GIS | GLOBAL INKJET SYSTEMS

Implementing High Speed Workflow Solutions for Improved Image Quality in Single Pass Inkjet Packaging

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How Hard Can it Be?

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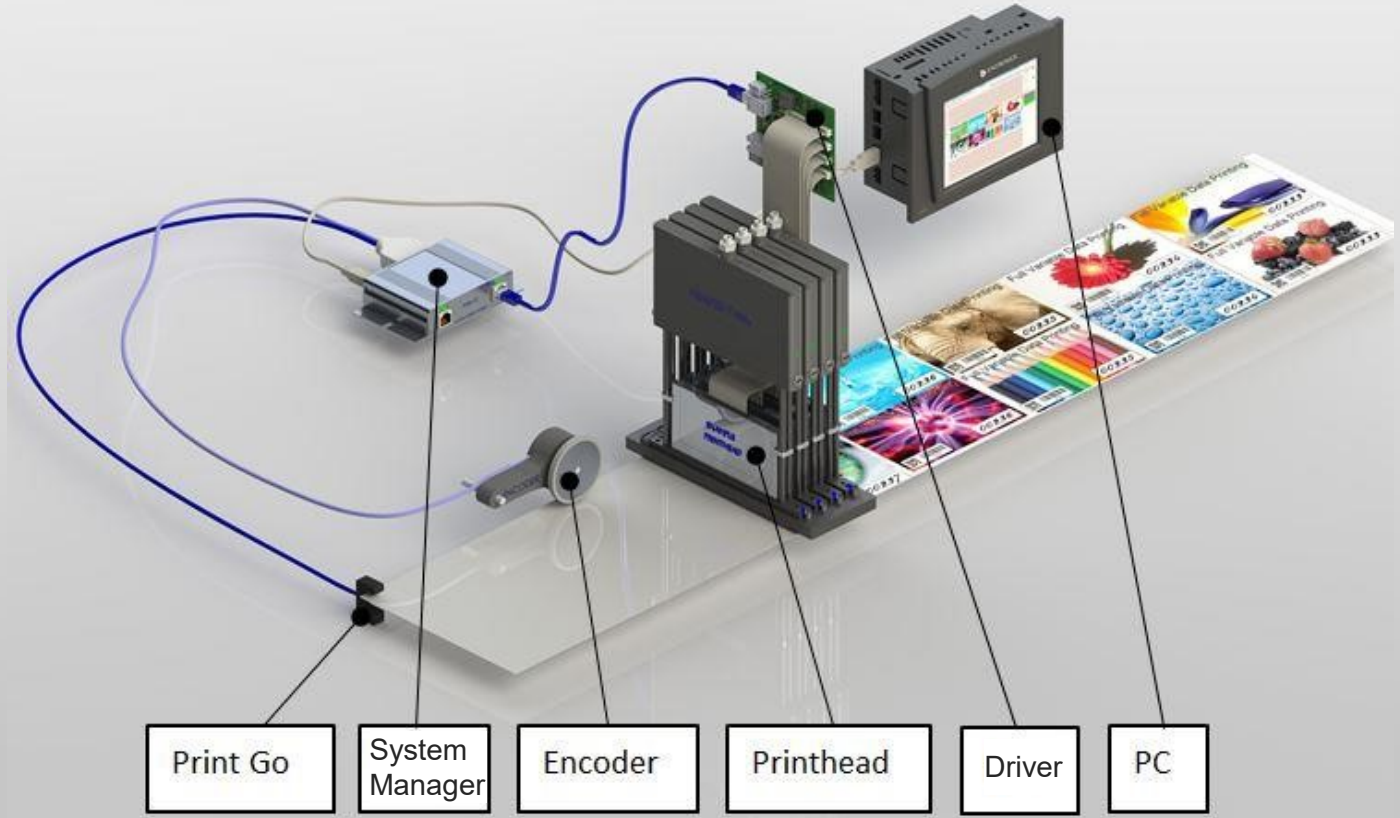

Factors Affecting Print Quality

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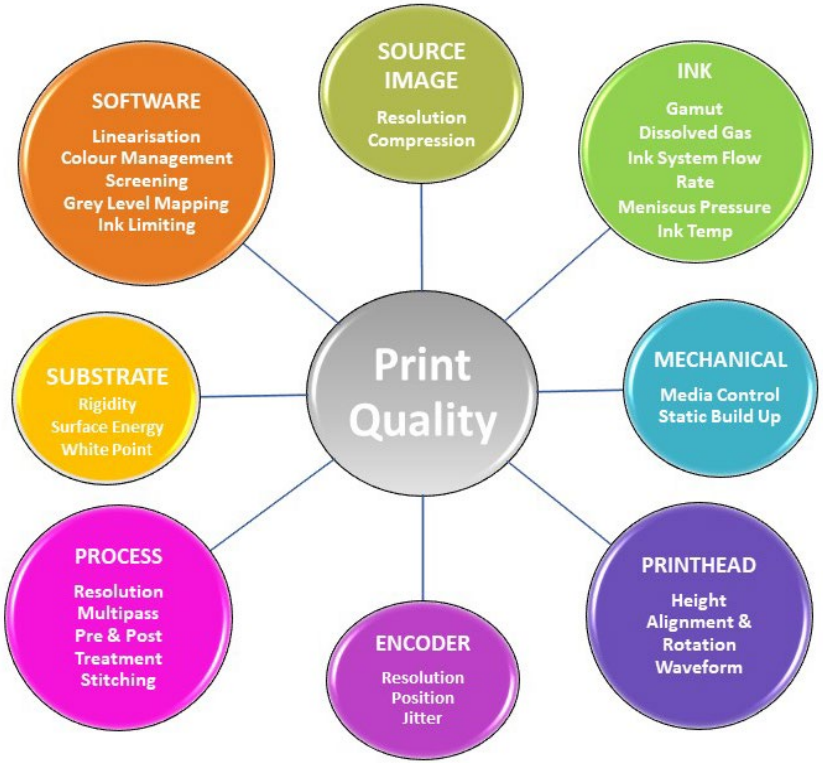

