Technology Update for Inkjet Print in Packaging

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**Smithers Pira Digital Print for Packaging US**
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GIS

- **Software & hardware component provider to inkjet system OEMs and project integrators**
- **Powerful, innovative & flexible technology to suit system and application needs**
  - Build better products - reduce development time - get products to market faster
- **Expertise in large systems - any number of printheads – any number of inks**
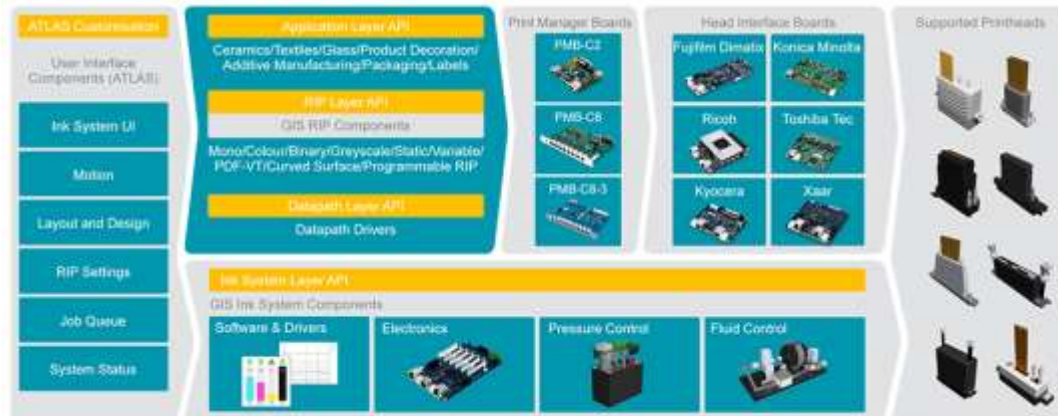
Agenda

- **Reliability and image quality techniques in single pass inkjet**
  - Post Drupa 2016 – reliability is now a given
    - Built in correction technologies
    - It's all in the finishing
- **An update on some latest market trends**
  - Corrugated – the new rising star market?
  - Printing direct to shapes
    - What will be possible?

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Post-drupa 2016

- **Digital transitioning from the short run argument to production capability**
- **Reliability of digital technologies (inkjet in particular) no longer seems to be questioned**
  - Lot of enabling technologies deployed under the covers

Edelmann
Landa

- **EFI - Nozomi**
  - Rafael Hinojosa, Spain
  - McGowans Print, Dublin
- **Heidelberg - PrimeFire 106**
  - MPS, Germany
  - Warneke paper Box, CO
  - Colordruck, Germany
- **Durst - Delta 130 SPC**
  - Schumacher Packaging, Germany

- **Landa - S10**
  - Graphica Bezalel, Israel
  - Edelmann, Germany
  - Imagine!, MN
- **KM - KM-1 Accuriojet B2**
  - Rehms Druck, Germany
  - Print Logistics Services, Germany
- **Many others….**
- **Numerous real user stories at this conference**

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Reliability & Image Quality - Many Variables...

And the more heads – the harder it becomes...

Correction Technologies

- **"Inkjet no longer fears the loupe!"** – **Sean Smyth 2016**
- **Pressure of comparison with analogue continues**
  - Improvements also continue
  - Lot of enabling technologies
- **Missing nozzles?**
  - Nozzle out compensation
- **Flat colours on wide arrays?**
  - Printhead linearization
- **Registration & alignment?**
  - Critical for finishing
    - Varnish, foils, textures

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smitherspira.com

SMITHERS PIRA

Inkjet technology at drupa 2016

Inkjet no longer fears the loupe!

