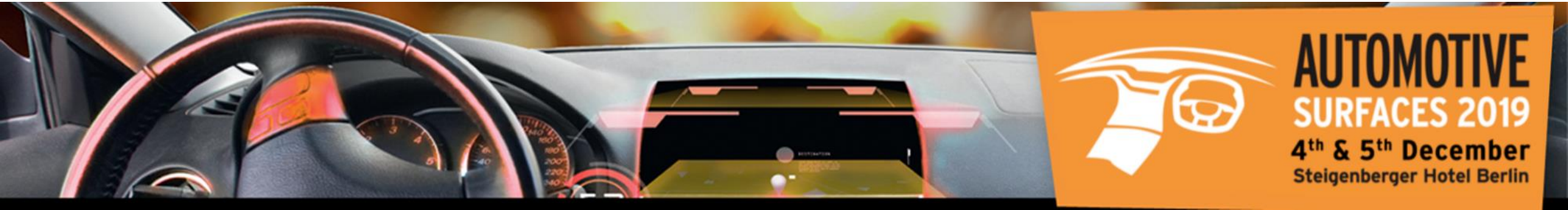
GIS | GLOBAL INKJET SYSTEMS

Advances in Industrial Inkjet for Automotive Surfaces

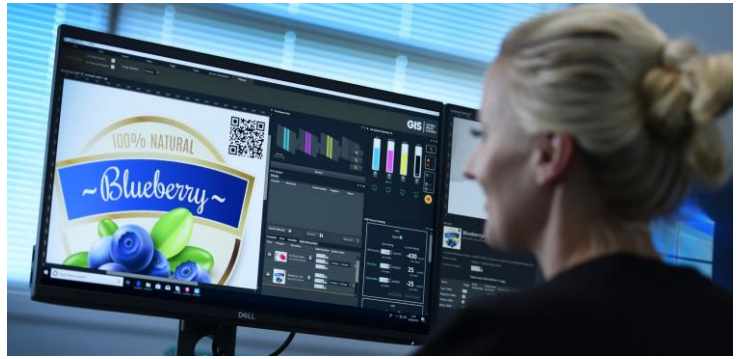
Phil Collins

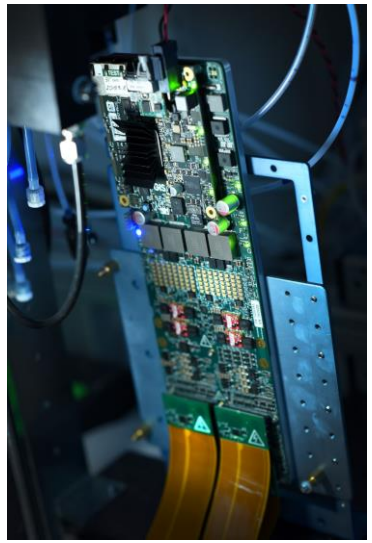
Director – Advanced R&D

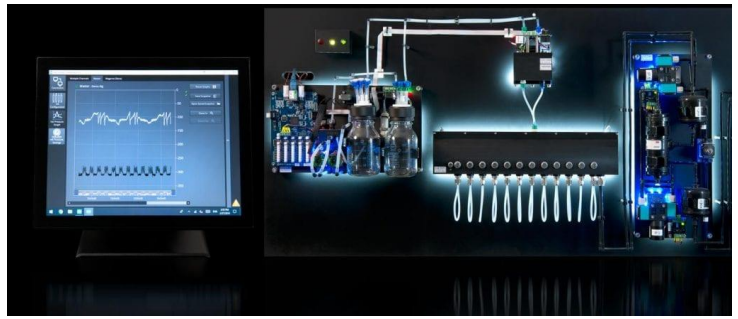


The GIS EcoSystem

Complete image management from pixel to drop





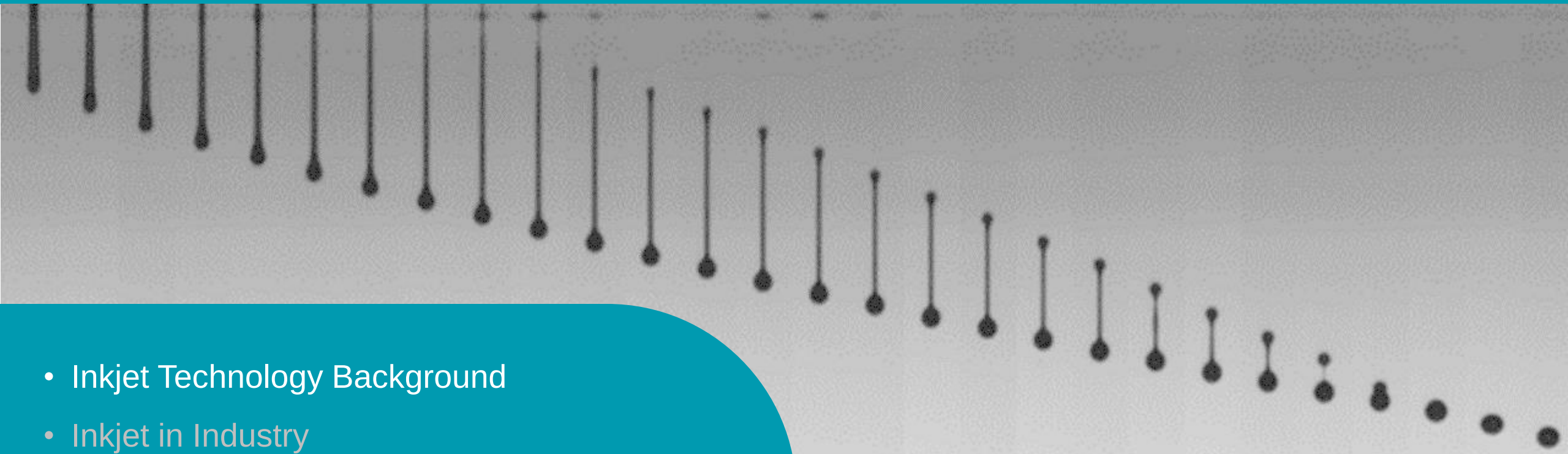


We work with customers from R&D, Prototype Development - through to Production

Phil Collins

- Engineer and mathematician
- Director – Advanced R&D
- 35 years experience in graphics and printing

