GLOBAL INKJET SYSTEMS

CONTROL | PERFORMANCE | INNOVATION

Innovative Software Techniques for Single Pass Reliability

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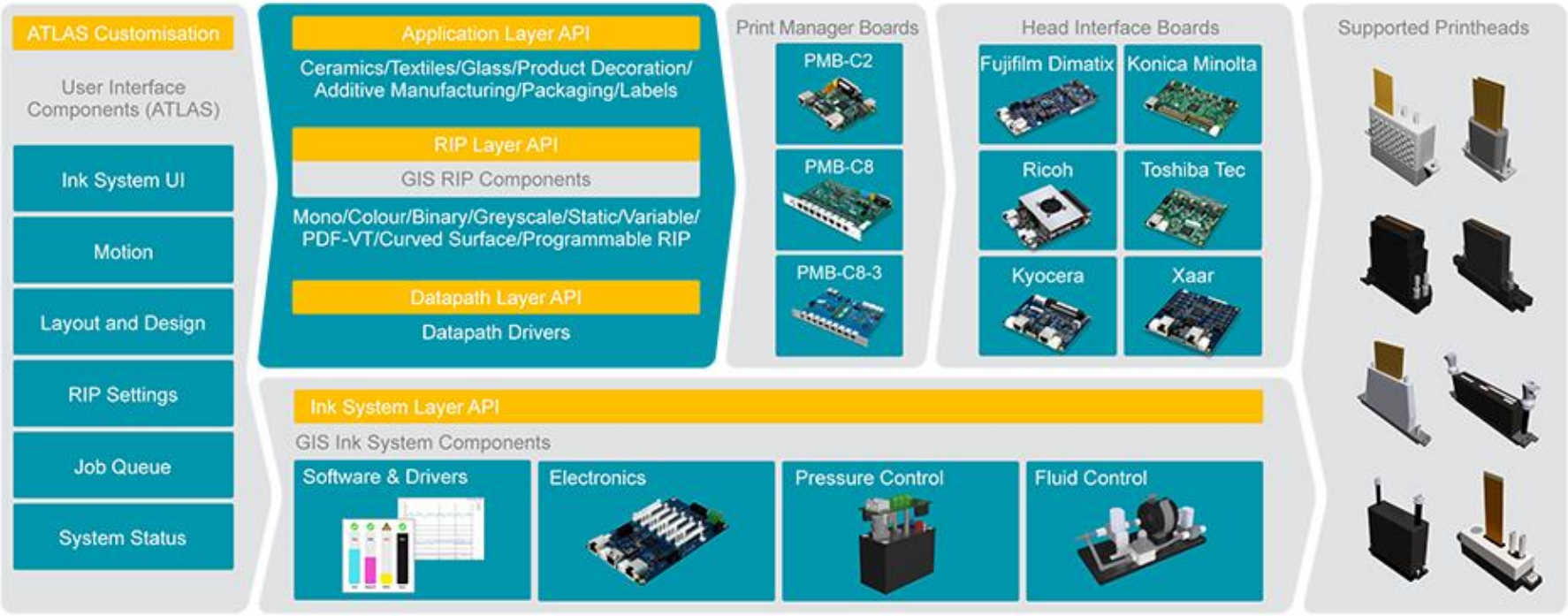
THE QUEEN'S AWARDS FOR ENTERPRISE INTERNATIONAL TRADE 2013