Factors Affecting Print Quality

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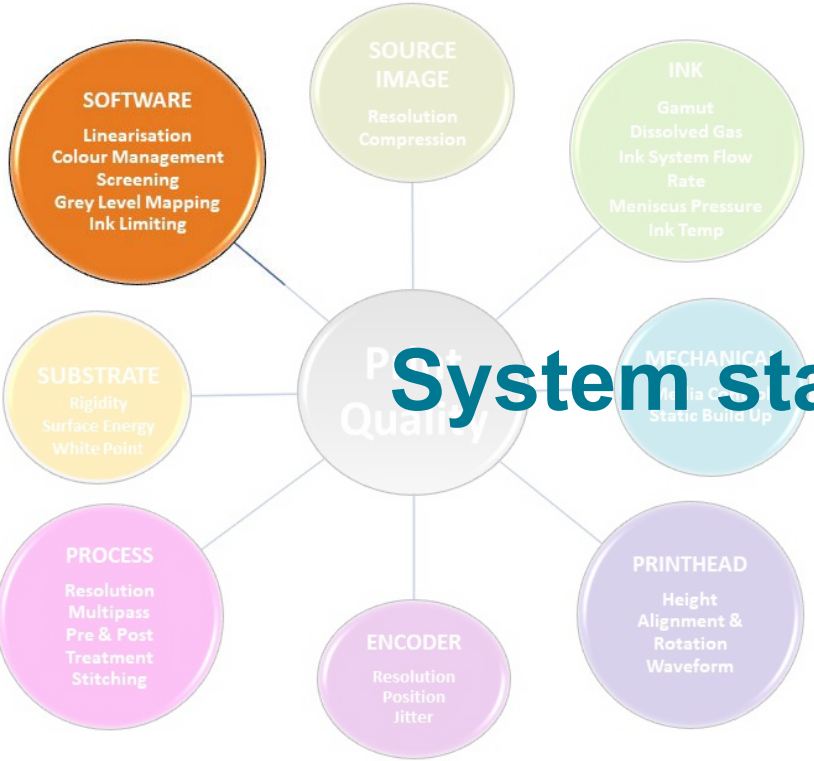

System stability is critical

What Can Be Achieved with Software Alone?

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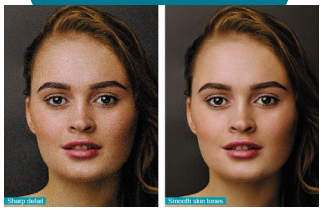
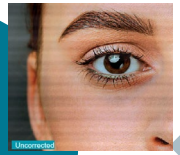
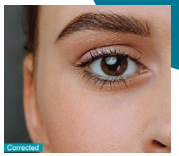
Print Mode and Screeners



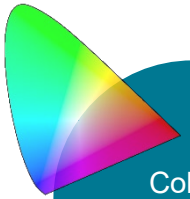
Channel linearisation

Nozzle Density Compensation

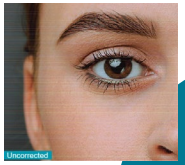


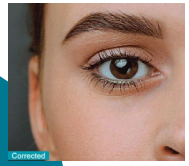


Colour Correction



Missing Nozzle Compensation



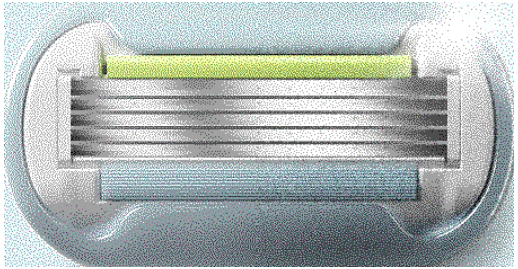


Screened Image Processing

PDF PDF/VT TIFF VPI VPX

Screeners

- Error Diffusion (ED) and Ordered Dither (OD) Screeners
- Comparison is difficult without controlled viewing conditions
- But side-by-side ED shows slightly less grain in skin tones and better fine detail
- Differences become smaller at higher resolution
- OD significantly faster to compute than ED

