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Characterisation of Print Path Deviation in 3D Printed Continuous Carbon Fibre Composites

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Department of Mechanical & Construction Engineering

EM²G
Engineering Materials & Mechanics Group

The Opportunity

Images: Markforged

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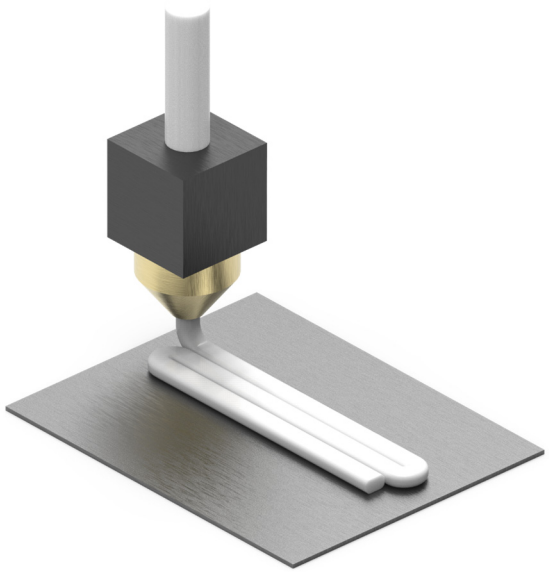
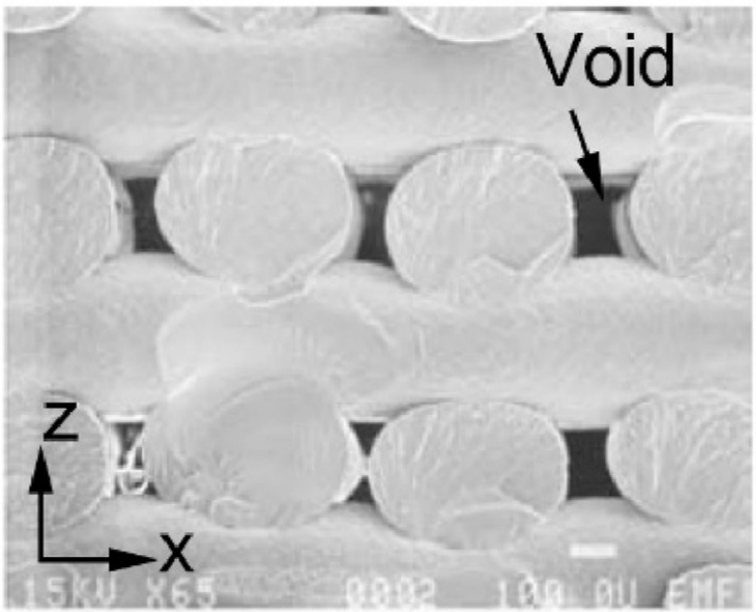
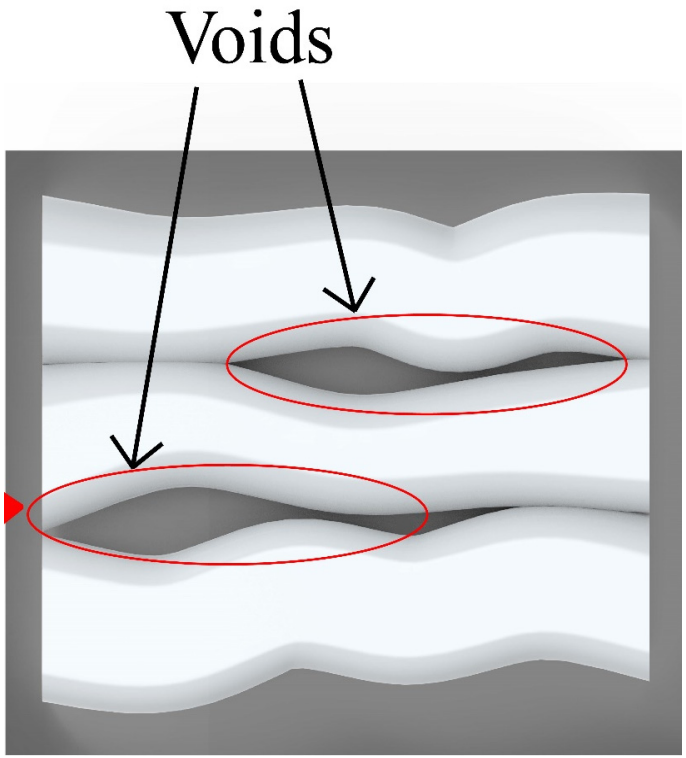
The Challenge





Tao et al., 2021



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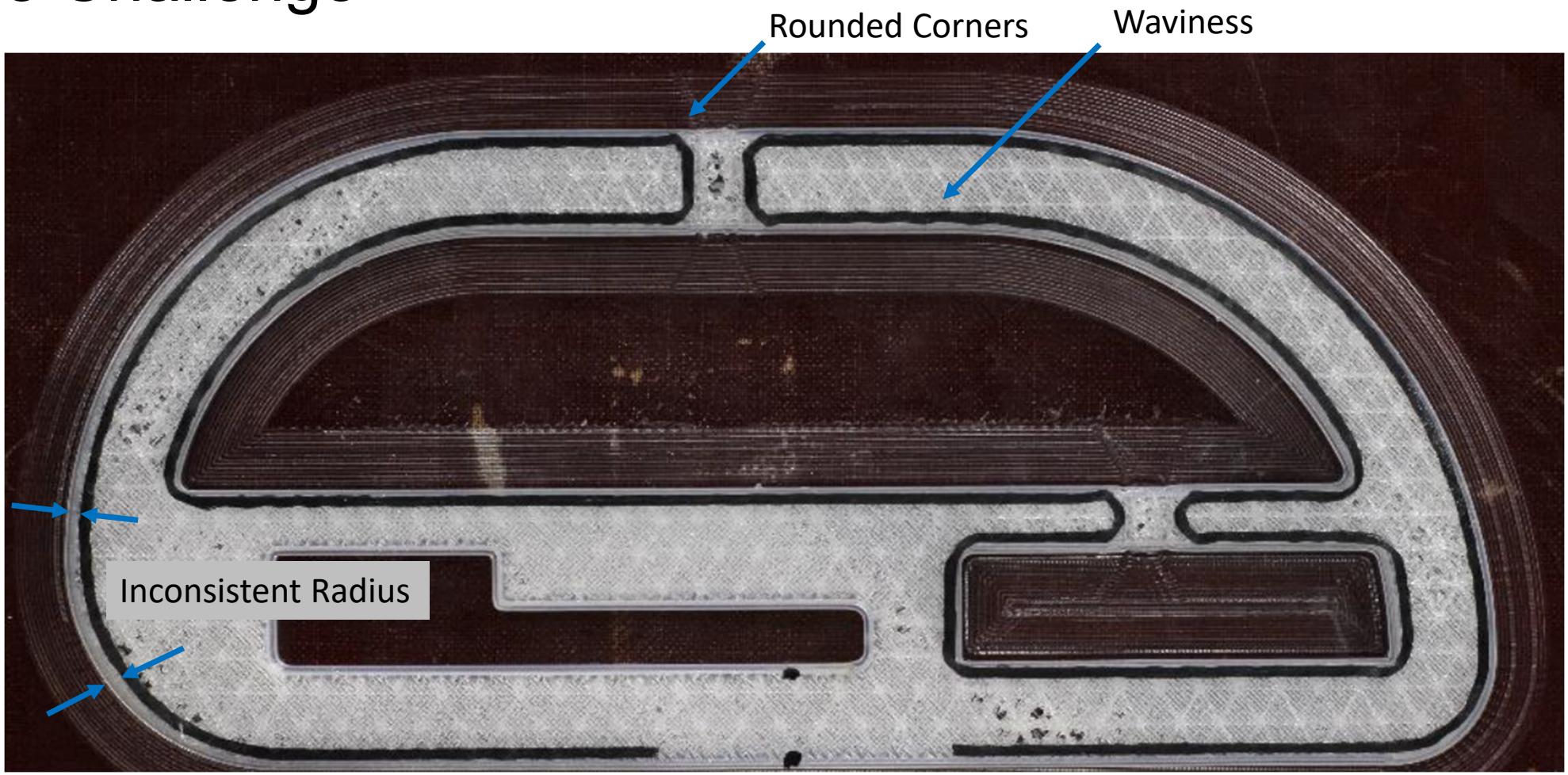
The Challenge