IN PRINT

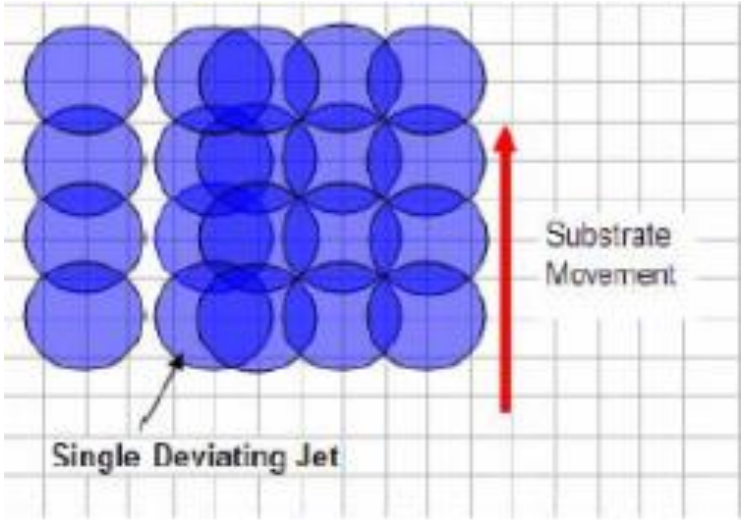
Global Inkjet Systems

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

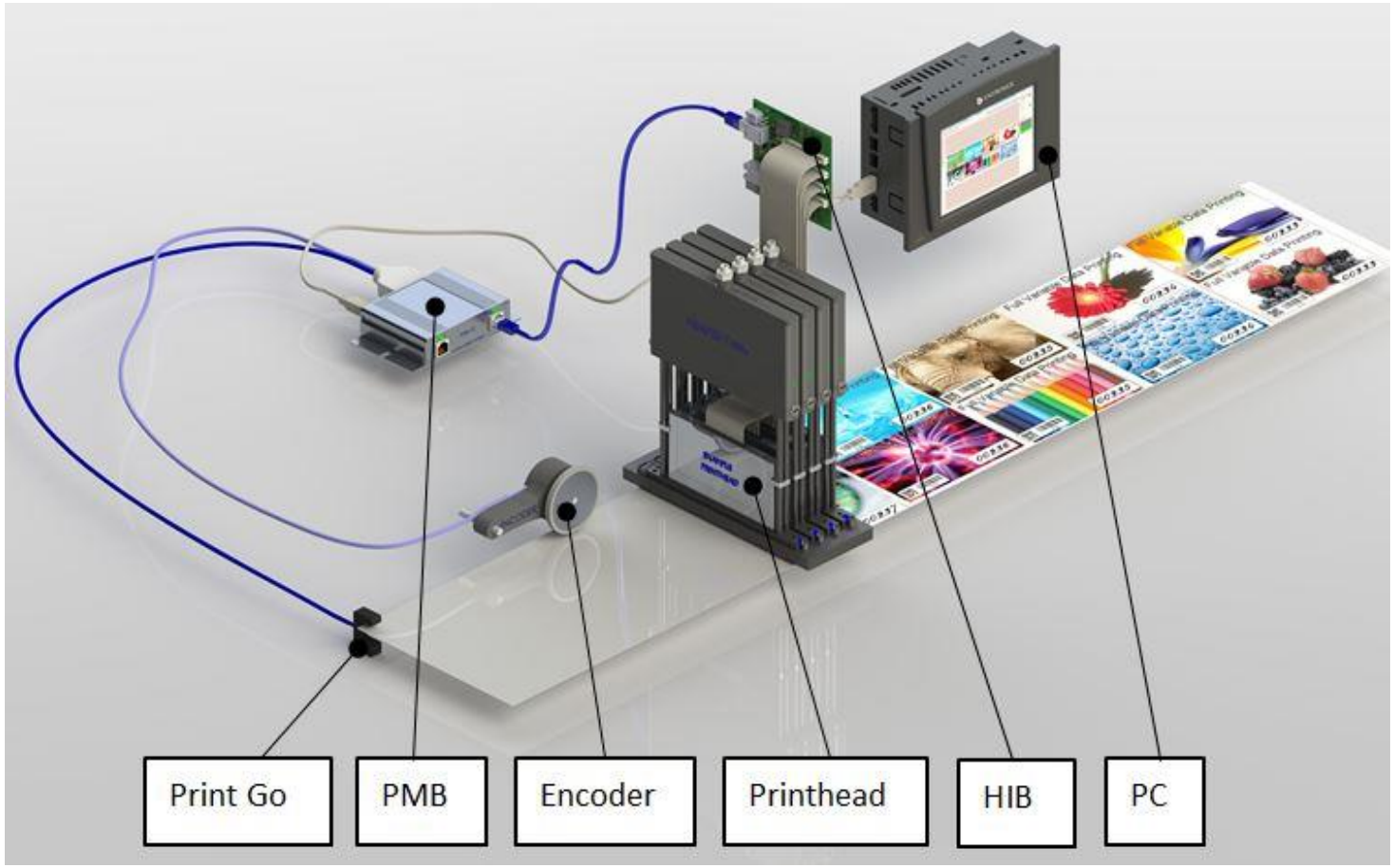


Single Pass Printing

- **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



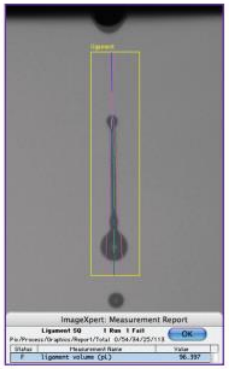
It may look simple, but…

When building a single pass system – there are many variables…

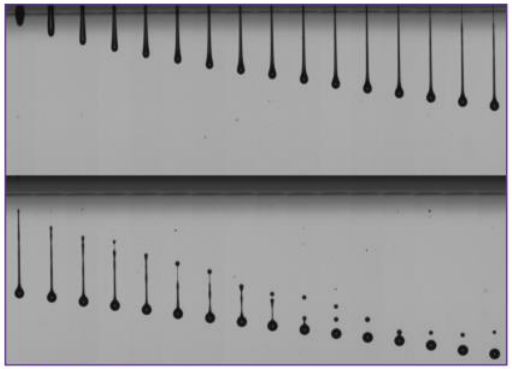
And the more heads – the harder it becomes…