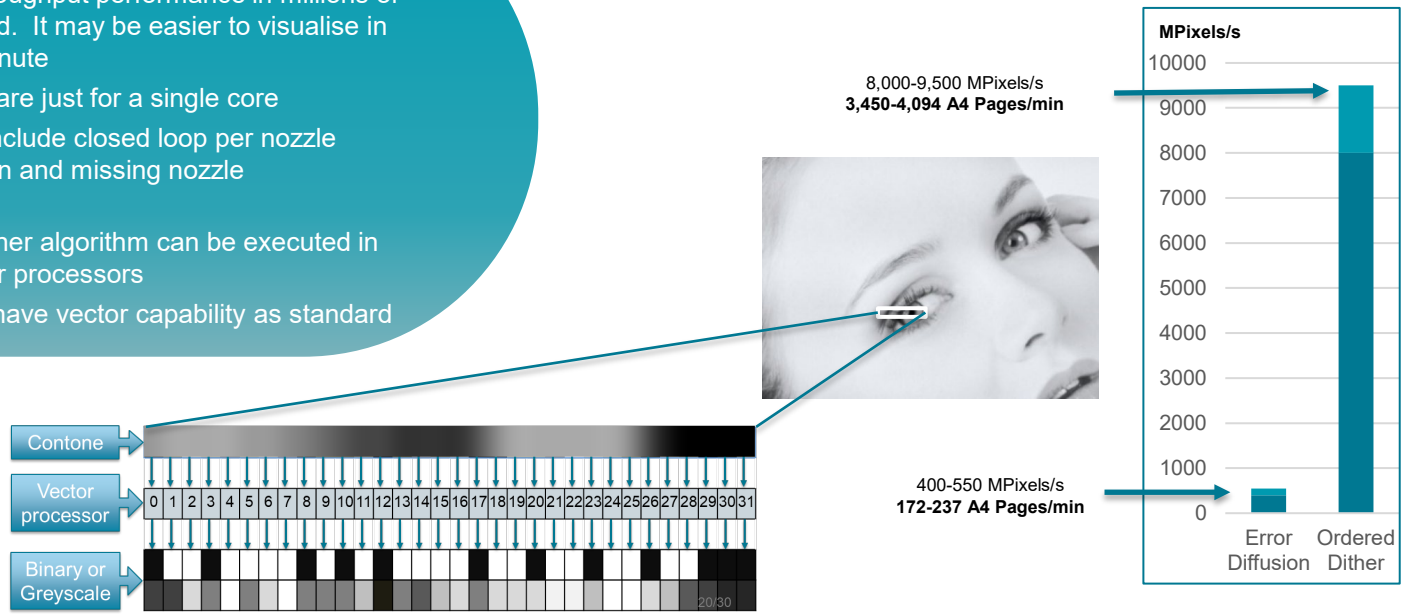


Error Diffusion Ordered Dither

Error Diffusion Ordered Dither

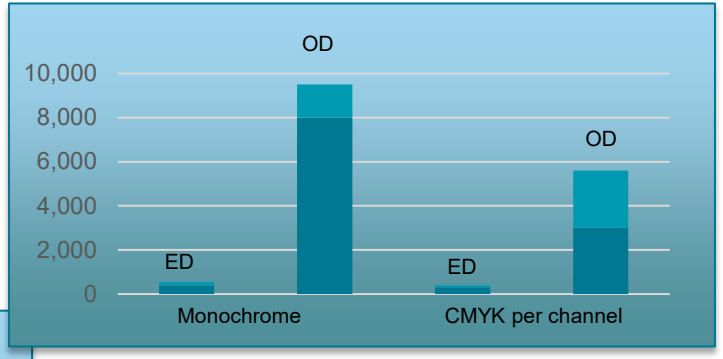
GIS Screeners

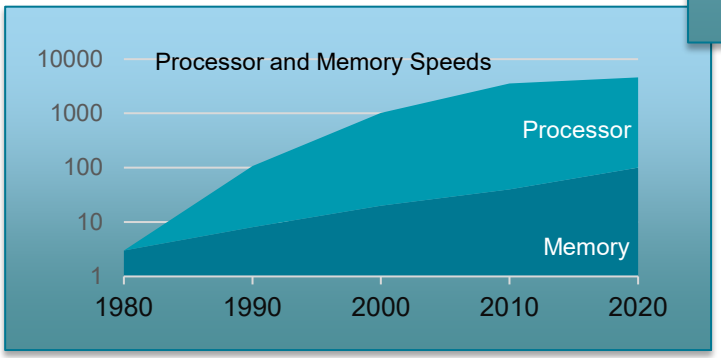
- Ordered Dither is significantly faster than Error Diffusion – GIS has accelerated both
- We measure throughput performance in millions of pixels per second. It may be easier to visualise in A4 pages per minute
- These numbers are just for a single core
- Screeners can include closed loop per nozzle density correction and missing nozzle compensation
- The Ordered Dither algorithm can be executed in parallel on vector processors
- x64 processors have vector capability as standard



GIS Screeners

- Not only is single core performance comparison impressive
- But multi-channel throughput is now limited by cache and memory bandwidth rather than processor clock speed
- And this is addressed in newer processor models





- Processor clock speeds have almost stopped increasing over the last 10 years
- Manufacturers are concentrating on delivering performance in other ways
  - 10x more cores in the last 10 years
  - Integrated vector processors
- These benefit OD rather than ED screeners

Screeners

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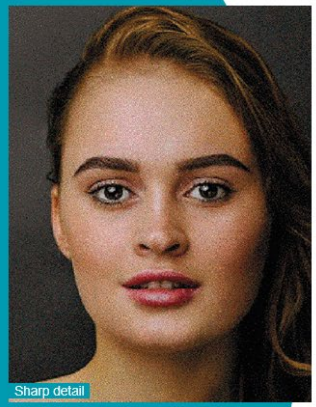
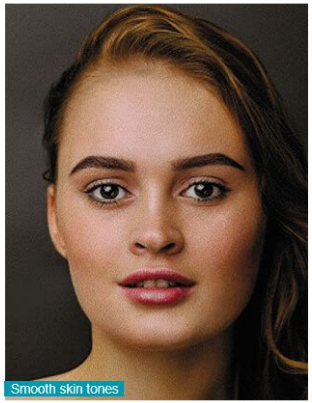
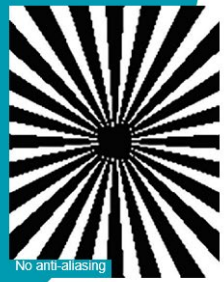
Screener Optimisation

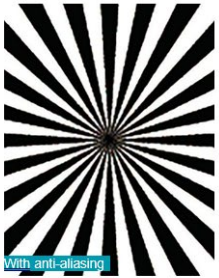
Ultra-fast binary and greyscale screeners are crucial to achieving the best image reproduction for the type of image being printed, allowing the best image quality conversion of contone images to produce smooth grey-level transitions while maintaining sharp line detail when working with a limited number of printhead grey levels.

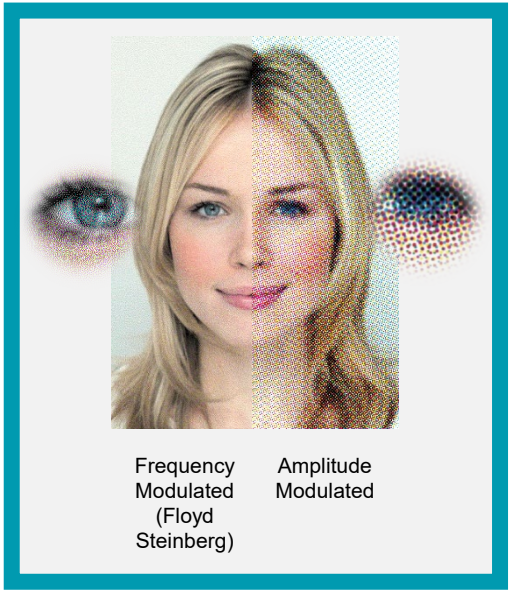
GIS Screeners are the most optimised screeners on the market, allowing for inline RIP-on-the-fly to maximise press usage and profitability for the press operator. Once the screener type has been selected, the screener is optimised to achieve a smooth contone to grey-level mapping, full greyscale dynamic range and ink limiting.