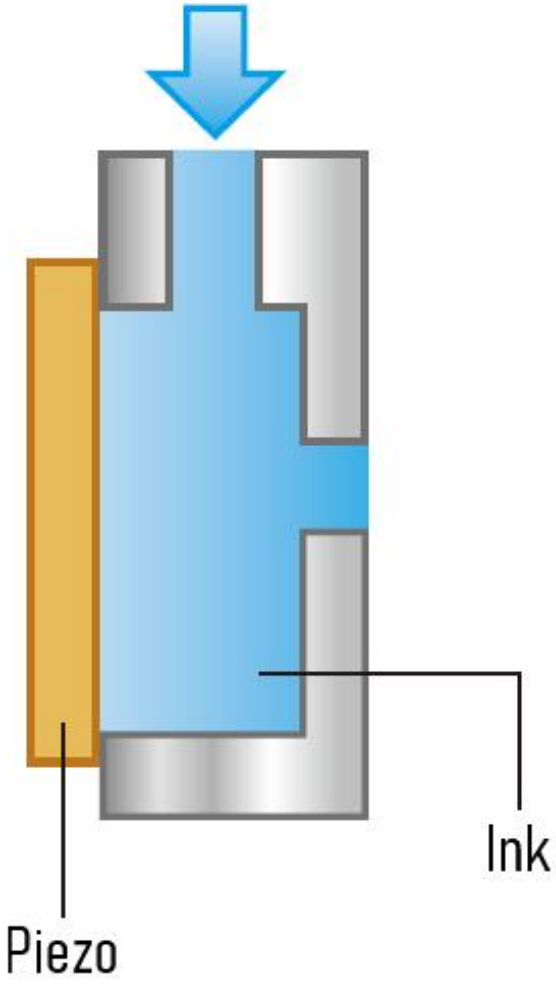
Agenda

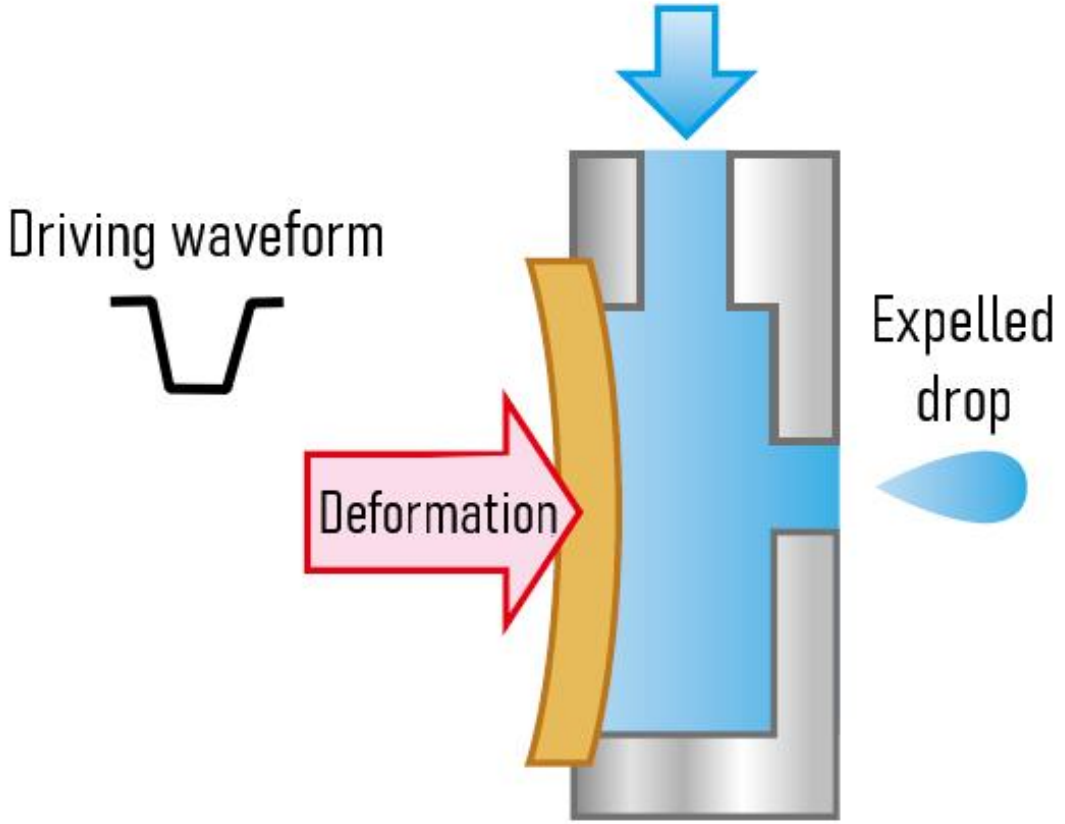


- Inkjet Technology Background
- Inkjet in Industry
- Technology Update
- Automotive Hard-Coats
- Case Study: Coating a Real Product

Inkjet Technology: Piezo-electric nozzle

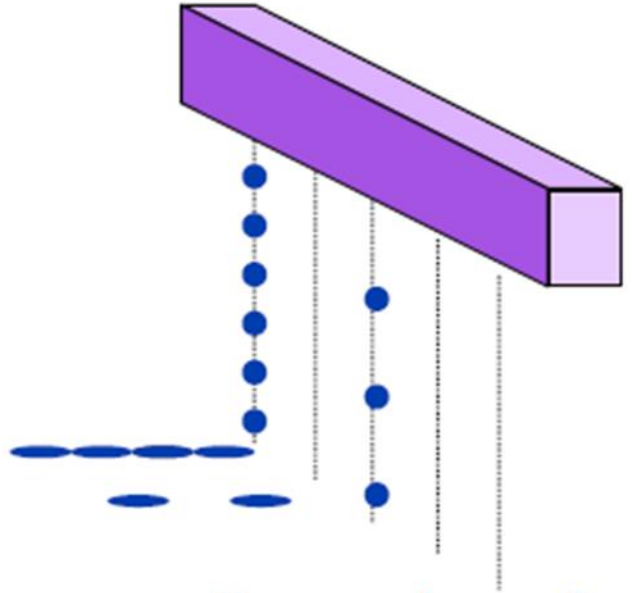
The dominant technology in industrial inkjet is piezo-electric drop on demand





Inkjet Technology: Printheads

- **Industrial inkjet printheads**
  - Drop sizes: 2 – 200 picoLitres
  - Firing rates: 10 – 220kHz
  - Highly integrated: 1000's of nozzles per head
  - Modular and scalable
  - Long operating life: ~10^{10} operations
  - Printheads and variants for many applications



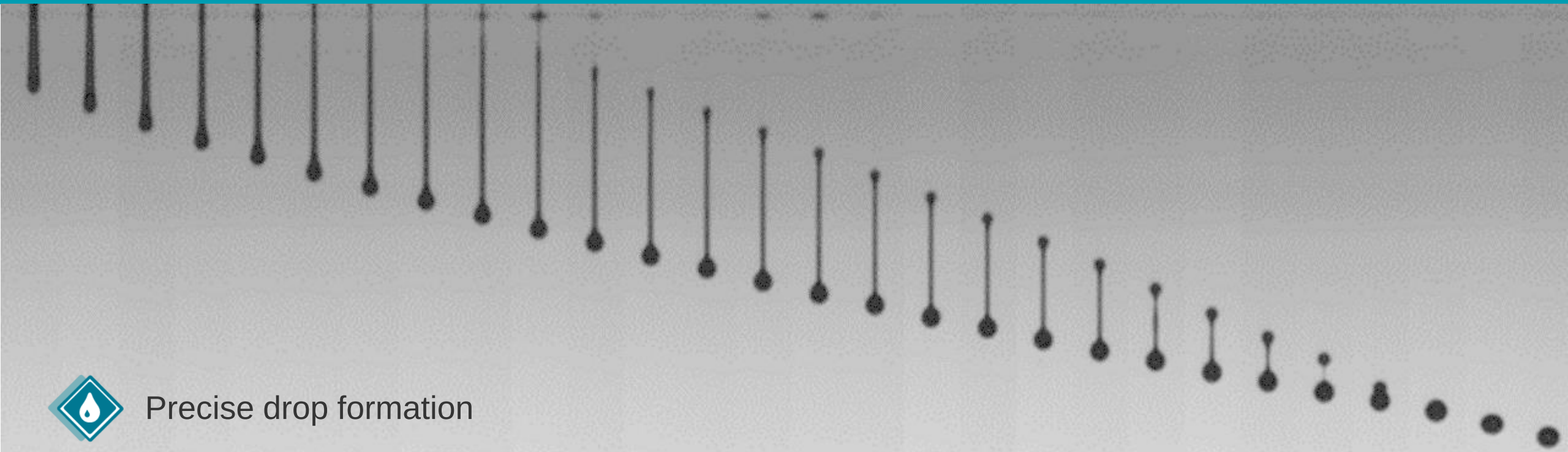
Drop on demand

drops generated only when required

Inkjet Technology: Many Benefits

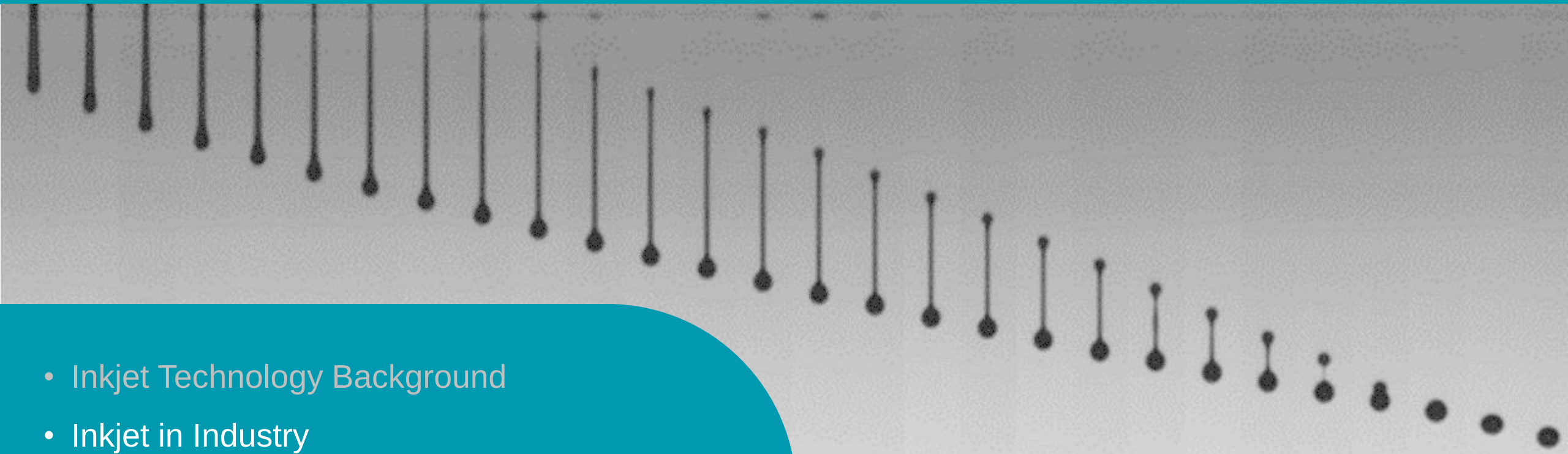
- Non contact
- Additive process
- Subtractive process
- Broad fluid capability
  - UV curable fluids
  - Conductive fluids
  - Jettable polymers & dielectrics
  - Jettable active & passive electronics
  - Acid resist
- Precise drop formation
  - Small drops for small features
  - Large drops for coatings/area fill
- Precise drop location
- Conserves expensive materials
- Reduces cost
- High drop production rate capability
- Long printhead life
  - Heavy duty cycle capability
- Proven reliability in production environments
- Inkjet as a partial or complete solution
- Integrated into standalone & hybrid manufacturing systems
- Highly integrated, modular technology

Inkjet Technology: Key Benefits



- Precise drop formation
- Accurate non-contact deposition
- All under digital control

Agenda



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Inkjet in Industry: Big Presses

Disclaimer

Global Inkjet Systems supplies inkjet technology and components to 150+ original equipment manufacturers world-wide. As a matter of policy, we do not disclose our customer relationships.