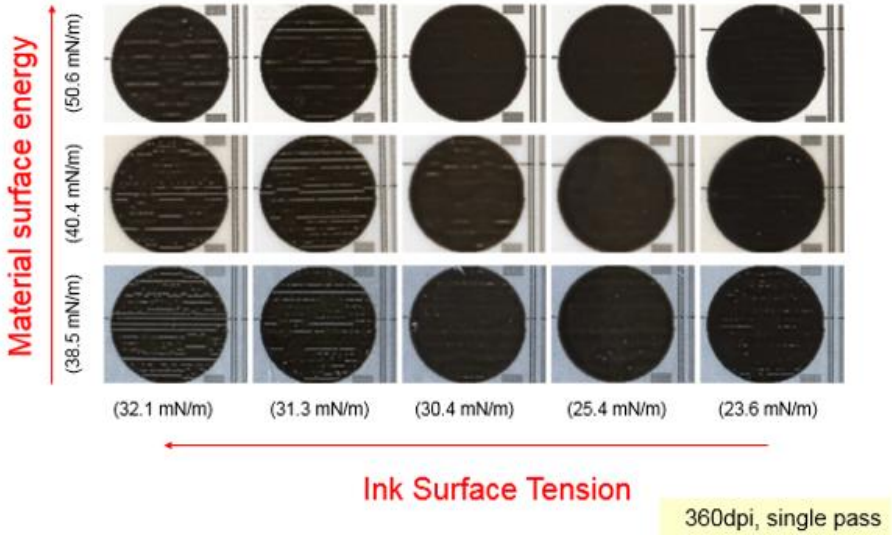
Inks & Substrates

- **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



Ligament volume measurement

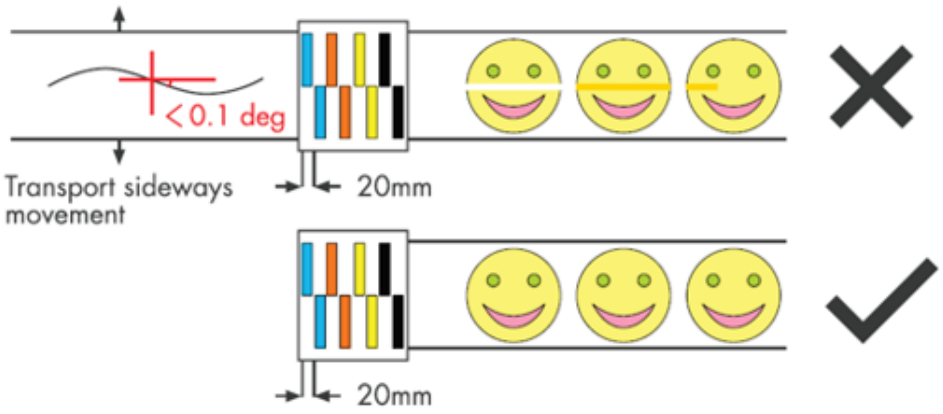

View droplet formation

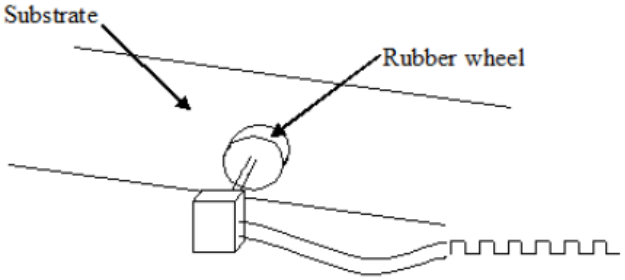


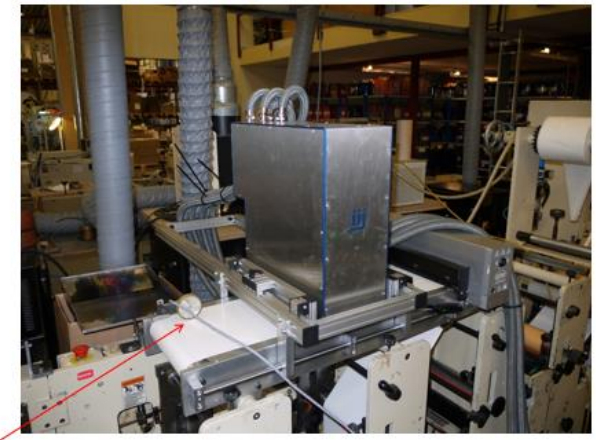
Images courtesy of Industrial Inkjet & Imagexpert

Mechanical Issues

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





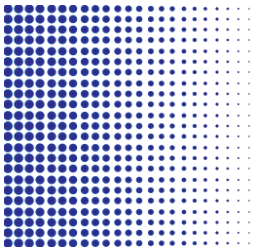


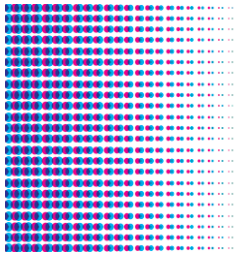
Shaft Encoder as close to inkjet as possible!

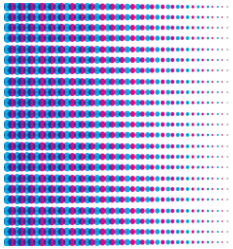
Images courtesy of Industrial Inkjet

And more

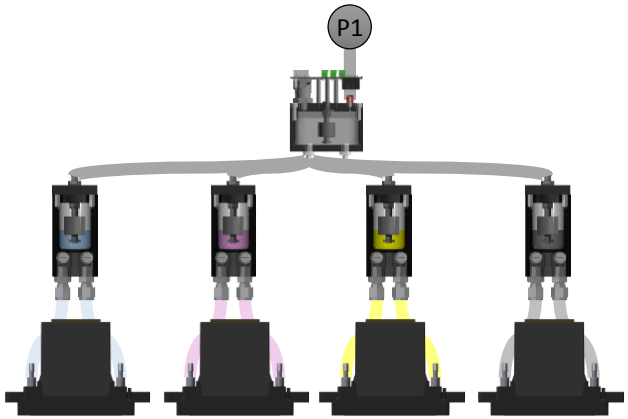
- **Print bar to print bar registration**
  - Printhead alignment
  - Media control
  - Time of flight/jetting parameters