Optimising Screener Quality

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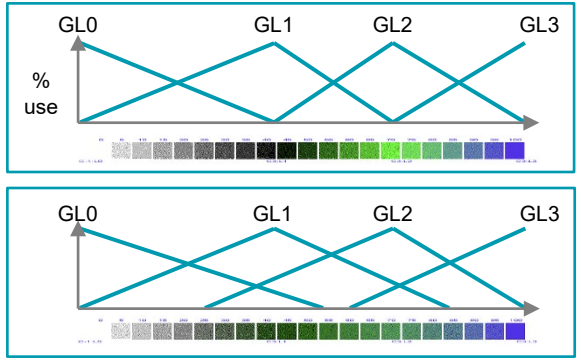
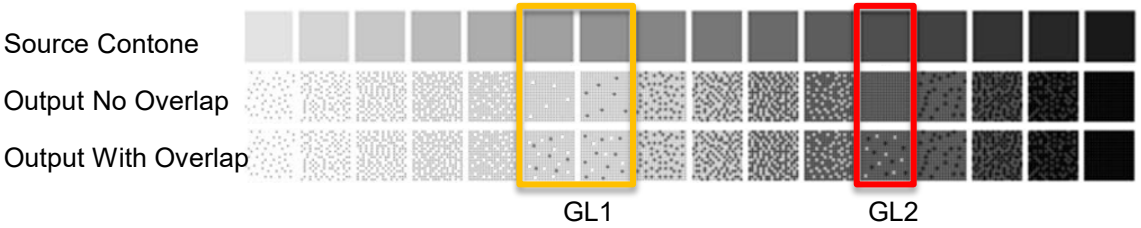
Another inherent issue is greyscale texture

Avoid areas of single drop sizes in greyscale

- Human visual cortex is also sensitive to texture
- Greyscale screeners should avoid areas with single drop sizes because they create a change of texture
- This Is achieved by mixing in other drop sizes, known as grey level overlap





Grey Level Selection

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Ink Channel Limiting

What is it?

- For each ink in turn, reducing the maximum amount of ink that can be deposited

Why do it?

- It prevents bleeding and flooding of the substrate
- Reduces total ink consumption
- Improves print quality
- Improve effectiveness of colour management

Method of control?

- 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

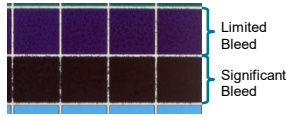


Figure 1: Example of ink bleed on a substrate

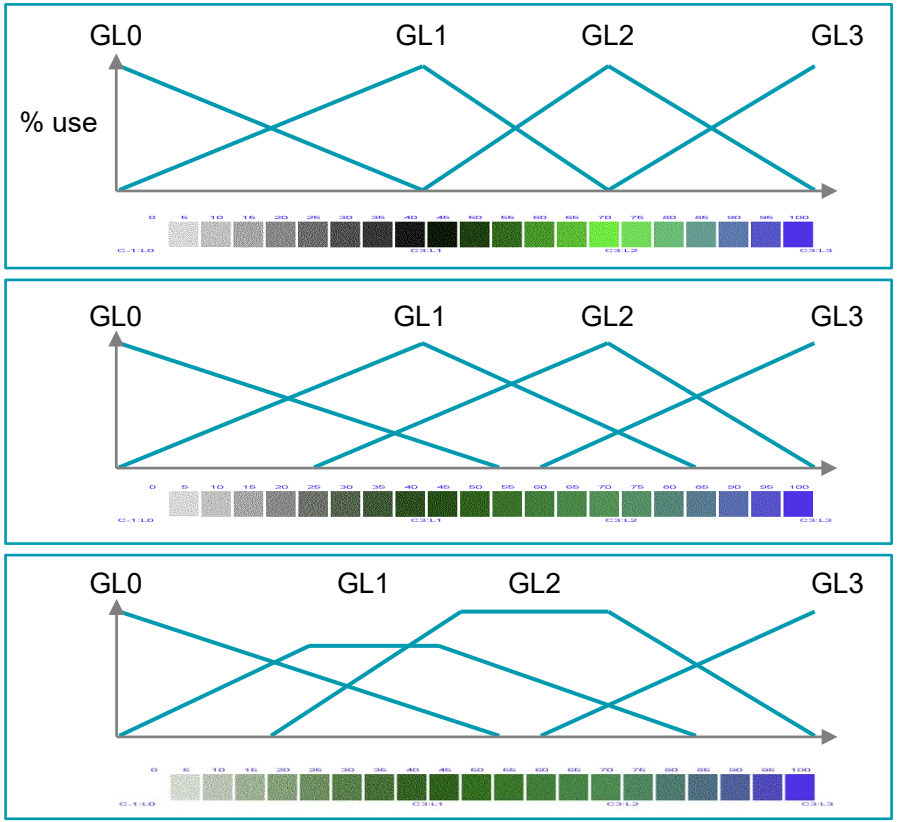
Figure 2: Ideal tonal response

Figure 3: Typical tonal response

Figure 4: Final Grey Level Selection

Blending Grey Levels

- RIP technologies often allow the user to specify the locations where grey levels overlap and how they overlap
- This can improve image quality, especially on systems where the ink can have a gloss finish, as it avoids areas of density where only a single drop size is used
- This technique is only applicable to systems printing with multiple grey levels



Linear Colour Channel Density

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Incorrect colour channel density linearisation means the input colour value for a single colour does not match the output colour value comparatively to other colours

Results in non-linear response and incorrect colour

Process black (=C+Y+M+K) shows colour shift

Colour Channel Linearisation

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What is it?

- Linearisation ensures the printer maps contone values evenly throughout the scale, from 0-100%

Why do it?

- It makes multiple printers behave in a similar predictable way
- It makes colour management easier

Method of control?