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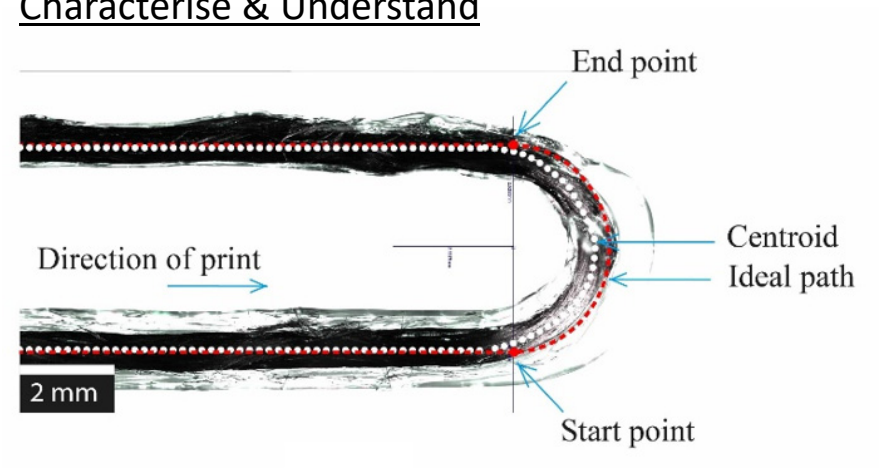
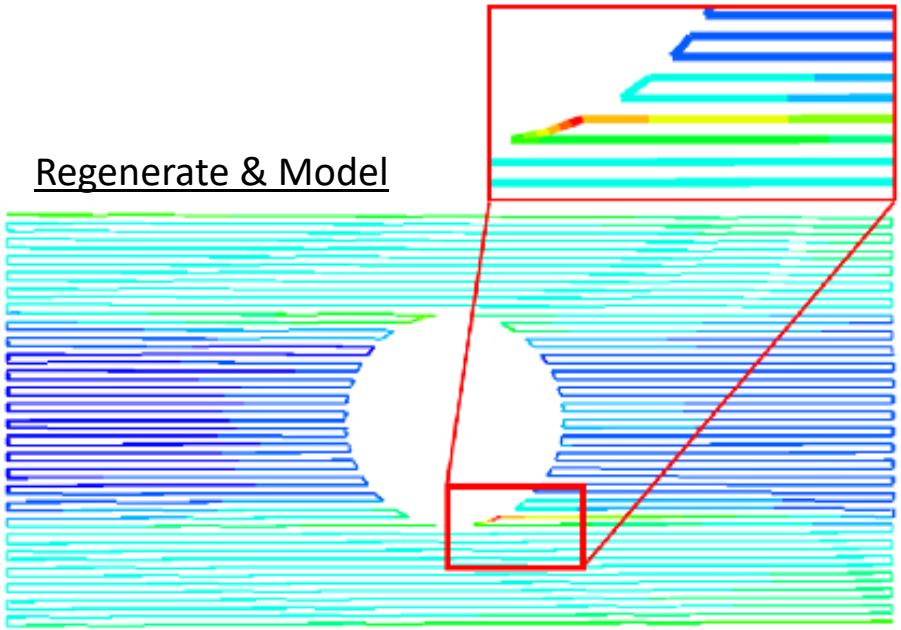
Our Solution