Full Dot Overlap


Partial Dot Overlap


No Dot Overlap

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



Shared Pressure Control

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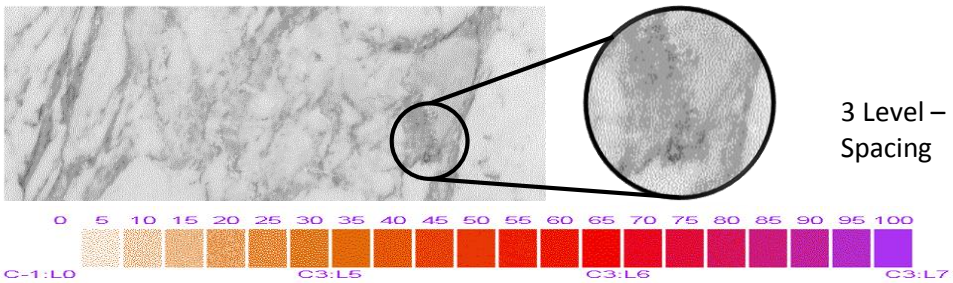
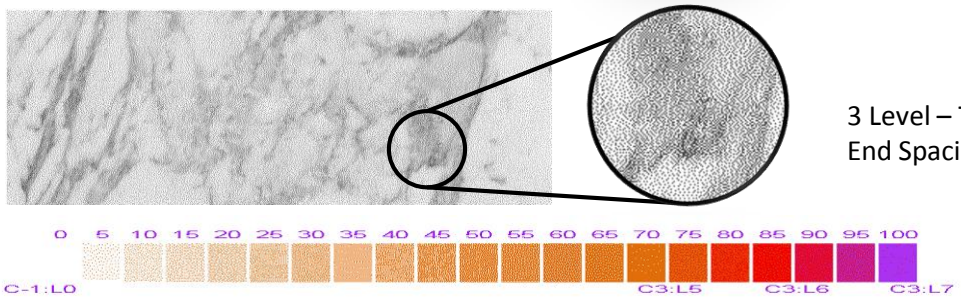
Getting the most out of your RIP and software tools

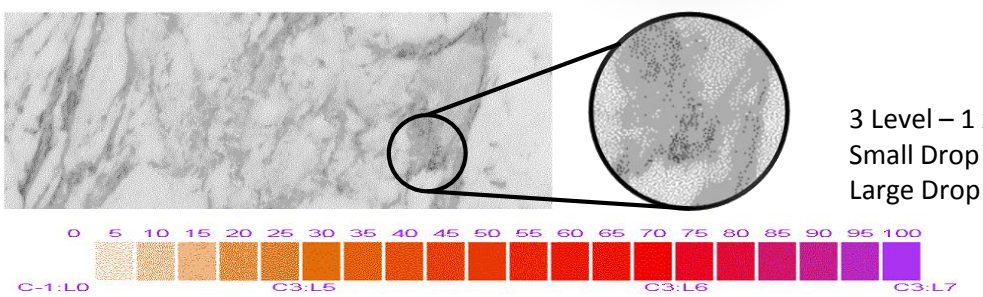
Grey level selection…..