These slides contain images chosen to illustrate the range of inkjet print systems which is available in the market. The presence, or absence, of any manufacturer's products in these images does not in any way imply a commercial relationship between that manufacturer and GIS.

Image sources: Inca Digital, Kateeva, Martinenghi, Canon web sites

Inkjet in Industry: Ceramics

Image Source: System Italy

Inkjet now dominates ceramic tile production

That floor looks like stone

- but it isn’t

Inkjet in Industry: Textiles

Image Source: SPG

Digital print for textiles has reduced minimum viable print run lengths and shortened turnaround times

Image Source: Seiko Epson Corporation

Inkjet in Industry: Décor

Graphics and textures for all kinds of decorative products: wall coverings, edge banding, flooring, doors, window frames, furniture…

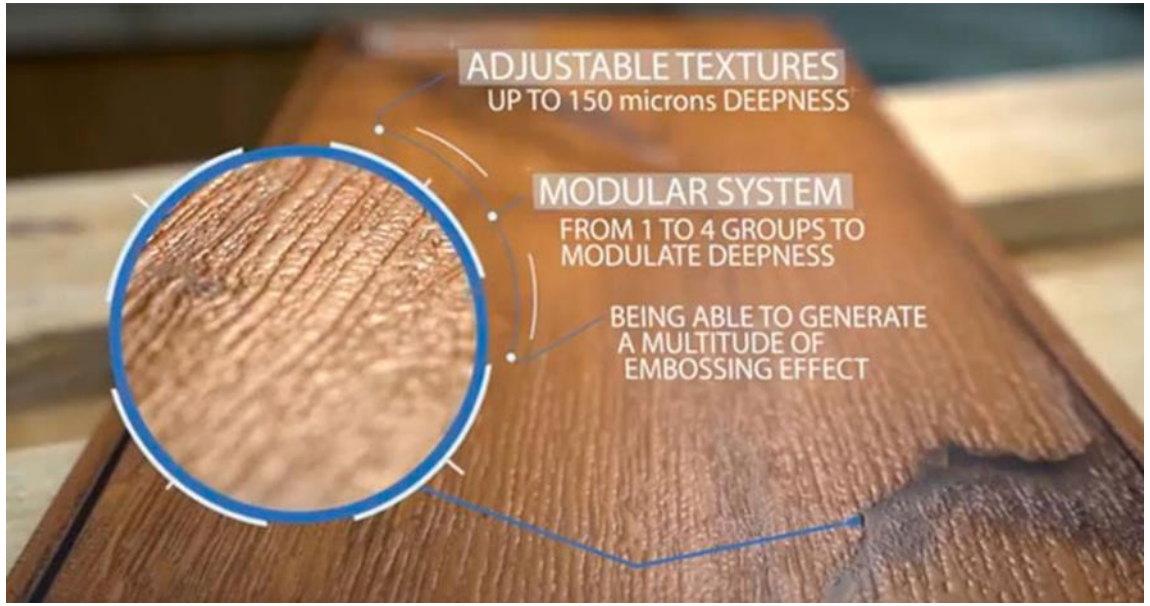


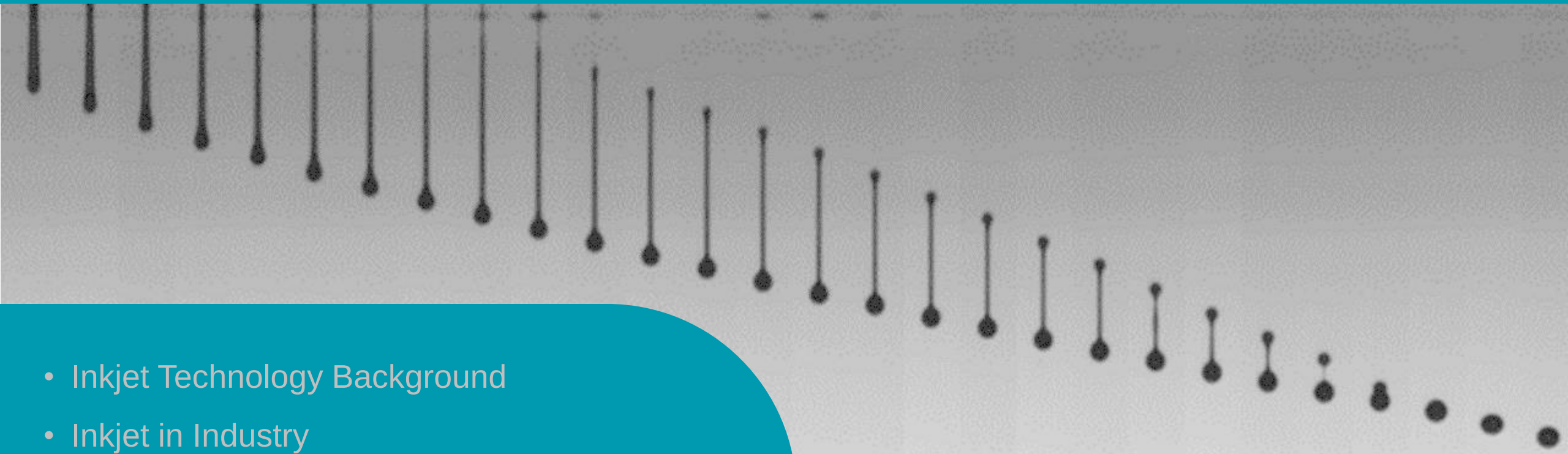
Image Sources: Hymmen, Cefla, Interprint

Inkjet in Industry: Automotive

- Decoration and protective coatings
- Mostly partial coverage so far
- Still some way from mainstream product

Image Sources: Nakan, Heidelberg/Ritzi

Agenda



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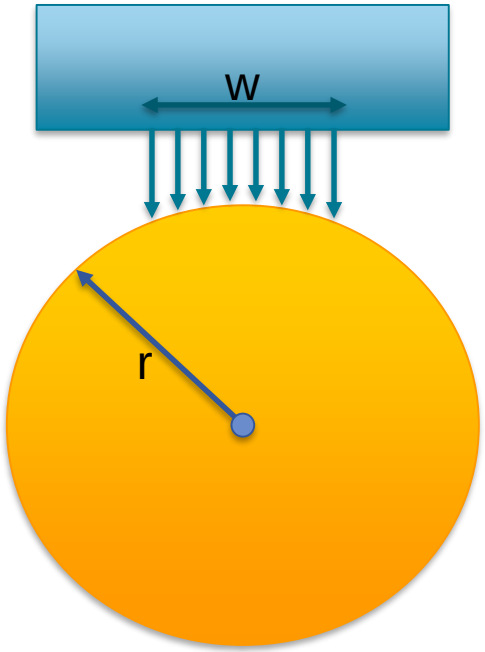
Technology Update: Throw Distance

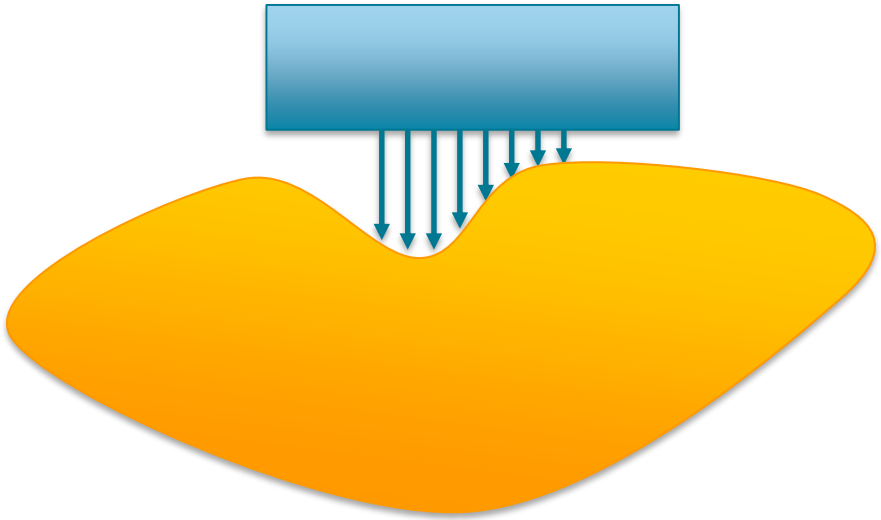
Inkjet is usually associated with throw distances of 0.5 – 4 mm.