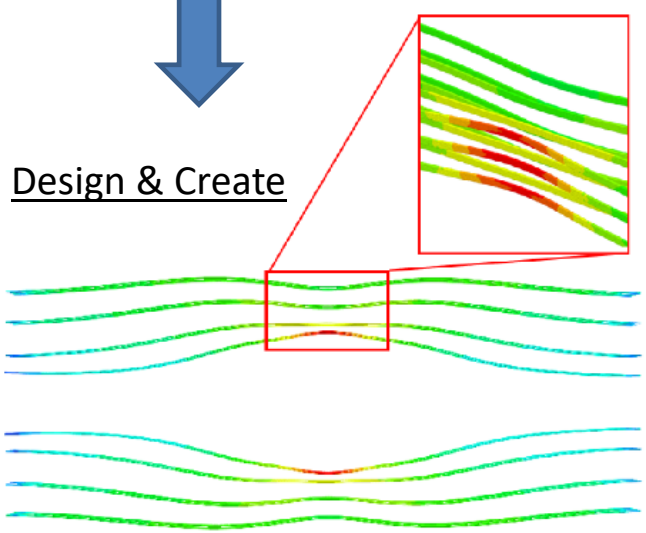
Characterise & Understand



Regenerate & Model



Design & Create



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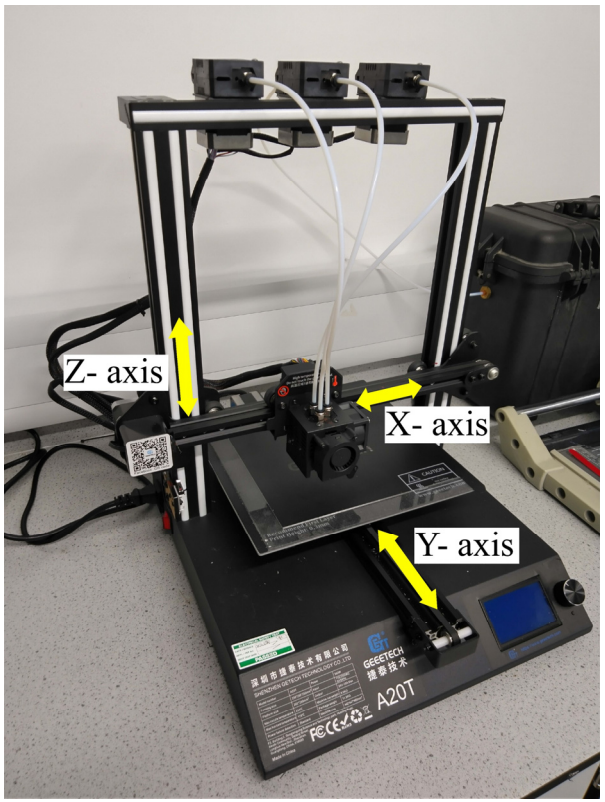
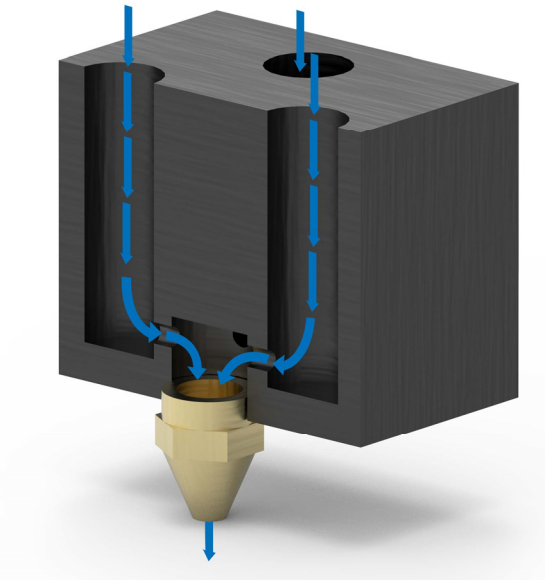
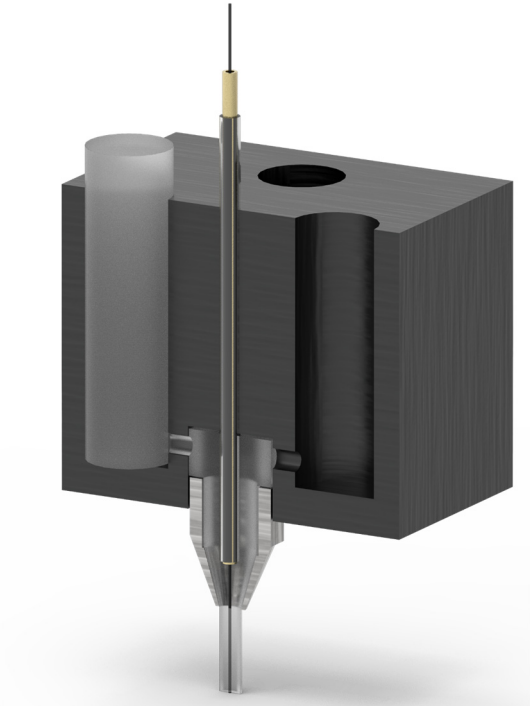
3D Printer Setup



Geeetech A20T



3-in-1 extruder



modified CCF extruder

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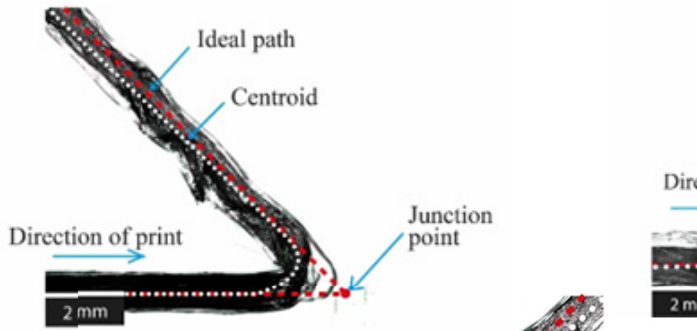
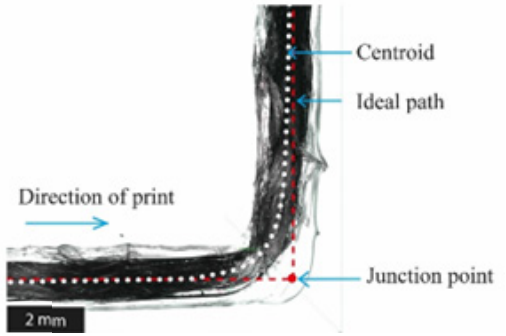
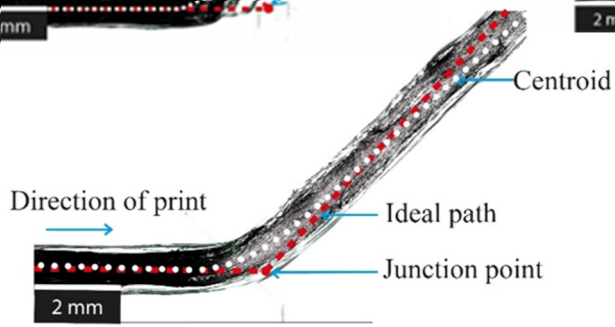
Printing

carbon fibre-nylon filament
printed at 5 mm/s

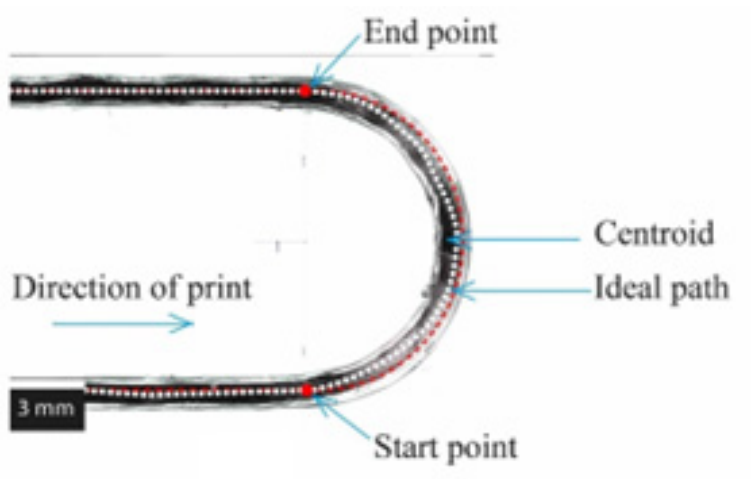
Straight paths







Angled corners
(45°, 90° and 135°)



Curved paths
(2, 4, 6 and 8mm radius)