Inkjet reliability is improving
Inkjet quality is improving on standard papers
Increasing productivity – print engines and workflow
New features and functions, new opportunities

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Missing Nozzles

- **Nozzle sizes are getting smaller**
  - More easily blocked or deflected
- **Large print bar arrays**
  - Many more nozzles
  - Higher probability of issues and lower MTBF
  - Need coping strategies
- **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 Compensation

- **Individual or isolated nozzles work best**
  - Clusters of nozzles much more difficult to hide
  - Technology works best where there is some bleed/drop overlap
- **Many different strategies exist using neighbouring nozzles**
  - Correction in contone or screened data
    - GIS believes best results achieved with contone correction
  - Hide error in same colour plane to neighbouring nozzles
  - Hide error in other inks - in multi-ink backgrounds
    - If Cyan nozzle fails - could add a little black to hide white space
- **Works best in mid & light mid tones**
  - Also improves dark tones
- **Helps disguise/makes the missing nozzle less visible**
  - Less white space
- **Numerous patents exist**

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Nozzle Out Compensation

Uncorrected

4 Level CMYK
Magenta nozzle out on line 511

Single Channel Corrected

Flat Colours

- **Inkjet systems need to**
  - Stitch printheads without visible joins
  - Print large areas of solids/flat colours
- **Drop volumes not always consistent across printhead**
  - More apparent the more heads you have in an array
  - "Non-linearity" in drop volume
  - Even small difference can affect final print – particularly areas of solid colour
  - We want uniformity - flat colours
- **Lots of reasons this can happen:-**
  - Printhead manufacturing issue - drop ejection may not be consistent
  - Temperature variation in ink system - affects ink viscosity
  - Piezo activity - heavy use of some sections of printhead creates warm areas
  - Electronics - uncalibrated/low quality electronics may affect drop volume
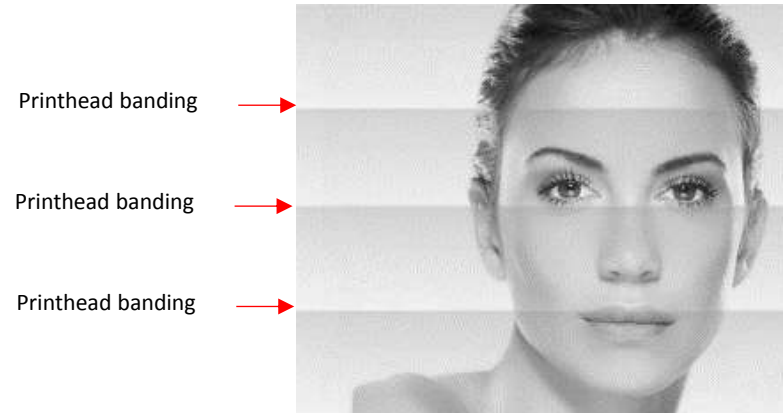
Printhead Linearization

- **Some electronic/printhead solutions – but greatest capability in image correction**

- **Electronic/printhead solutions**
  - Depending on printhead technology
    - Trim each nozzle/cluster of nozzles/nozzle bank
      - Trimming can introduce drop alignment problems
        - (Tuning for volume will modify velocity)

- **Image correction**
  - RIPed data (contone or screened) can be manipulated to:-
    - Reduce the number of drops in given area, or
    - Reduce the size or value of the greyscale drop in a given area

Printhead Linearization

Printhead banding →

Printhead banding →

Printhead banding →

Linearized printhead →

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Finishing/Adding Value

- **We want digital to have the same capability as analogue technologies**
  - Not just CMYK, but CMYK++
    - White, spot colours, spot/flood coat, foil, other special effects & textures
- **Two of the key themes at drupa 2016**
  - N-colour inkjet presses proliferated
    - 5-8 inks
    - OEMs claiming up to 95% of Pantone colours
  - Inkjet coating/textures/ foil
    - MGI, Scodix, Steinemann, Autobond, Domino
    - Hybrid – inkjet in-line with toner technologies
   - Xeikon Fusion
      - HP Indigo Combination Press

HP Indigo Combination Press
Spot varnish, tactile effects and foil
Print sample from Interpack 2017