Surface curvature creates a requirement to jet further



Convex

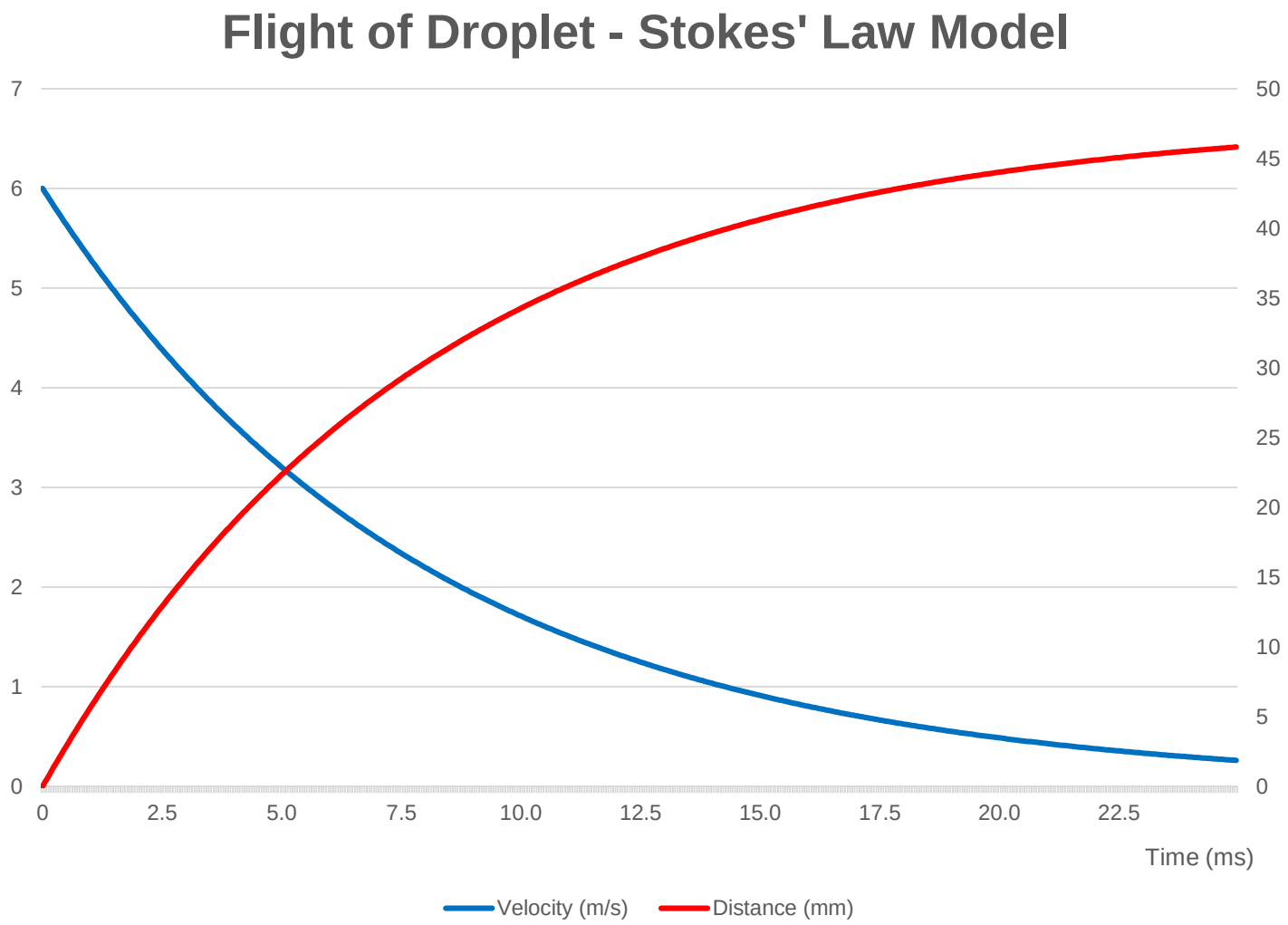
$r >\approx w$



Near-convex

$h < h_{max}$

Technology Update: Throw Distance



This is a droplet drag model for

- 70 picoLitre drop
- Nozzle velocity 6m/s
- Density ~1(000)

Although this is a theoretical model it seems to hold quite well in laboratory tests across a range of drop sizes and speeds

The drops lose their way once they slow down to below ~1m/s

A distance of 30-40mm is achievable for coating applications

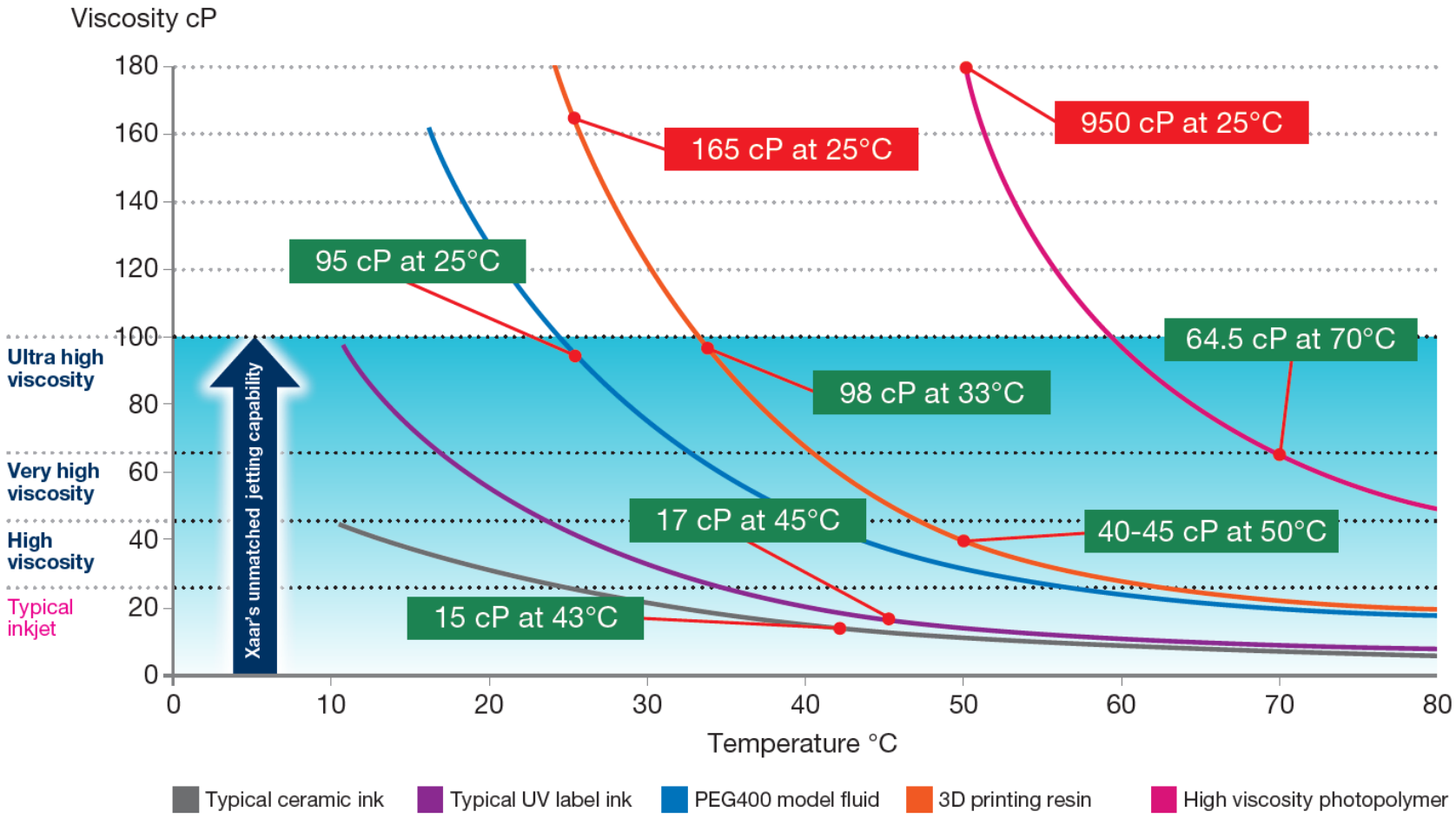
For print and graphics, 5-10mm is more realistic