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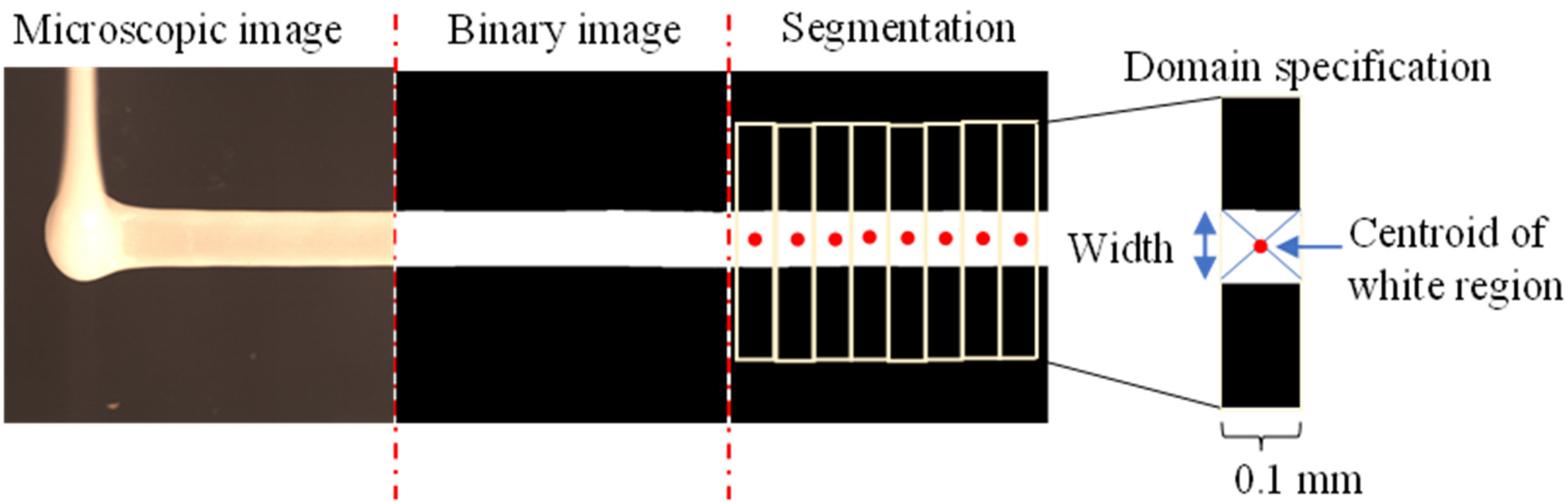
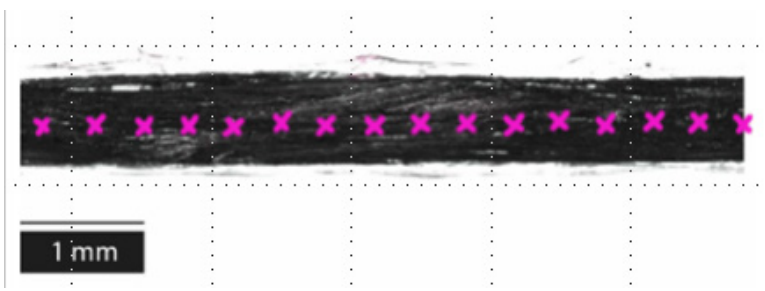
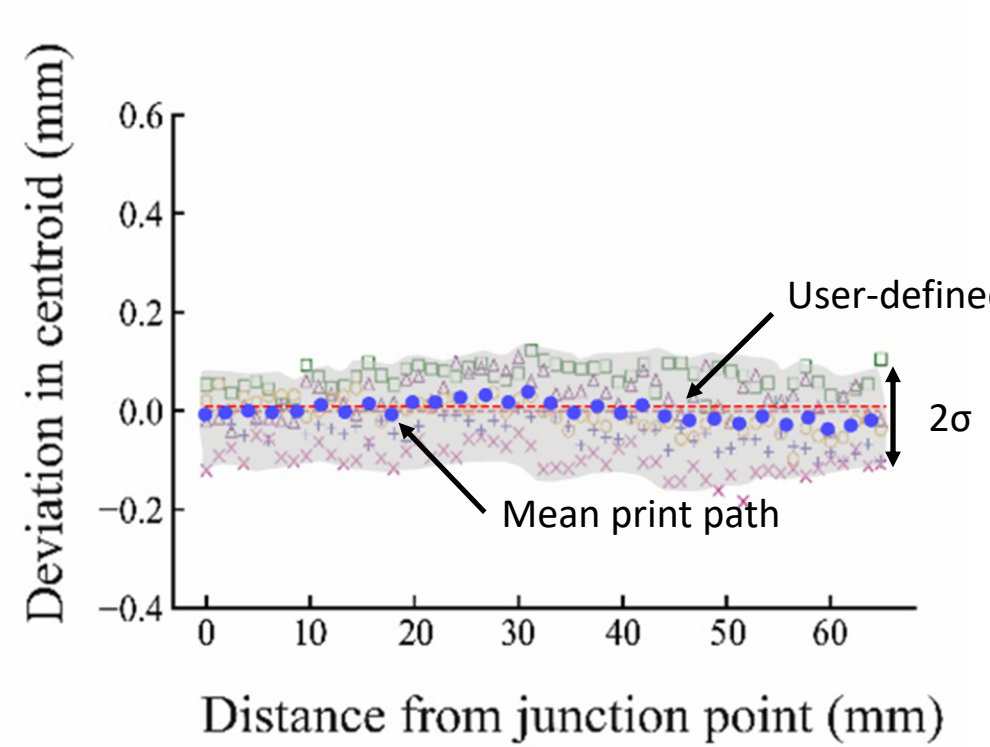
Image Processing



Characterisation





$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} \delta_i^2}{N}}$$

Root mean squared deviation (RMSD)

Mean Deviation from ideal	-0.009 mm
RMSD	0.062 mm

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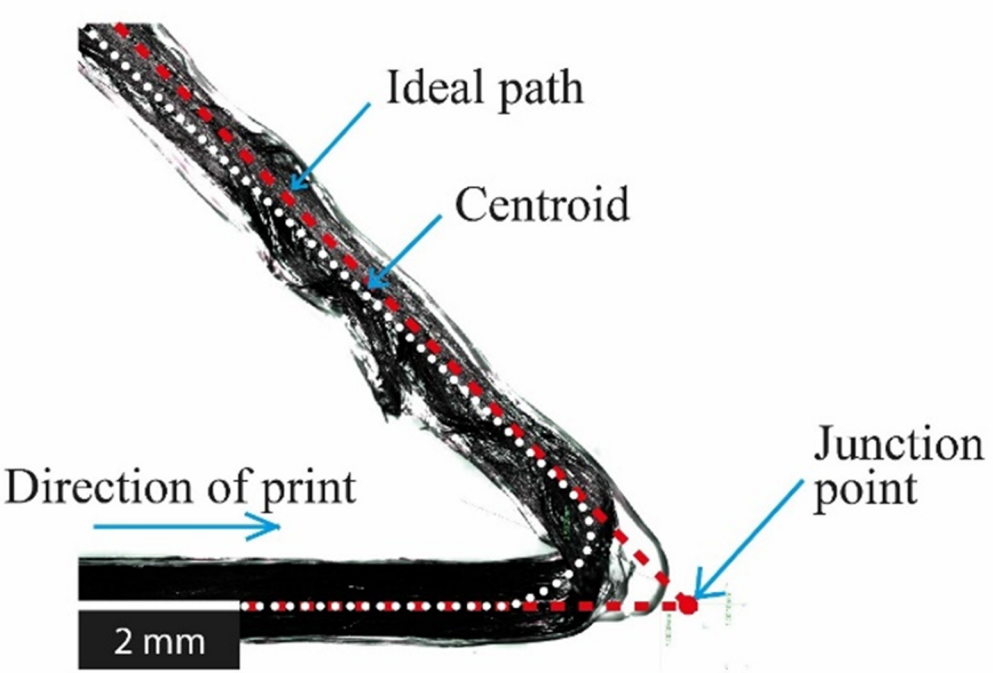
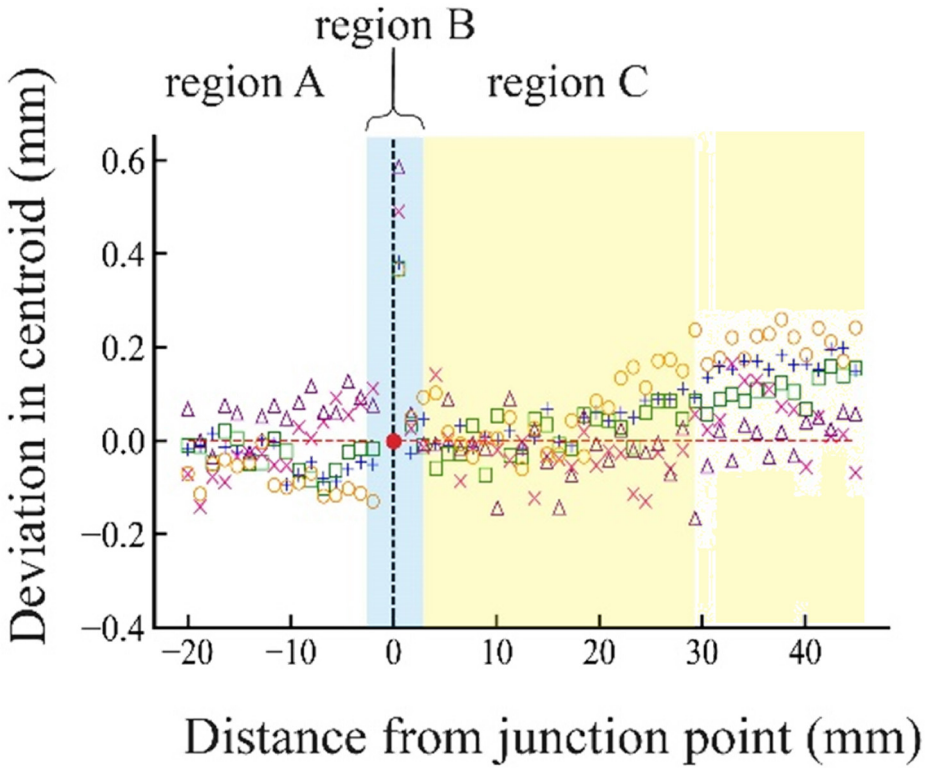
Results – 45°





