the Xerox Corporation. This talk will provide an overview of the spot color control system and consistency requirements. We will show how we expressed this color control system as a MIMO control problem and then applied state feedback and Model Predictive Control algorithms to achieve accurate spot color rendition.

- **WeA02.4 (20 min): *Control of Non-linear / Non-holonomic Sheet Registration Devices***, by Martin Krucinski and Marina Tharayil of the Xerox Corporation. This talk discusses image-to-paper registration, which measures how well an image is positioned on the paper relative to its intended position. We describe various approaches to controlling sheet registration devices. As one example, some registration systems with two-DOF split-nip differential drive systems have non-holonomic constraints, and use a polynomial path planning method to register the three DOF of the sheet.