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Finishing/Adding Value

- **Textures – an example from the wood finishing market – shown at Ligna 2017**
- **Kuei, Italy – in-line single pass demonstration with Cefla Finishing**
  - High 3D definition, textures, haptic effects
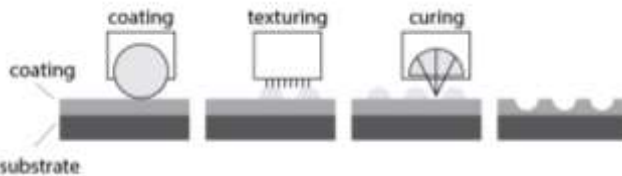
"The process is straightforward, on the wet coating applied with standard techniques (roller/spray/curtain) our proprietary fluid is jetted. The structure is then formed and UV curing is fixing it." www.kuei.it

Challenges of Finishing

- **Key challenge is alignment & registration with pre-printed substrate**
  - Pieces or in-line web
- **Many different possible distortions (image and/or media) – can be solved by:-**
  - Mechanical
  - Vision systems + software

Translation (X & Y)

Rotation

- Product detect (X translation)
- Feeders or software offset (Y translation)

- Feeders
- Vision system + fiducials + software
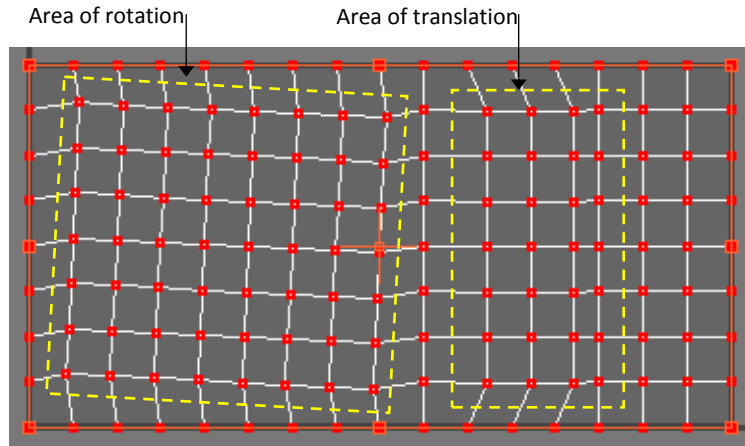
Challenges of Finishing

Trapezoid / Skew

- Vision system + fiducials + software

Stretch and Compression (X & Y)

- Vision system + fiducials + software
- Encoder + product detect

Area of rotation   Area of translation

GIS Correction Map For Finishing Layer (inverse of error)
Mesh based correction accurately places finishing data in the desired location.
Handles all translation, rotation, stretch, compression and skew as well as
localized distortion correction

- General software conversion approach
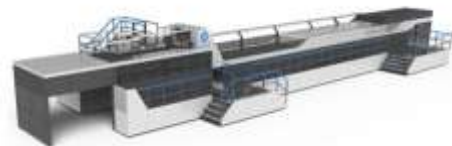- If you can measure the error – we can correct it

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Corrugated Web & Sheet

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Corrugated Sheet – Single Pass

- **CCE Munich & Sino-Corrugated, China 2017**

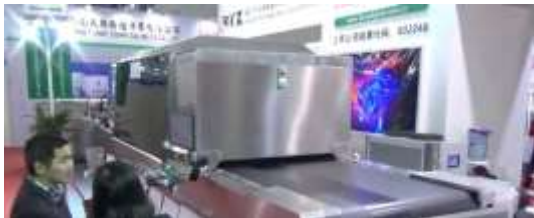

Macorbox – prototype
360 x 360 dpi – AQ or oil based inks

Shenzhen Wonder – Wonderjet WD200-24A
https://www.youtube.com/watch?v=Blio96syfPs

Handway – Glory 1604
600 x600dpi Kyocera heads AQ inks
https://www.youtube.com/watch?v=fZnp2ZHINY4

Sold in US by CET, Atlanta - DG1560
In Europe branded Erajet -Era Automation -
and Toutin Service