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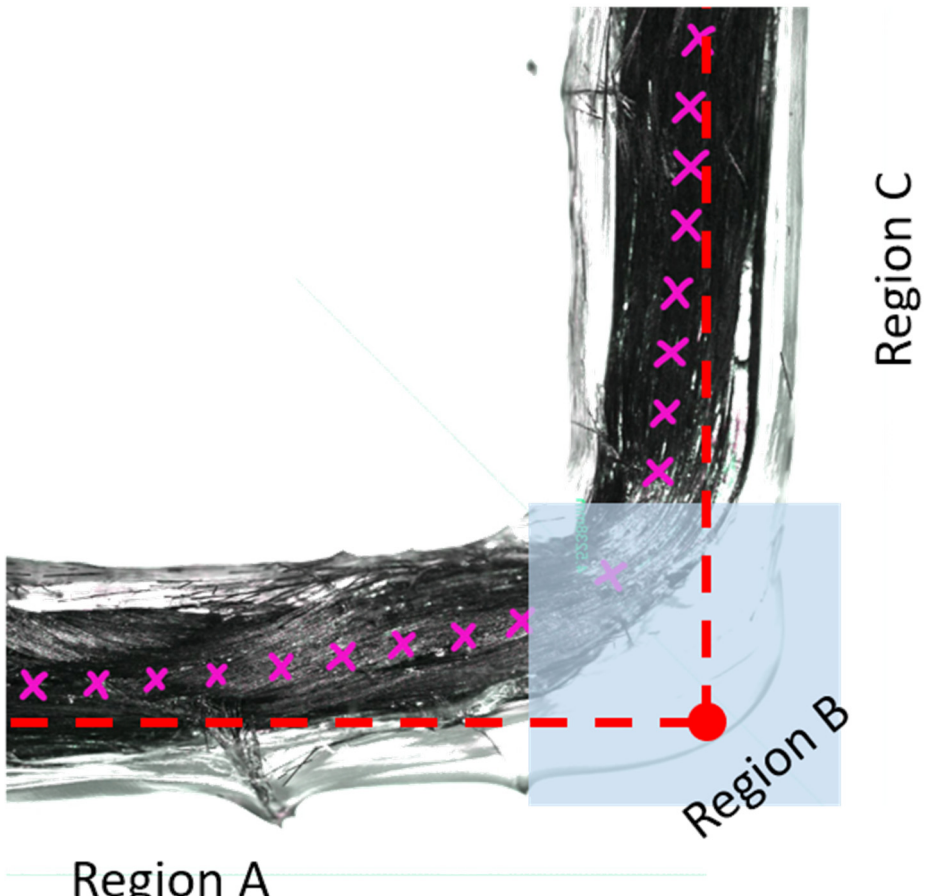
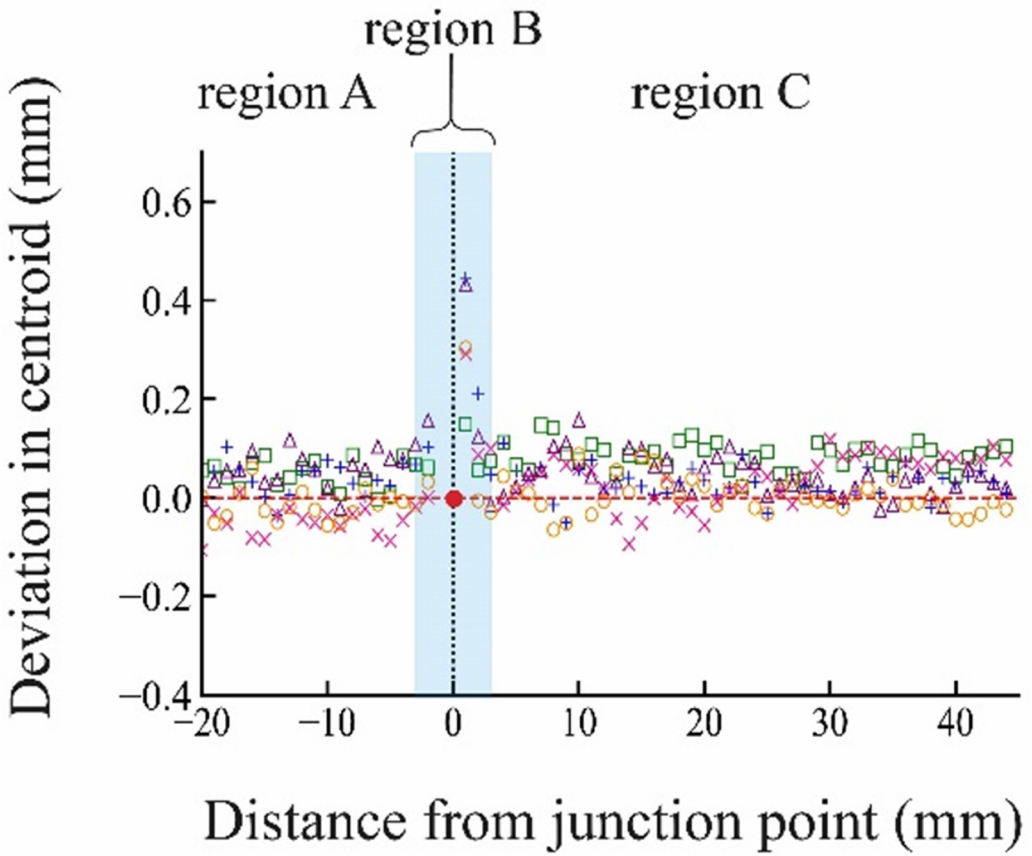
Results – 90°