3 Level – Even Spacing



3 Level – Top End Spacing



3 Level – 1 x Small Drop + 2 x Large Drop

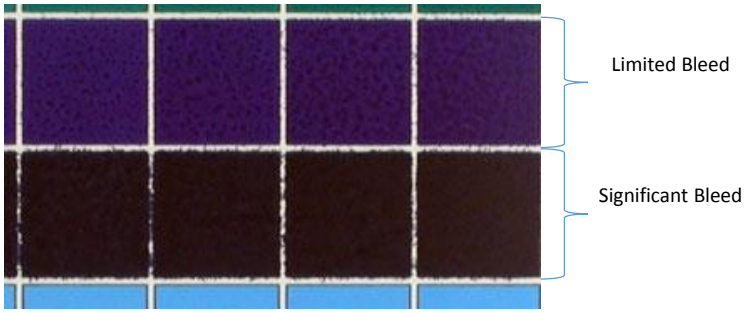
A key starting point for maximising image quality is to chose your drop sizes carefully

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

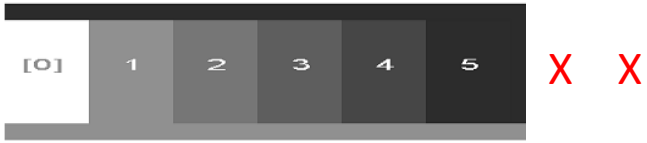
- **Ink limiting**
  - Prevents bleeding and flooding of the substrate
  - Reduces total ink consumption
  - Improves print quality
  - Improve effectiveness of colour management
- **Grey Level Selection**
  - Only use grey levels that are required
  - Can be done in the waveform or in RIP software
- **Software Ink Limiting**
  - A mechanism to limit the maximum amount of ink deposited by each channel



Example of ink bleed on a substrate

Ideal tonal response

Typical tonal response



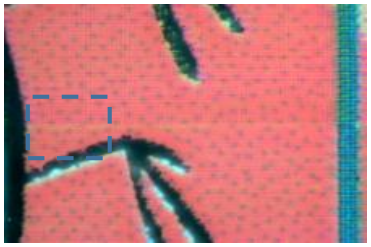
Final Grey Level Selection

And printhead stitching….

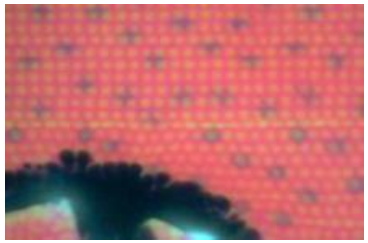
- **The human eye is very good at spotting discontinuities - particularly in areas of flat colour**
  - **Printhead alignment**: typically positioned <20% of the diameter of a drop
  - **Ink substrate interaction**: ink moves over time creating visible artefacts – ink migration control