Flora Digital https://www.youtube.com/watch?v=JnGGuyEBnAE

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Direct to Shape

- **Metpack & InterPack 2017**

Martinenghi – Michelangelo KX48P

Hinterkopf D240

NMP Systems – Direct Print - KHS

Direct to Shape

- **Tonejet**
  - New collaboration with Rockwell Automation
  - 2-piece can decorator
  - Rockwell Automation iTRAK® system
  - Controlling speed of each individual can
    - Demonstration InterPack
    - Launch InPrint 2017
    - Shipping early 2018

iTRAK is a modular scalable motion control system that provides independent control of multiple magnetically propelled movers on a track.

https://www.youtube.com/watch?v=YtSuGHA48QE

Direct to Shape
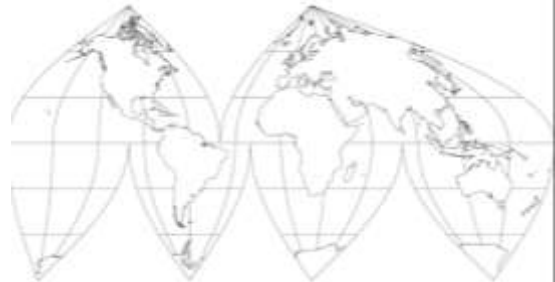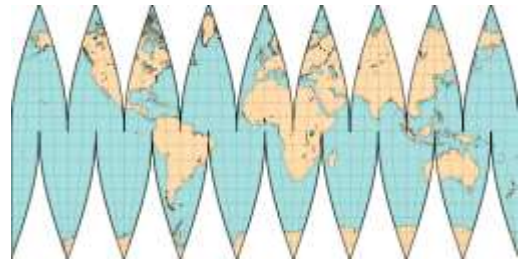
- **KBA MetalPrint**
  - Metal Decojet
    - 3 piece containers
    - Aqueous inks
    - Suitable for food packaging
  - Metal CanJet
    - 2 or 3 piece cans
    - UV curable inks CMYK+W+V
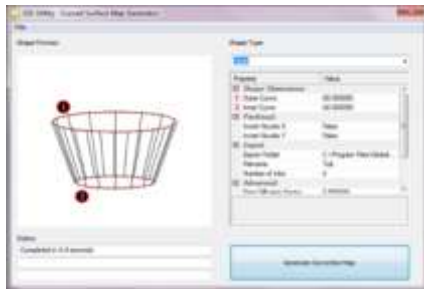   - Up to 12,000 can/hr (2-up)

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Understanding Shapes

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Direct to Shape

- **Cylinders, cones and tubs – all now technically possible and commercially available**

GIS image compensation software

- **What about more complex shapes?**
  - Spheres?
  - Irregular containers?
  - Industrial parts?

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Direct to Shape

- **The rise of robotic systems….**

Images courtesy of IIJ

Images: Heidelberg

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Direct to Shape

- **The goal – to print onto any shape using inkjet**
- **Requires state of the art software**
  - Colour management techniques
  - Surface geometry aware screeners
  - Printhead nozzle geometry & drop time of flight compensators
  - Advanced stitching strategies
  - Sphere shown here, but same strategies apply to any shape

Sphere printing video

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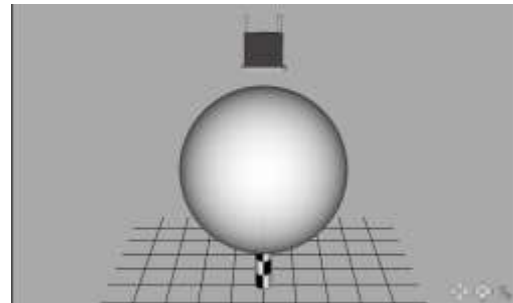
Summary

- **Inkjet print in packaging**
  - Still a market of pioneers rather than mainstream
  - Are we at/reaching the tipping point?
  - Momentum increasing
- **Advanced software and RIP technologies are key**
- **Inks are critical**
- **Opportunities**

Thank you

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Please note our new address

Technical support offices in UK, Japan and China