Technology Update: Viscosity Range

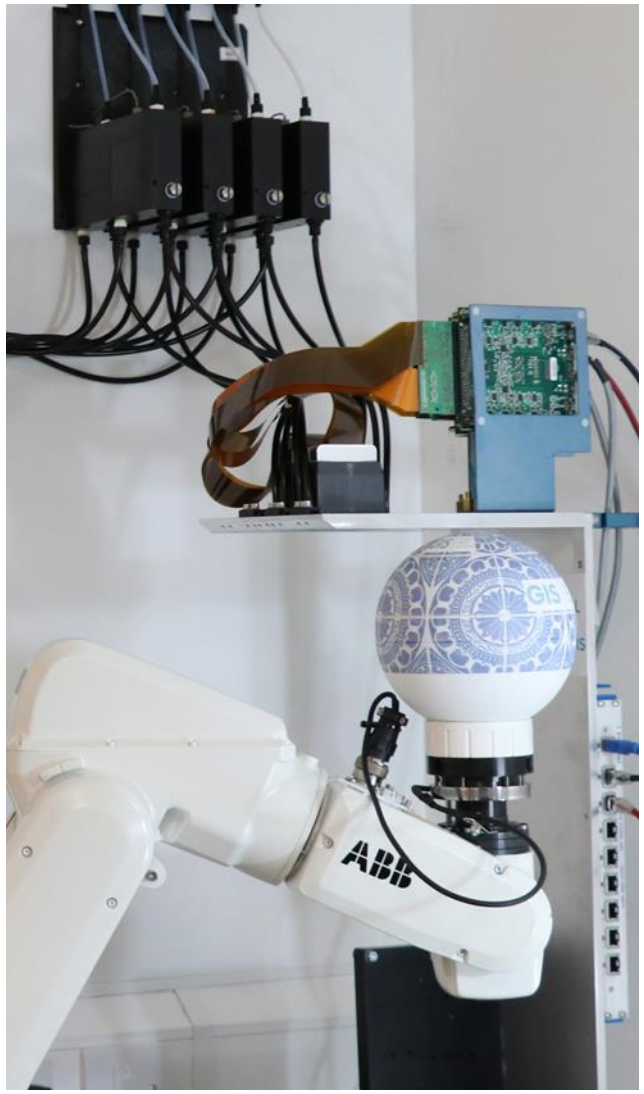
Xaar has released experimental data showing that their TF Technology® printheads are capable of jetting fluids at much higher viscosity than previously thought.

Ricoh has also disclosed information about jetting high viscosity fluids.

Not yet commercially available, but it points the way towards inkjet application of all kinds of paints and coatings.



Technology Update: Complex Curved Surfaces



Last year, GIS showed spherical objects which were printed with graphics using rotational motion under a 4 colour CMYK printhead array

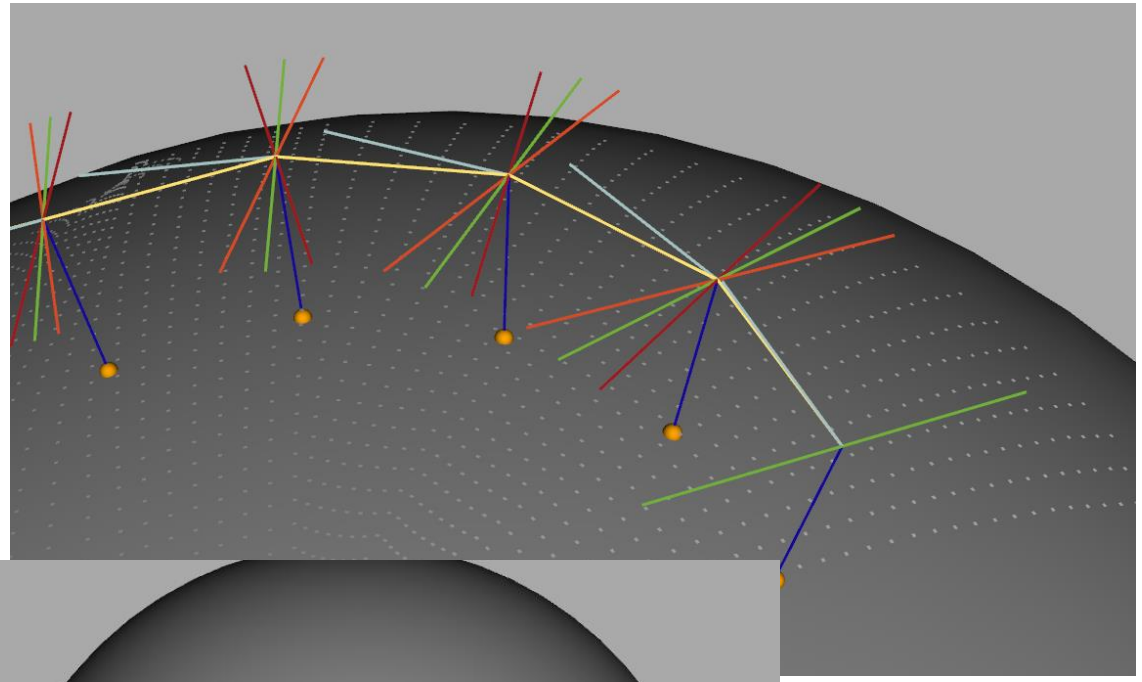
Technology Update: Complex Curved Surfaces

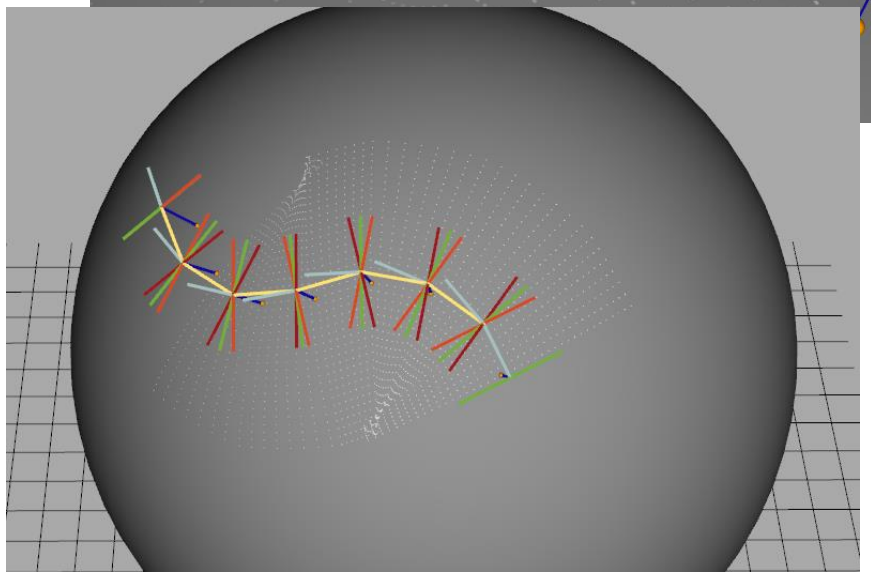
GIS has developed tools for designing print operations on complex curved surfaces

- First the designer places a series of points across the surface, guided by an interactive display of the area which will be printed
- The points are joined to form a path, and given a flying height.
- The designer also adds masking as required

When the path is complete, the system generates:

- Instructions for a robot moving either the printhead or the object, and
- Image data for the print, including masking:
  - Implicit – where drops don't reach the surface
  - Explicit – where the designer adds it





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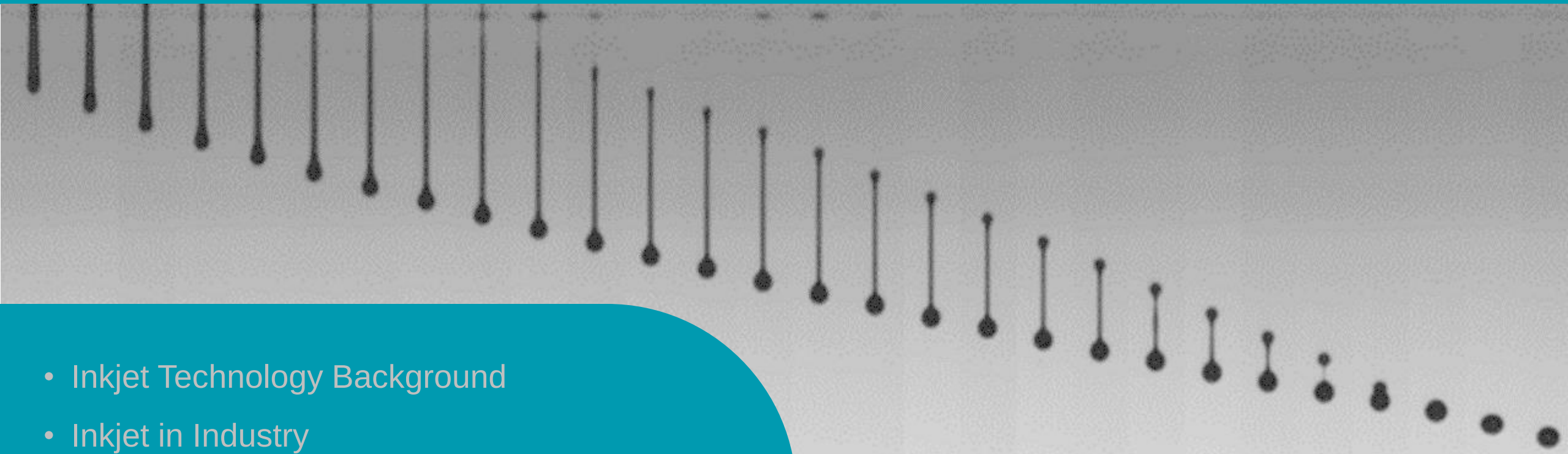