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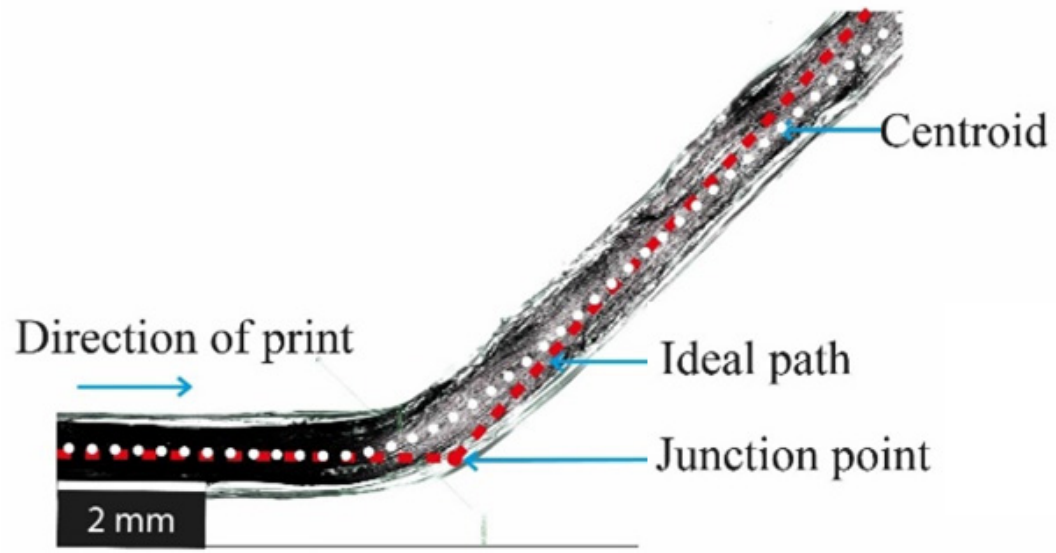
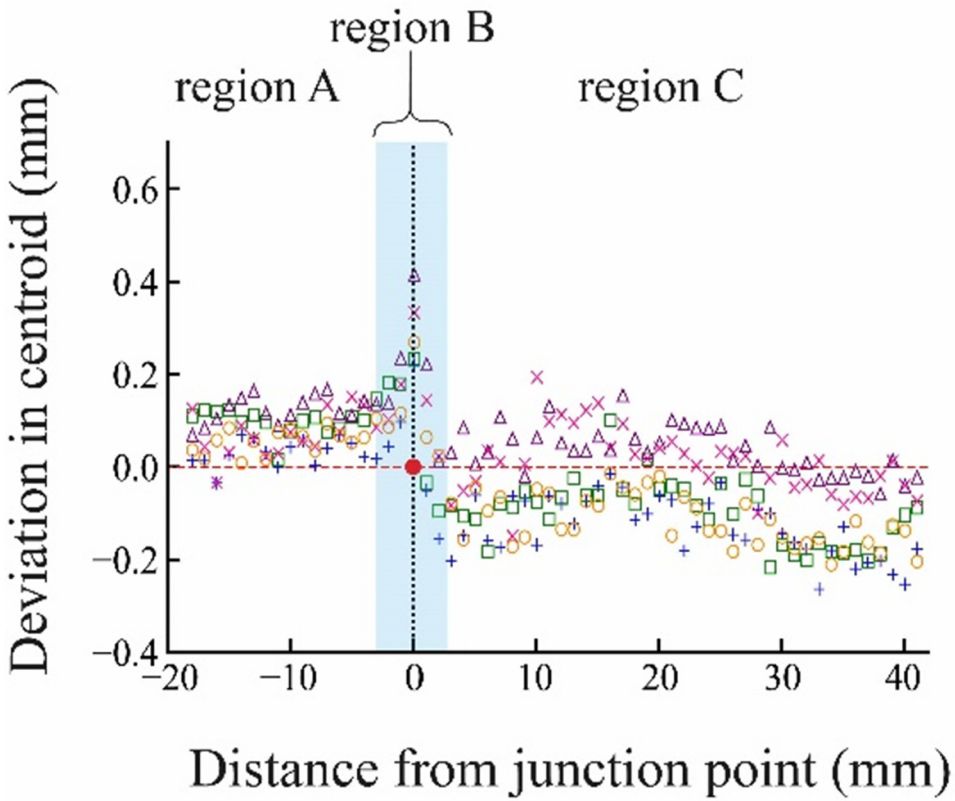
Results – 135°