"Flat" or "No" Stitch across flat colour

Stitch Line →



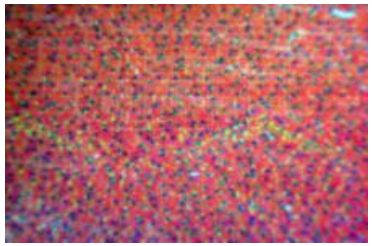
Stitch Line →



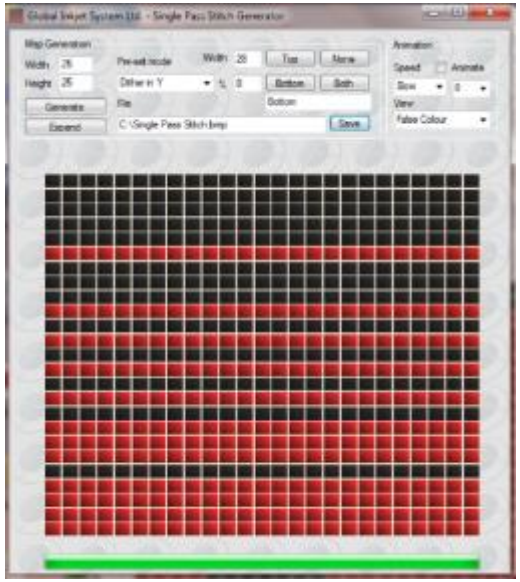
'Moving Stitch' across flat colour

Stitch Line →

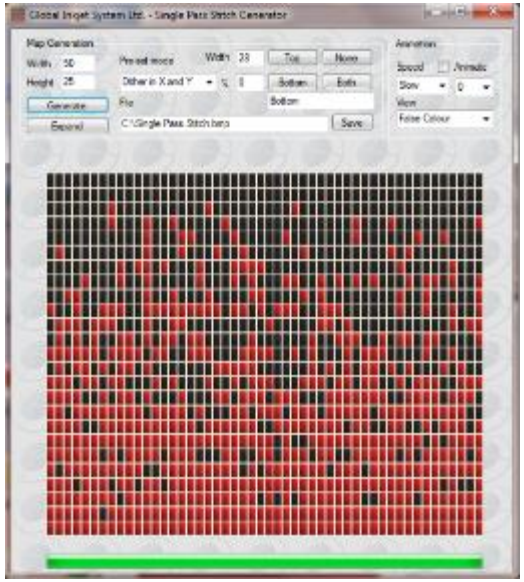
Stitch Line →



- **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**

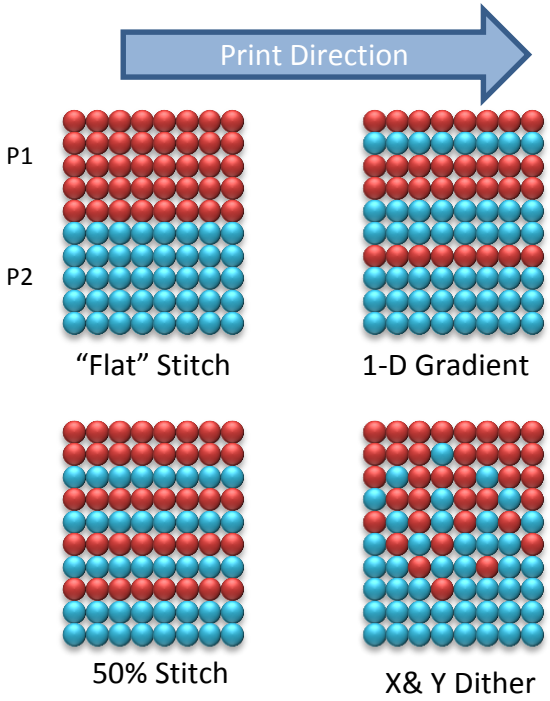


2-D Density



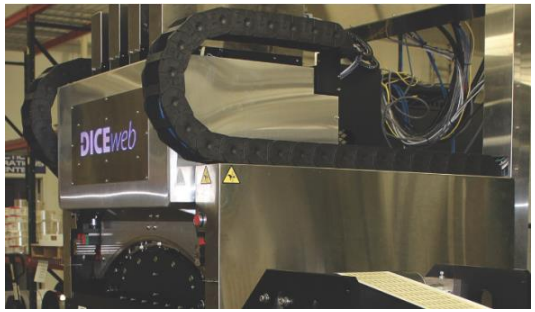
X & Y Dither

Digital Stitching Strategies - examples



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

Product launches – ITMA, DRUPA…..

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

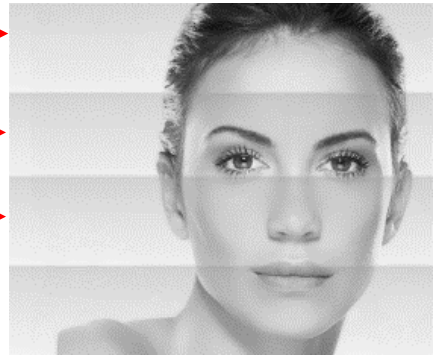
Printhead Density Control

- **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**

Printhead banding

Printhead banding

Printhead banding



Linearized printhead

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

Nozzles Out

Nozzles Out Compensated

- **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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