- Generate a linearisation test chart
- Print it
- Measure the output data
- Import the measurement data into the RIP to apply

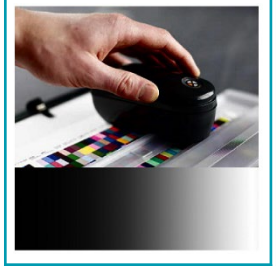

Figure 1: Not linearised

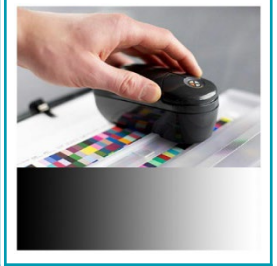

Figure 2: Linearised

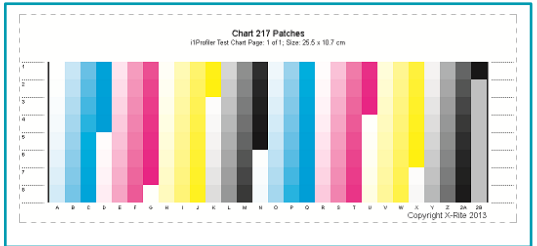

Figure 3: A Linearisation Test Chart

Colour Channel Linearisation

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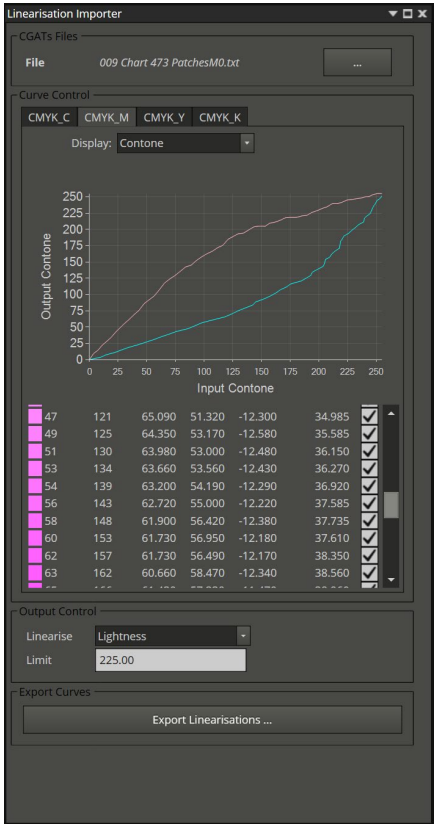
- Channel linearisation needs to be performed on each process colour channel
- This is achieved by printing individual channel linearisation test charts, measuring the printed charts with a densitometer resulting in the linearisation correction such as CGATS
- Each print mode will need its own linearization and colour profile



Nozzle Density Compensation

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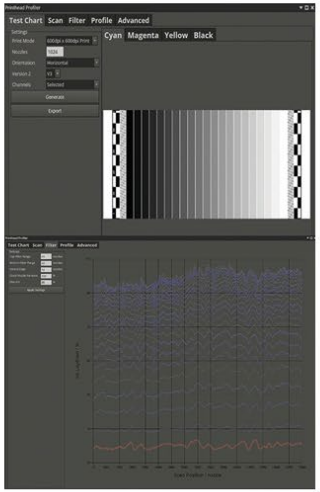

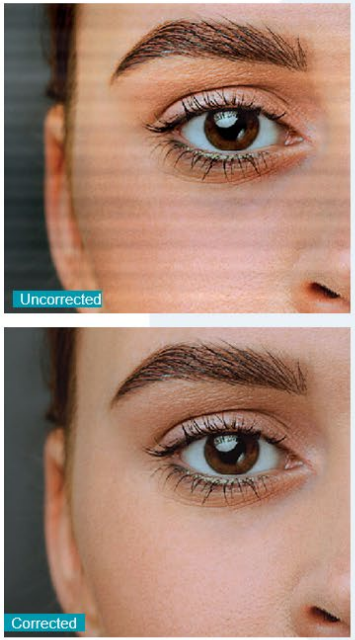

Nozzle Density Compensation

Nozzle Density Compensation adjusts every pixel in the original image with the aim of producing the same output print density for the same input density of the original image for every nozzle.

The application of the GIS Printhead Profiler image correction software can be tightly integrated with the screener software to achieve the fastest correction possible and maintain the highest possible performance of the datapath from original image file to printed output.

Nozzle Density Compensation

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Correcting for print density can be done through software

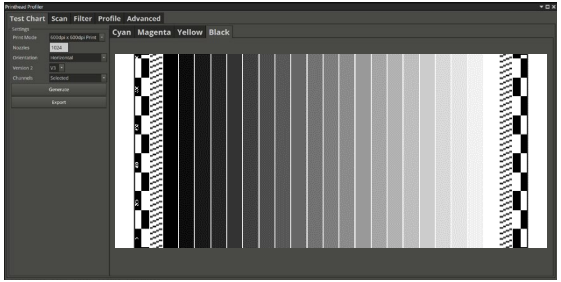
Print Density Analysis

- GIS has a suite of tools for creating a density pattern
- Once a test pattern has been printed and scanned users can import scanned images, analyze them and generate a correction file
- For in-line correction, a line scanner and fully automated workflow is also supported

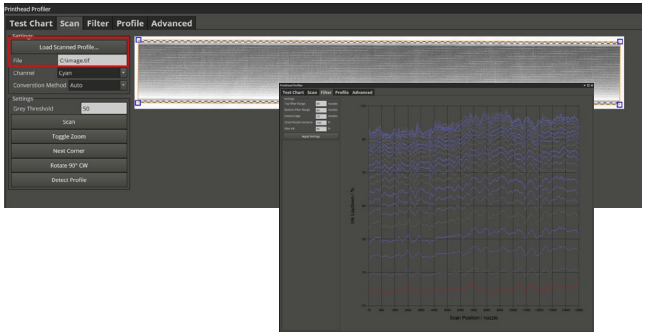
Correcting Density

- Using a correction file, GIS software can compensate all print data on the fly to minimize the density variations
- Users can specify correction methods, linearization curves and more
- Correction is normally done during screening to maximize print quality although it is also possible to density correct screened data
- Density correction is available **Fully Integrated** or **Standalone** for use with 3rd party software