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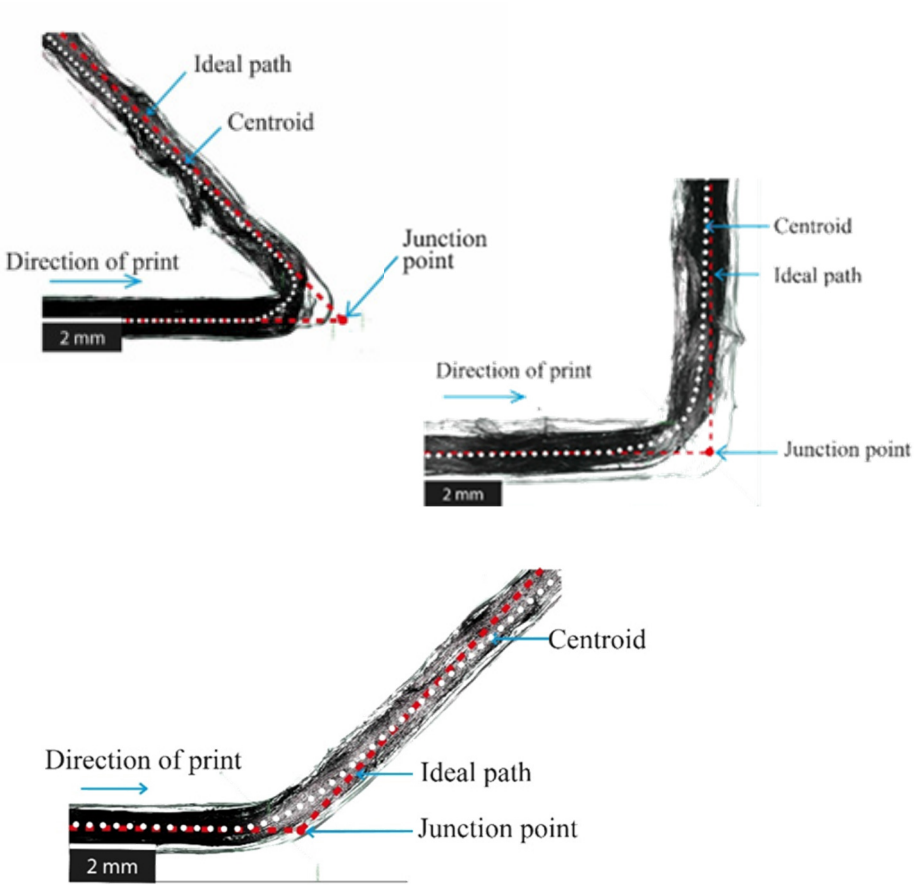
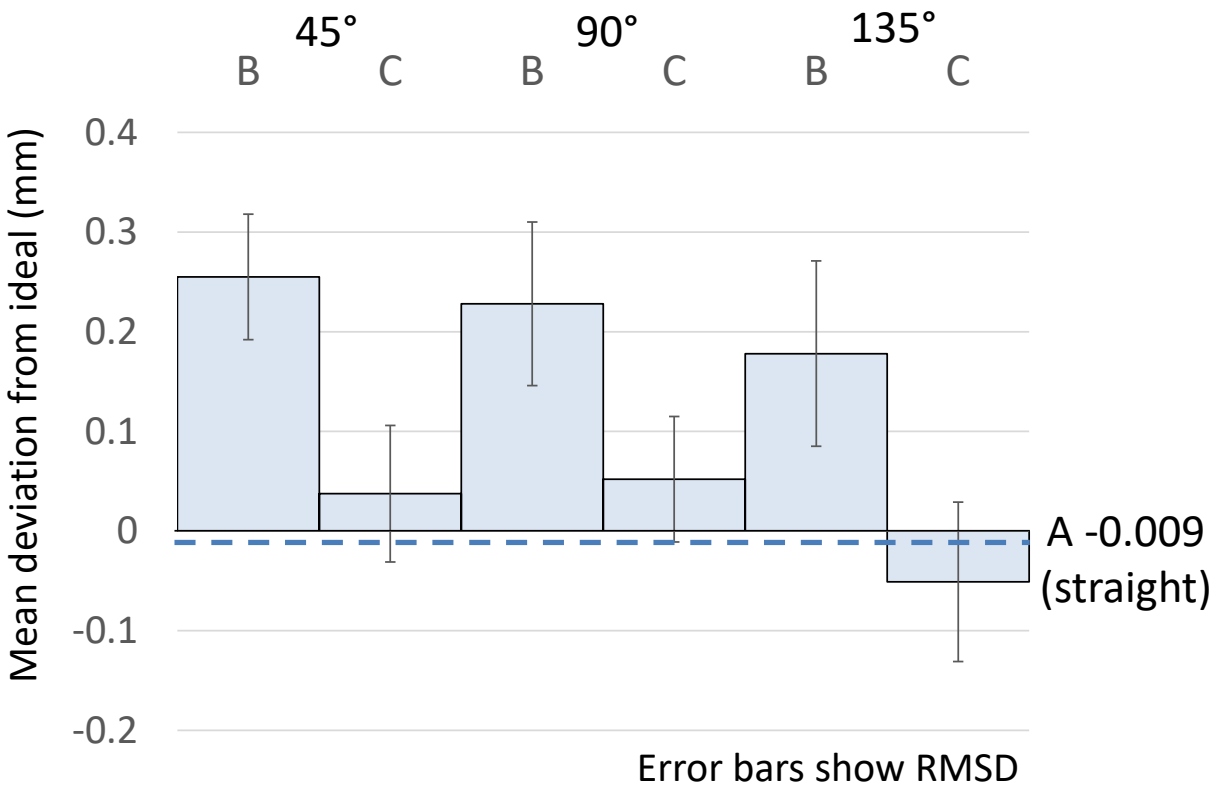
Results – Angled Corners





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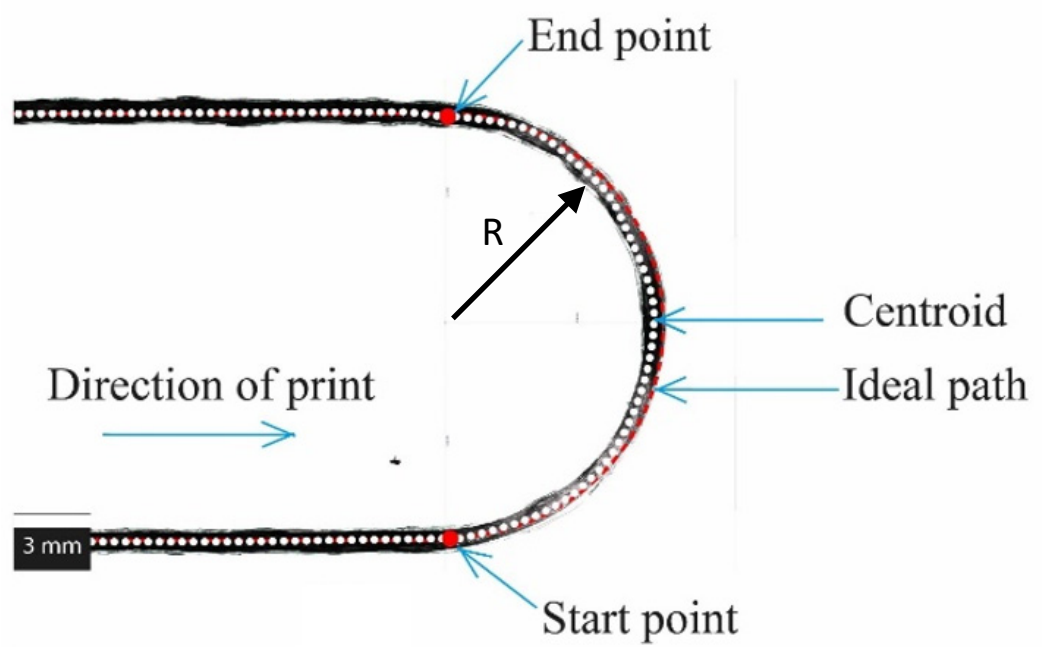
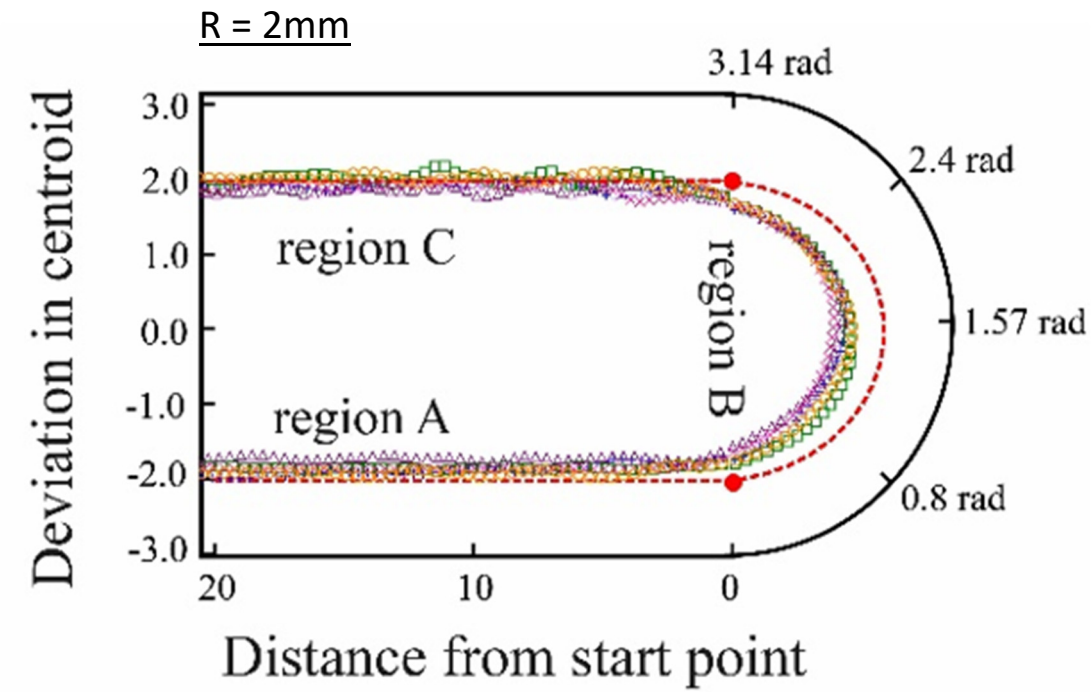
Results – Curves