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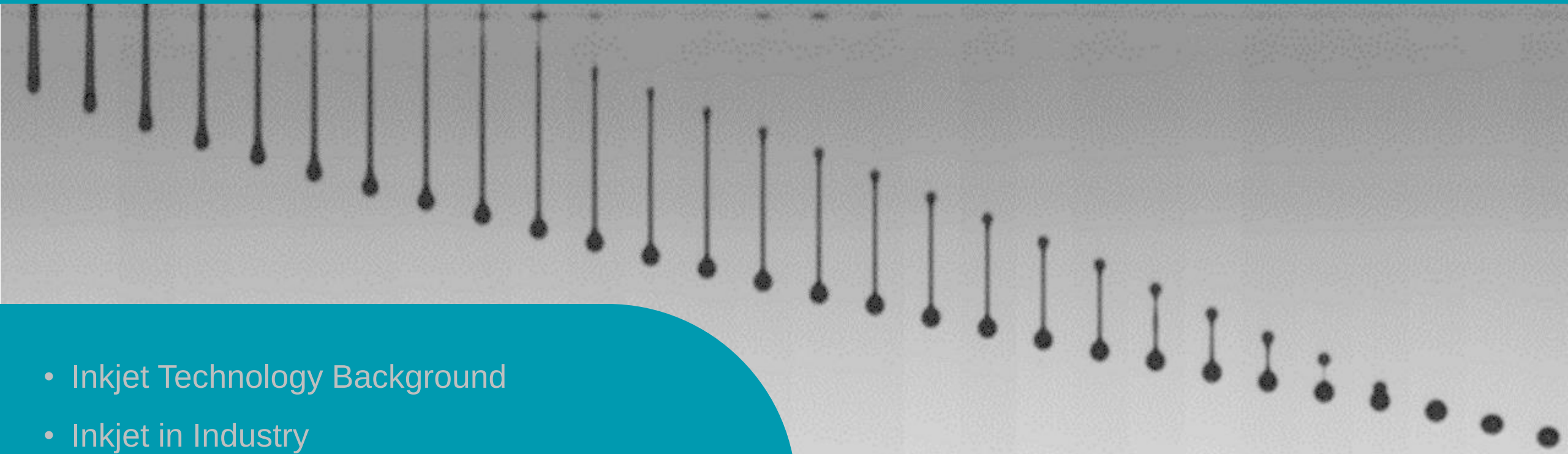
Automotive Hard-Coats

Hard-coats are an early market opportunity for inkjet

- Some are already available in inkjettable formulations
- There are many new requirements for coating plastic components
- Significant cost savings are possible
  - Materials savings
  - Process efficiencies
  - Environmental controls

Image Sources: Momentive SilFORT Hardcoats, 707motoring.com

Agenda



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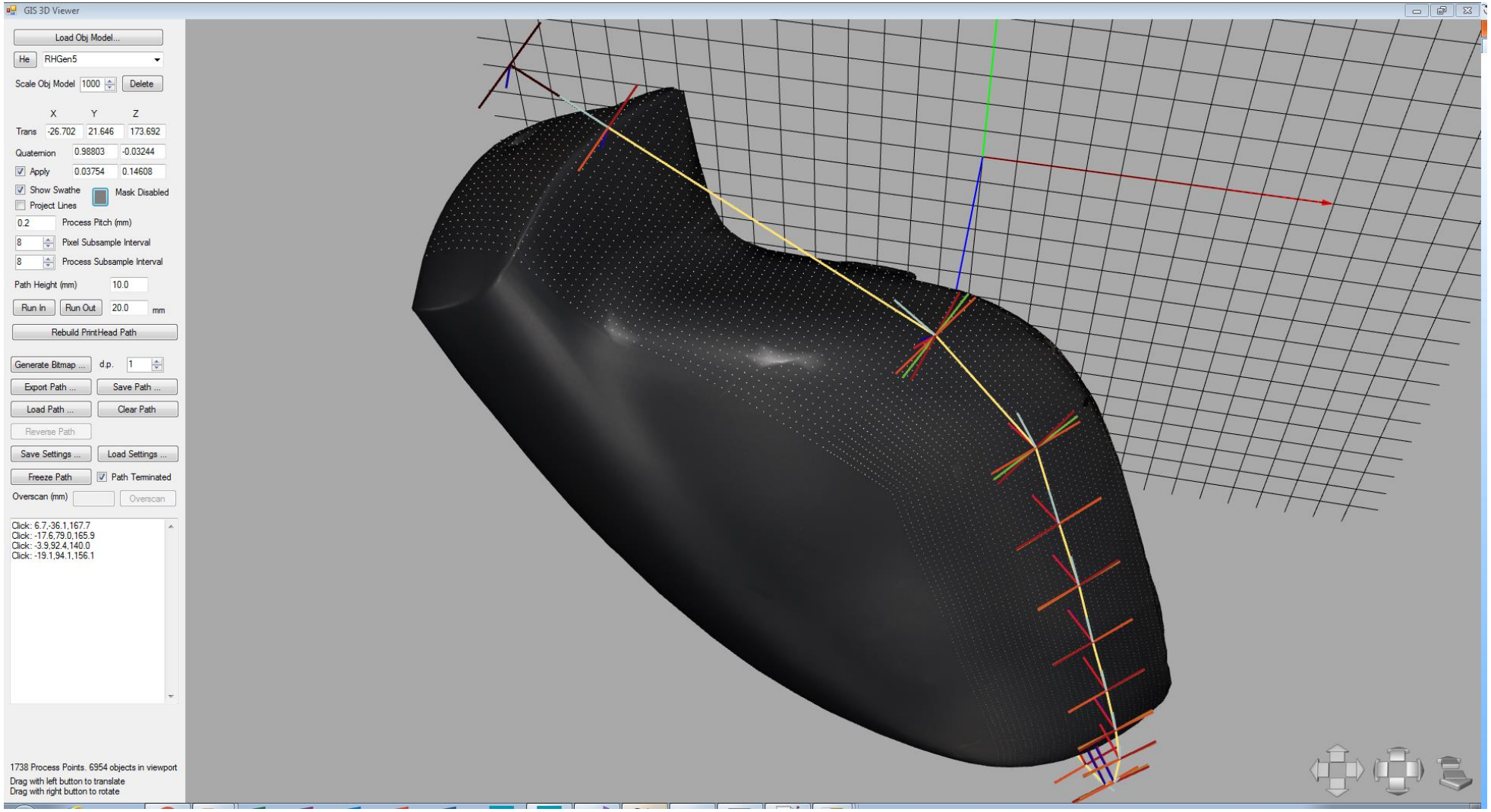
Case Study: Wing Mirror Cover

