Innovative Software Techniques for Single Pass Reliability

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Global Inkjet Systems

- Electronics, firmware, drivers, RIPs, software utilities, user interfaces and components for ink delivery systems
Single Pass Printing

- The arguments are well known
- Scanning
  - Safe and reliable
  - Errors recoverable
  - Lower productivity
- Single pass
  - No room for error
  - Defects highly visible
    - Missing nozzles
    - Jet straightness
    - Consistent jet velocity
    - Printhead density shifts
  - High productivity
  - Reliability critical
Inkjet System Integration

It may look simple, but...
When building a single pass system – there are many variables...

And the more heads – the harder it becomes...
Inks & Substrates

- **Ink/fluid jetting characteristics**
  - Good drop formation
  - Reliability, stability
  - Open time

- **Ink/substrate interaction**
  - Substrate surface energy matches ink surface tension
  - Wetting & adhesion
  - Substrate pre-treatment

Images courtesy of Industrial Inkjet & Imagexpert
Mechanical Issues

- **Accuracy of substrate movement**
  - No web weave
  - No stretch
- **Accurate encoder signals**
  - Positioning
  - Resolution

Images courtesy of Industrial Inkjet
And more

- **Print bar to print bar registration**
  - Printhead alignment
  - Media control
  - Time of flight/jetting parameters

![Full Dot Overlap](image1)
![Partial Dot Overlap](image2)
![No Dot Overlap](image3)

- **Reliable ink supply system**
  - Correct pressure
    - Shared or individual
  - Flow mode – recirculation
  - Degassing

![Shared Pressure Control](image4)
Getting the most out of your RIP and software tools
Grey level selection.....

A key starting point for maximising image quality is to choose your drop sizes carefully.

The smallest drop will often dictate the perceived graininess of the image.

Try to ‘spread out’ the grey levels over the contone range by selecting the appropriate printhead, ink and waveform.
And...ink limiting

- **Ink limiting**
  - Prevents bleeding and flooding of the substrate
  - Reduces total ink consumption
  - Improves print quality
  - Improve effectiveness of colour management

- **Grey Level Selection**
  - Only use grey levels that are required
  - Can be done in the waveform or in RIP software

- **Software Ink Limiting**
  - A mechanism to limit the maximum amount of ink deposited by each channel
And printhead stitching....

- The human eye is very good at spotting discontinuities - particularly in areas of flat colour
  - **Printhead alignment**: typically positioned <20% of the diameter of a drop
  - **Ink substrate interaction**: ink moves over time creating visible artefacts – ink migration control

![Image showing "Flat" or "No" Stitch across flat colour vs 'Moving Stitch' across flat colour]
• Stitches can massively improve output quality
• Different applications benefit from different strategies
• Overlap of printheads
  • 20-40 pixel (2-4mm)
  • Larger stitch area is better for quality
• GIS software offers many stitching strategies

Digital Stitching Strategies - examples

Print Direction

P1
X& Y Dither

P2
“Flat” Stitch

2-D Density

50% Stitch

1-D Gradient

X& Y Dither
Development of Single Pass

Stage 1
- 4,000 – 20,000 nozzles
- 300 - 600dpi native
- 10 – 100m drops/sec

Stage 2
- 100,000 nozzles
- Up to 600dpi native
- 100m – 1bn drops/sec

Stage 3
- 500,000 nozzles
- 1200dpi native
- 10bn+ drops/sec

Product launches – ITMA, DRUPA.....
Printhead Density Control

• A print arrays get larger, the challenge of printing large flat colours becomes increasingly difficult

• Many printheads have a small amount of non-linearity in their drop volume across the length of head
  • This can make stitching printheads without visible joins challenging

• GIS technology can compensate for printhead non-linearity in real-time making stitching easier and solid colours flatter and smoother
Nozzle Out Correction

- Nozzle sizes are getting smaller
  - Particles can block them (in the ink and in the environment)
- Large print bar arrays - many more nozzles – higher probability of issues
- Strategy 1: Double Up - Redundancy
  - Add second row of printheads per colour so when one nozzle fails another can be used
    - Expensive!
- Strategy 2: Hide the problem
  - Identify where a nozzle is faulty and spread the jetting responsibility to neighbouring nozzles and/or colours
Nozzle Out Correction - Image Processing Technology

• Identify the missing nozzles
  • Nozzle check pattern before print job
  • Inline with vision system

• Many different strategies to share data between nozzles
  • Can be done in contone or grey level data
    • GIS – most effective in contone data

• Works best in mid and light mid tones

• Clusters of nozzles much more difficult to hide than individual/isolated nozzles

• Substrate plays a part
  • Technology works best where there is some dot gain

• Helps disguise or make the missing nozzle less visible – less white space
Nozzle Out Correction - Image Processing Technology

• Can hide error in same colour plane to neighbouring nozzles
• Can hide error in other inks - in multi-ink backgrounds
  • e.g. If Cyan nozzle fails - could add a little black to hide white space

• 100s of patents
  • Use of nozzle out correction technology requires careful knowledge
Want to know more? – please visit us – Stand G38

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