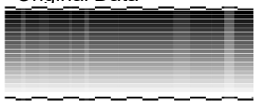
Test pattern



Scan Results Window



Original Data



Corrected Data

Print Output Enhancement

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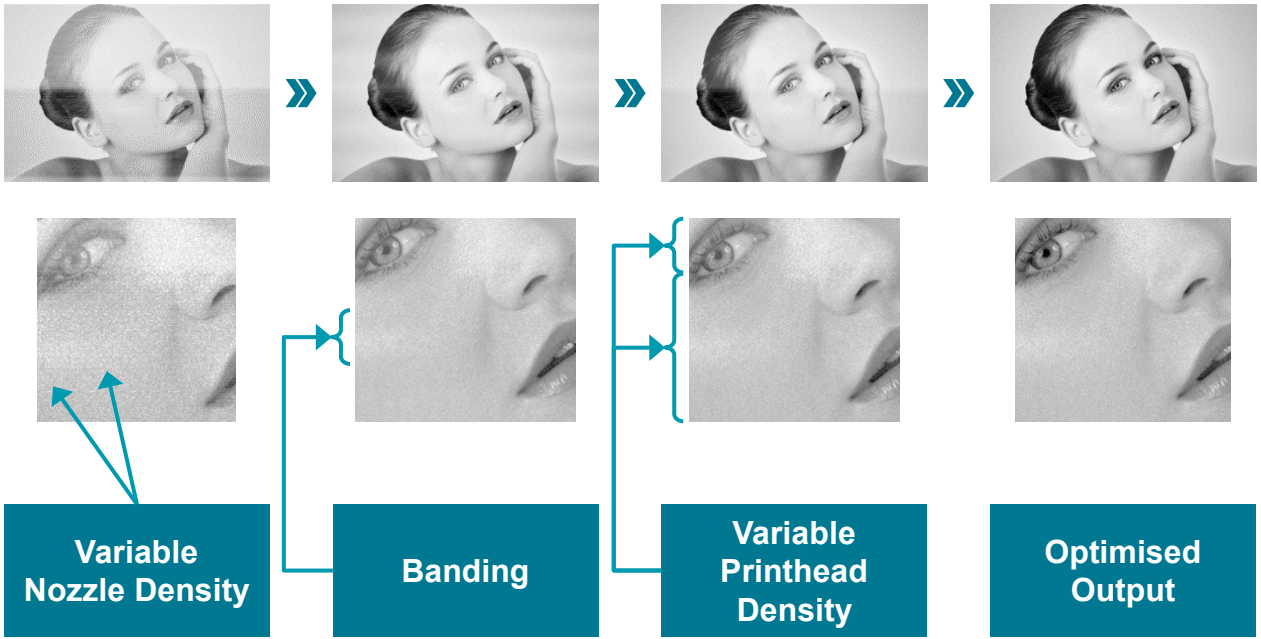
Able to correct density mismatches **per printhead, per bank of nozzles and per nozzle**



Colour Management

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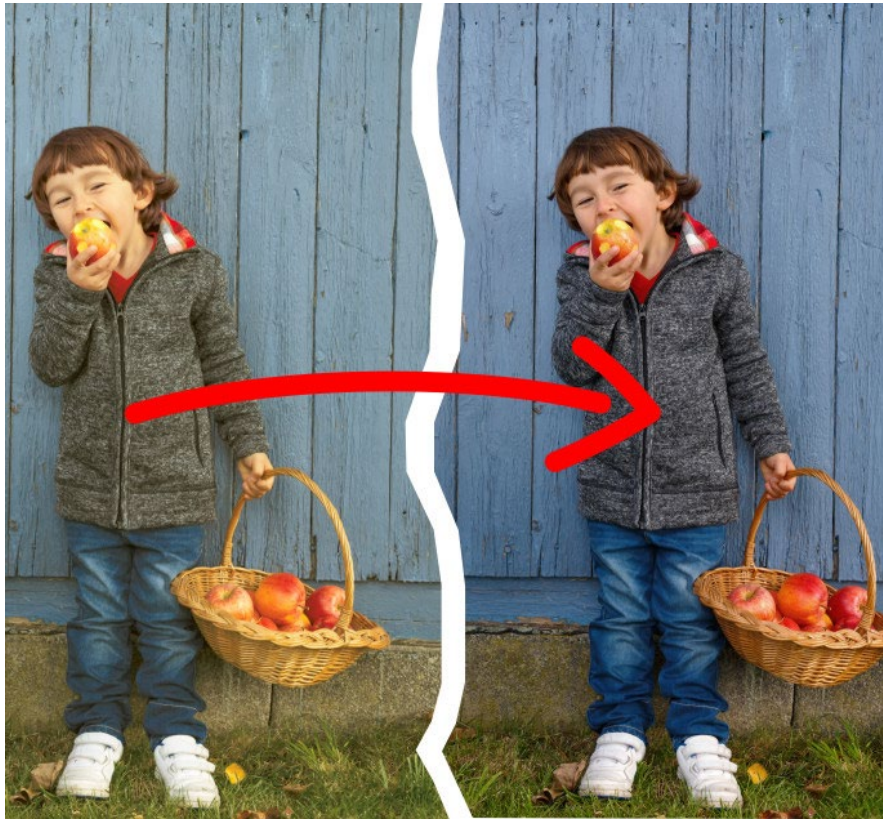
- Poor colour management results in the printed colour output not matching the desired colours of the original image
- This is the result of poor mapping of continuous colour tones into process colours and poor colour “mixing”
- Resolve by implementing a colour mapping process to produce a colour mapping profile (ICC)