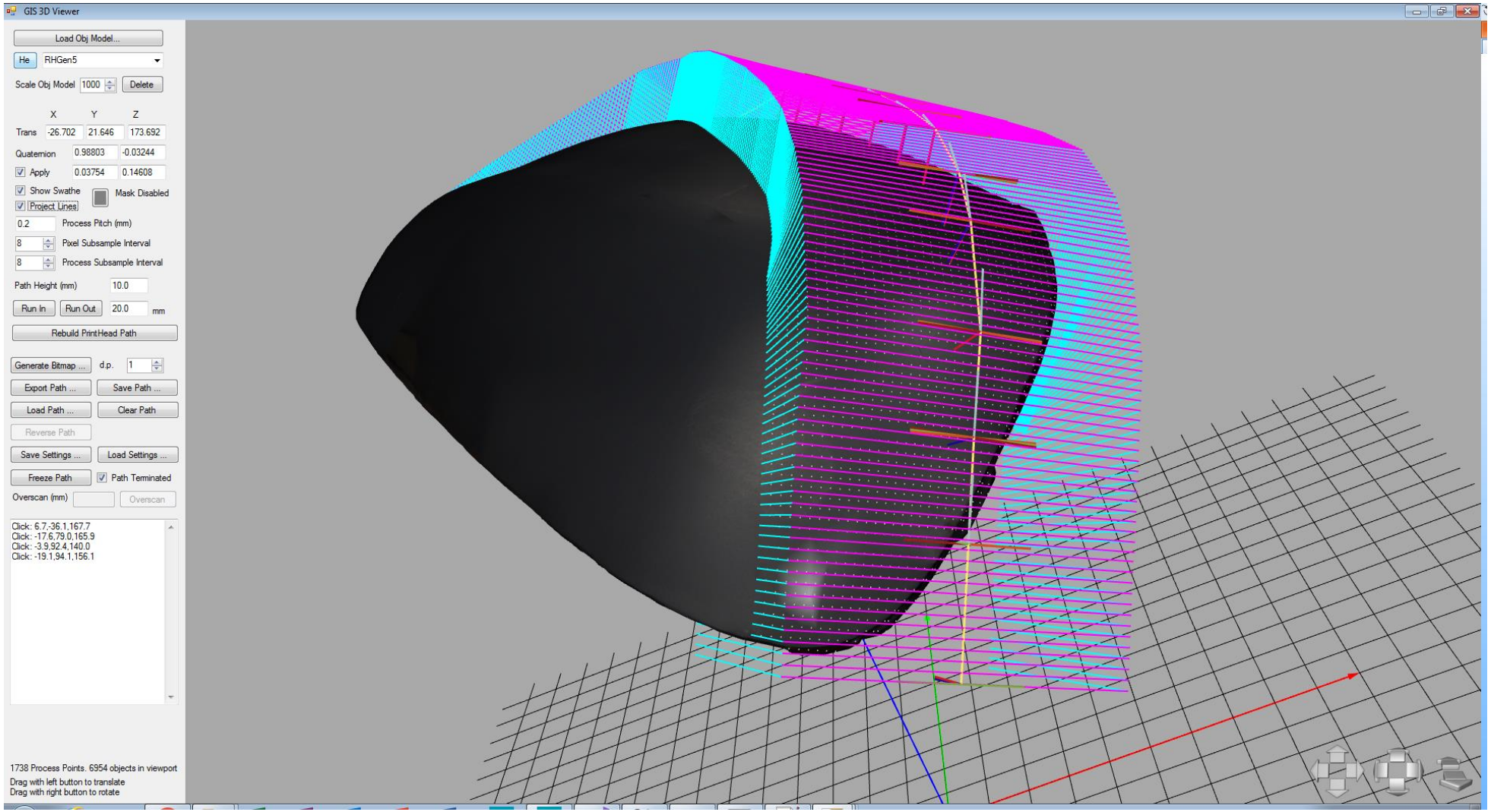
- Based on commercial work
- Objective: to apply an approved automotive hard coat* by inkjet over the exterior surface
- Using a generic after-market product with no commercial confidentiality restrictions