Colour Management

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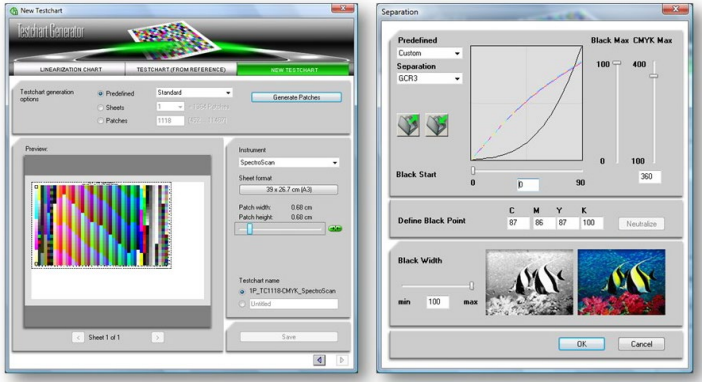
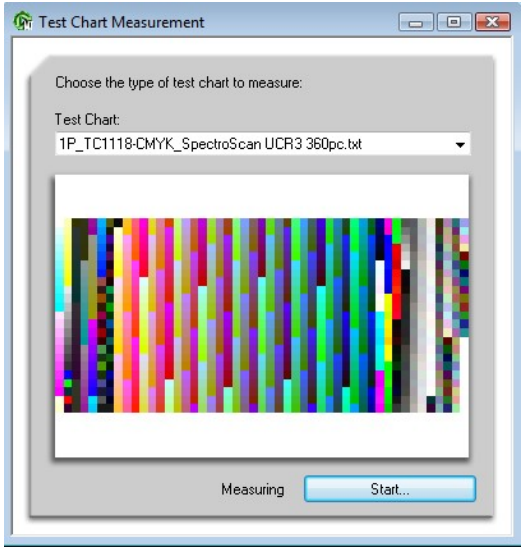
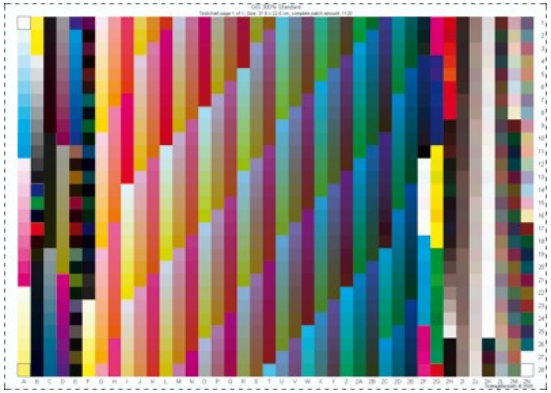
Colour Management / ICC Profile

- Generate test charts
- Print and measure charts
- Generate ICC profile
- Iterate







Missing Nozzle Compensation

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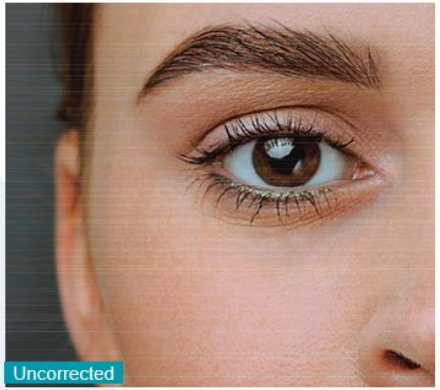
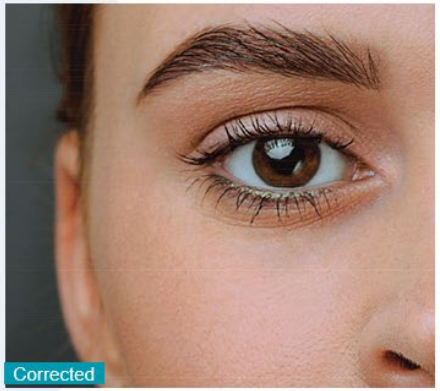
Missing Nozzle Compensation

Missing Nozzle Compensation reduces the visibility of missing nozzles. It is tightly integrated with the screeners to maintain optimal performance. In an ideal world all printhead nozzles would be perfect; however, due the size and number within a printhead this is often not the case. Misalignment of or even blocked or damaged nozzles can be masked by software, thereby removing the tell-tale faint lines or missing lines in the final printed image.

Missing Nozzle Compensation allows for neighbouring nozzles to be adjusted to compensate for those issues, thus significantly reducing the visibility of these artifacts and giving the impression that all nozzles are active.





Missing Nozzle Compensation

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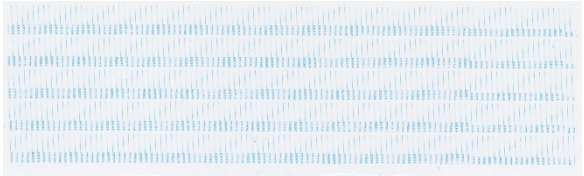
Uncorrected

Missing nozzle compensation



Atlas IQ® Tools – Software Compensation

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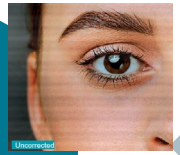
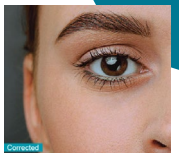
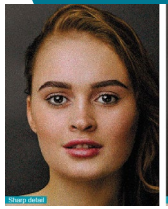
Nozzle Density Compensation

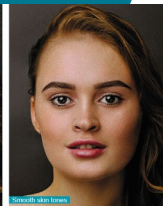




Channel Linearisation

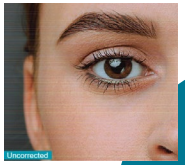
Print Mode and Screeners

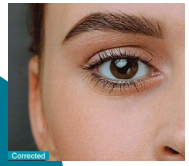




Colour Correction

Missing Nozzle Compensation





Screened Image Processing

PDF PDF/VT TIFF VPI VPX

Atlas® with Esko DFE

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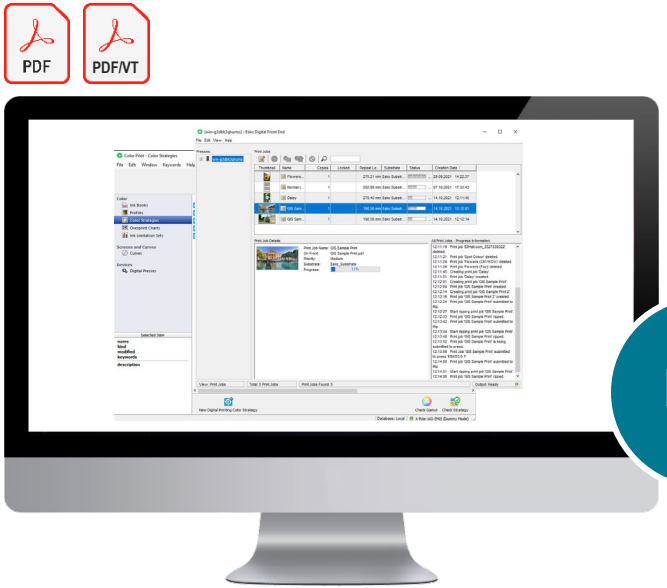