*Momentive SilFORT UVHC3000K

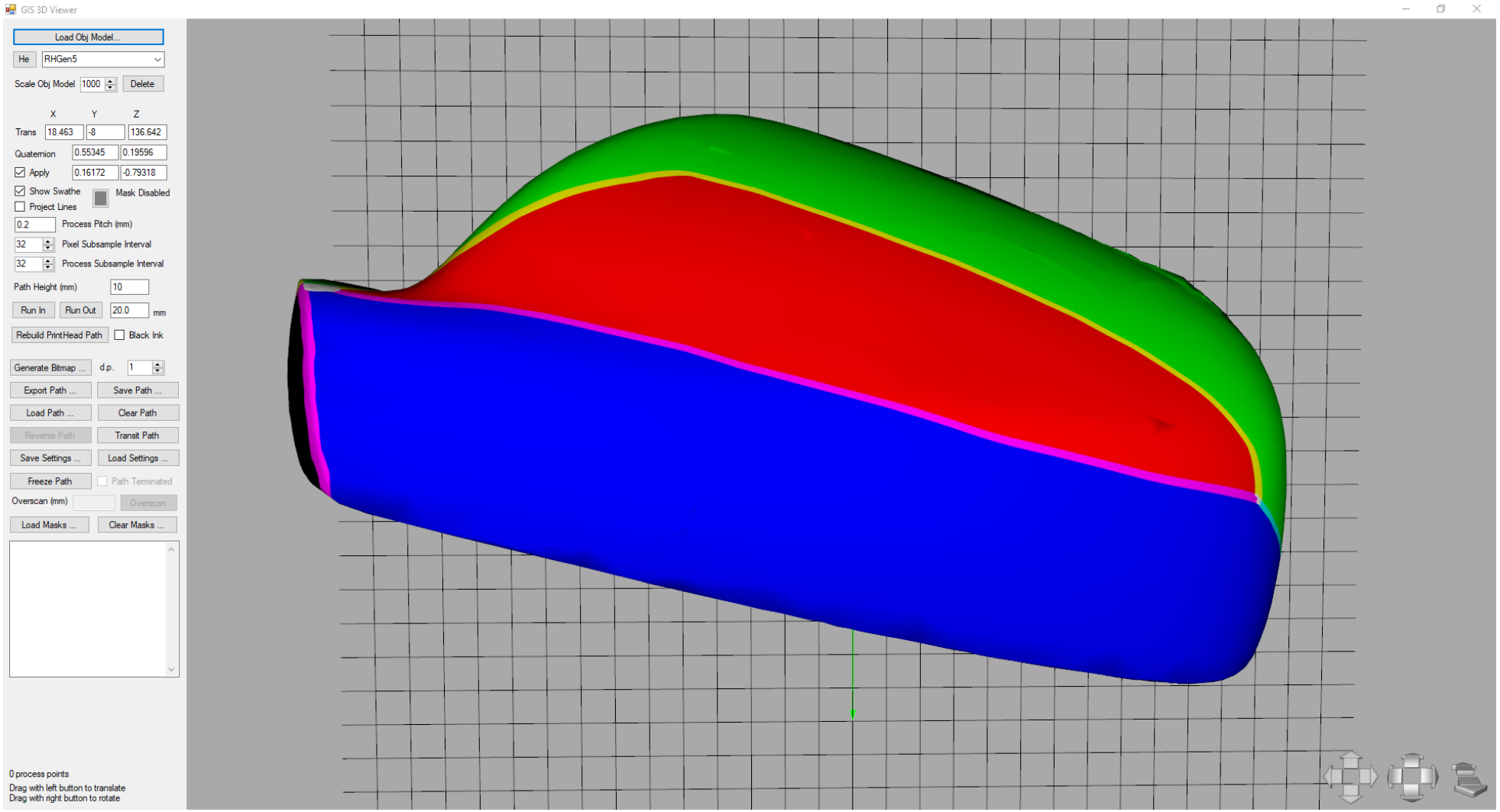
Case Study: GIS Print Path Designer



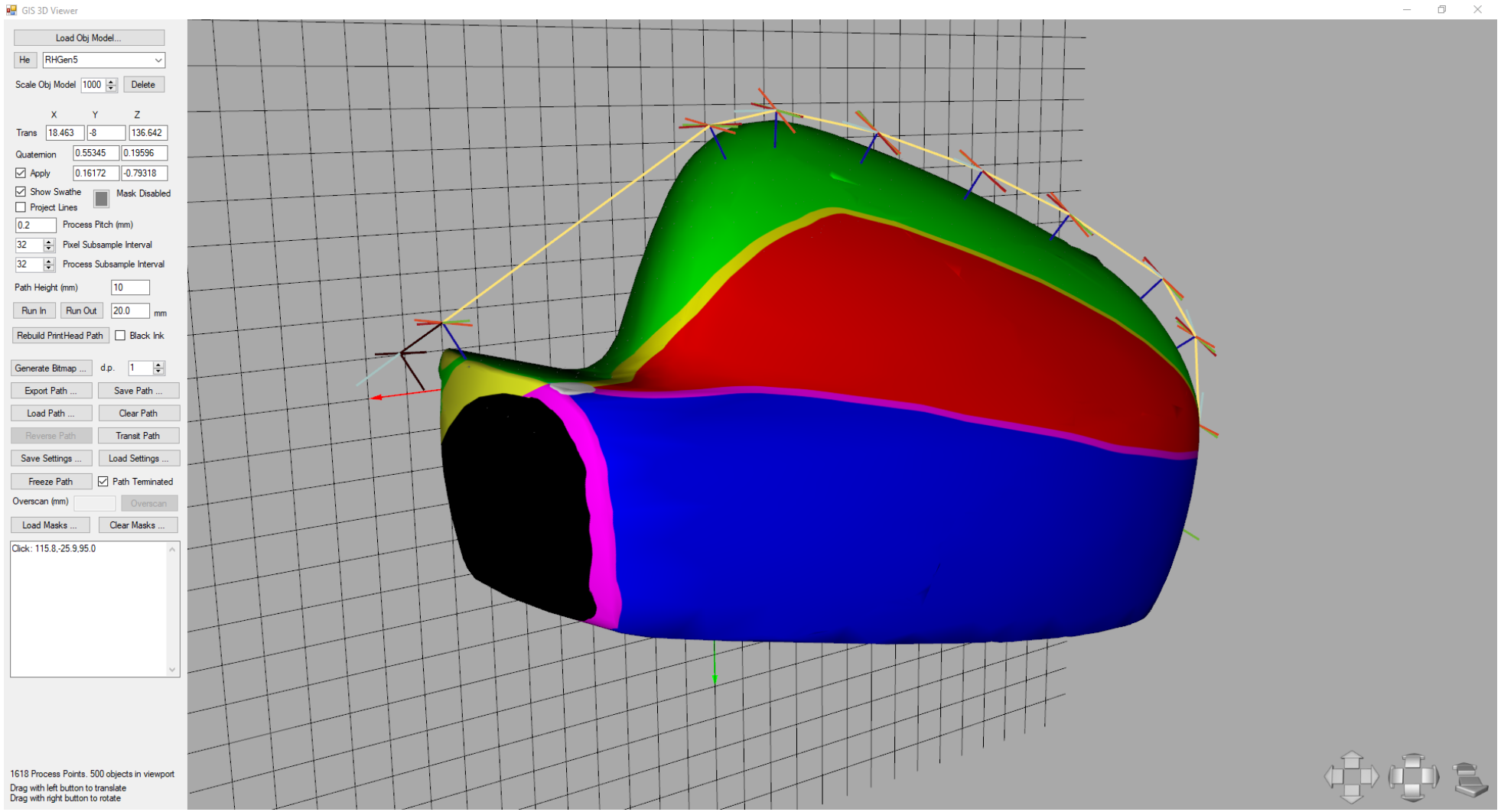
Case Study: Swathe Visualisation



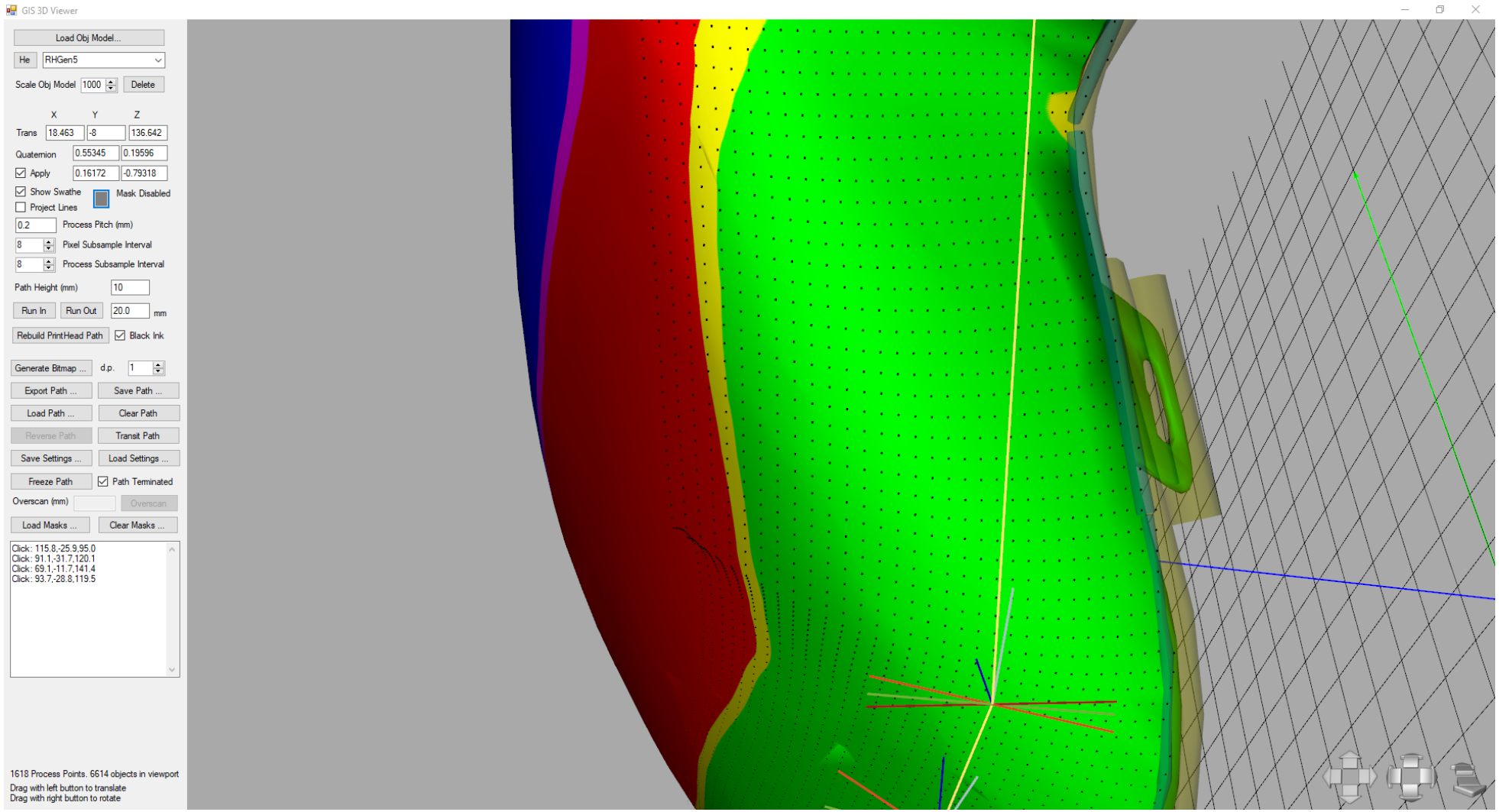
Case Study: Swathe Masking



Case Study: Across The Valley

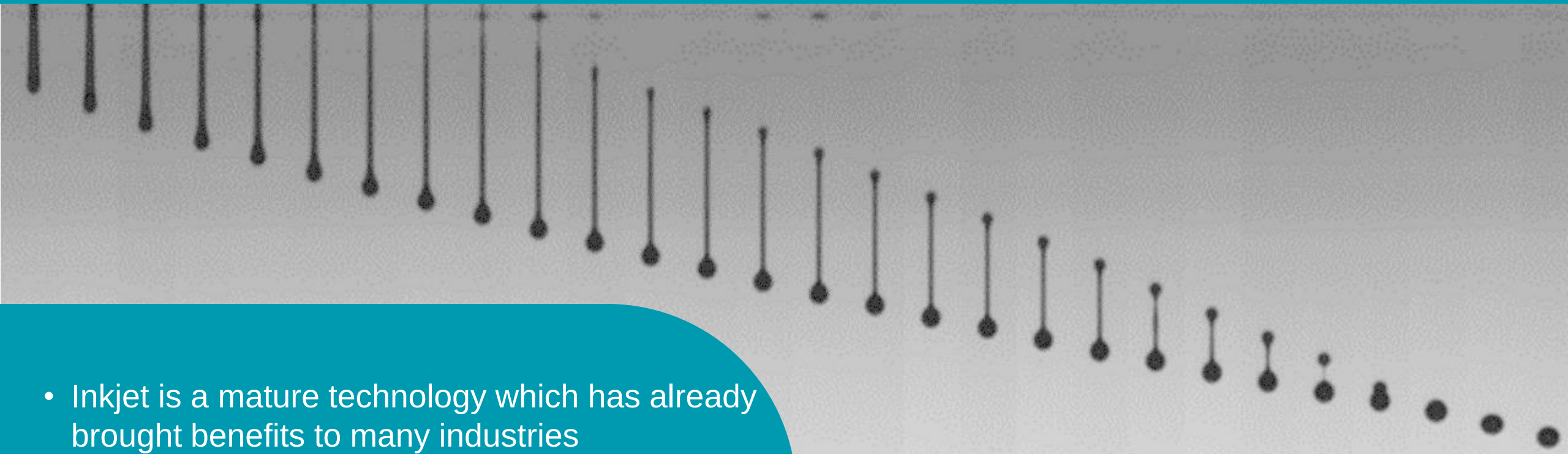


Case Study: Masking and Density



Case Study: The Movie

Summary



- Inkjet is a mature technology which has already brought benefits to many industries
- There are early market opportunities in automotive, for example with hard-coats
- And our ambition reaches much further

Any Questions?

Contacts

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