Atlas Server
(RIP)

File

GIS electronics
based printers

ESKO
SOFTWARE
PLATFORM

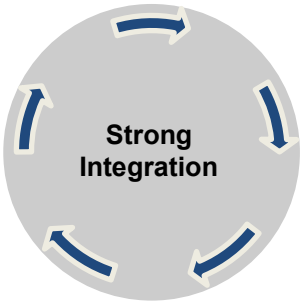
Atlas® with Esko DFE

ESKO
SOFTWARE PLATFORM

Industry leading software for

- Brand packaging management
- Workflow and Automation
- Prepress
- Color Management

Expertise in the labels and packaging market, brands suppliers and workflows



Supported jointly by expert services from Esko and GIS

GIS GLOBAL INKJET SYSTEMS

Leading industrial inkjet solutions:

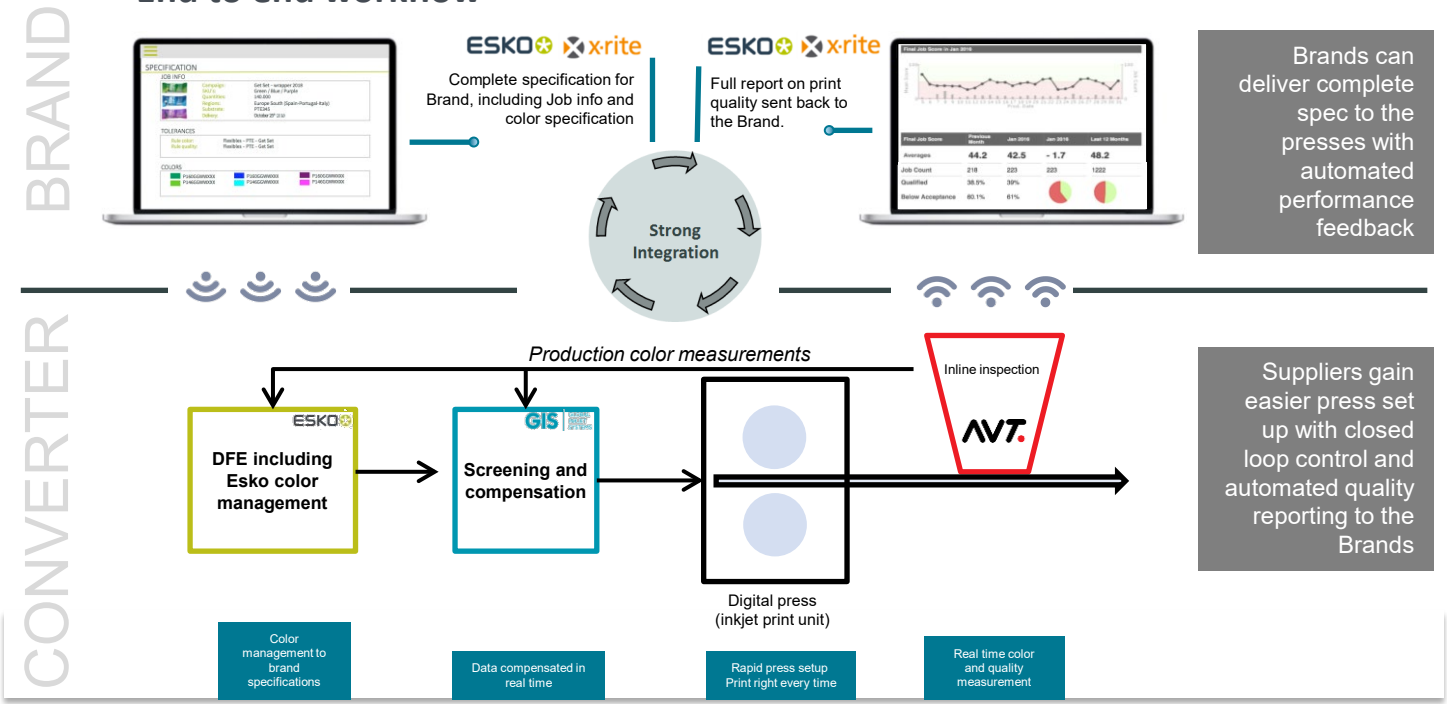
- Datapath Electronics
- Machine Control Software
- Print Quality Optimization
- Machine Control User Interfaces
- Ink Delivery Systems

Expertise in single pass, high speed variable data, scanning and direct to shape inkjet systems

Atlas® with Esko DFE

GIS GLOBAL INKJET SYSTEMS

End to end workflow



GIS GLOBAL INKJET SYSTEMS

Image optimisation for your digital printing:

- Ultra-fast binary and greyscale screeners
- Nozzle density and missing nozzle compensation
- Colour management, linearisation and ink limiting
- Dynamic registration; alignment, rotation and skew
- Print output simulation

GIS Atlas IQ Tools can be used for a variety of applications:

- Inline RIP-on-the-fly and offline RIP-to-file
- Tools available as bundled software, standalone or SDKs

GIS Atlas IQ Tools are compatible with GIS and 3rd party RIP solutions, user interfaces and datapath drive electronics.

Find out how GIS can help you supply a fully integrated image processing solution for label and packaging printing:

+44 (0) 1223 733 733 info@globalinkjetsystems.com www.globalinkjetsystems.com

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