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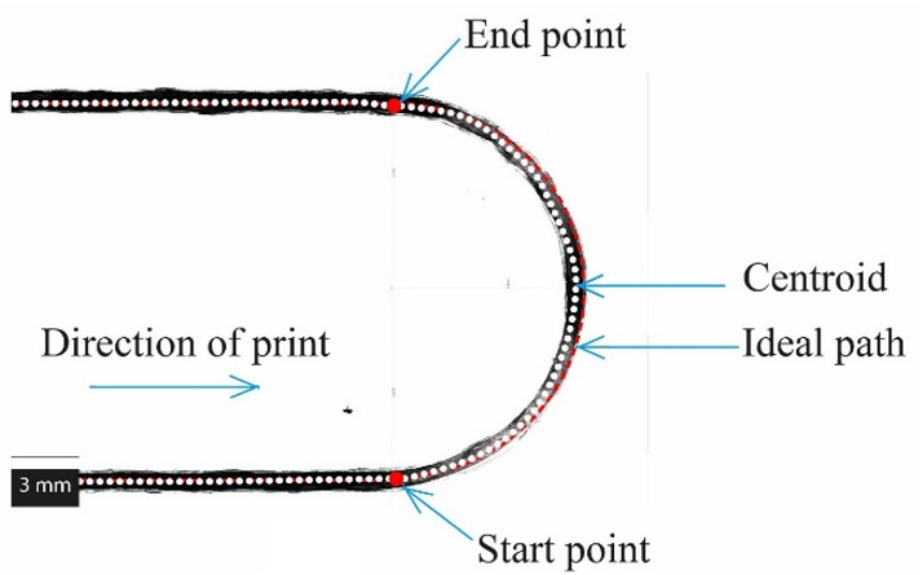
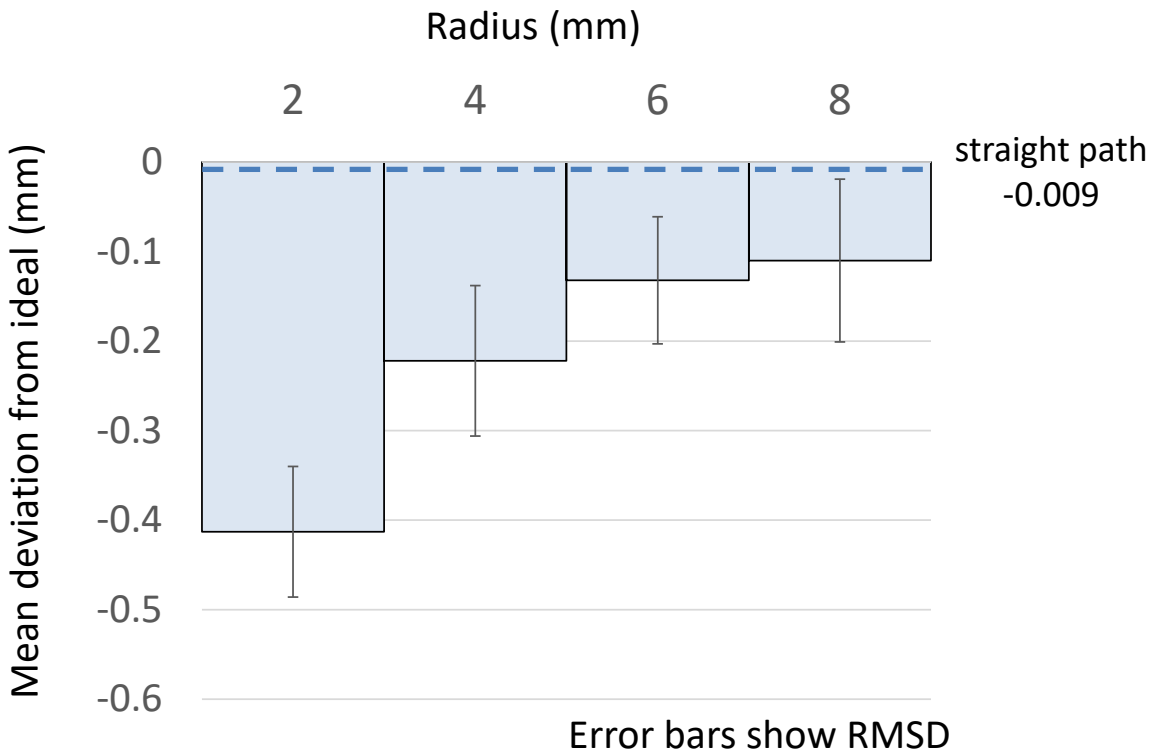
Results – Curves





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Key Advancement

- Statistical characterisation of fibre position
- Range of geometric features

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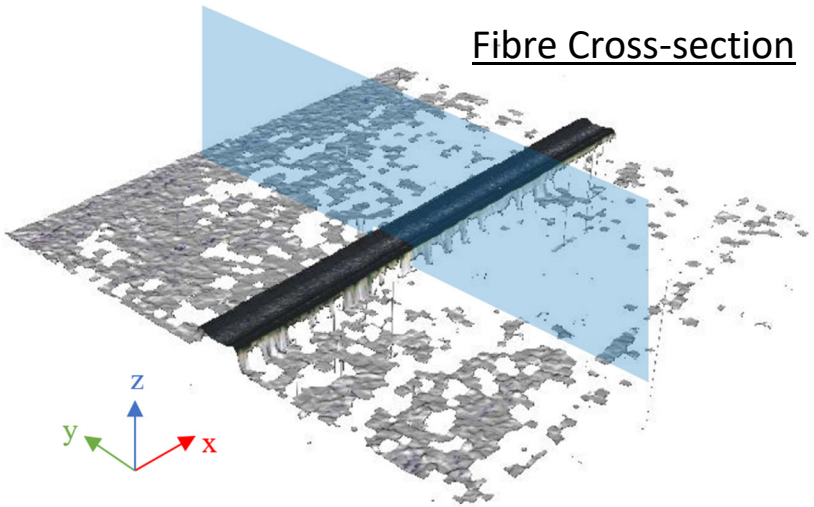
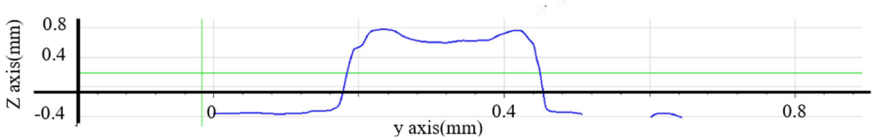
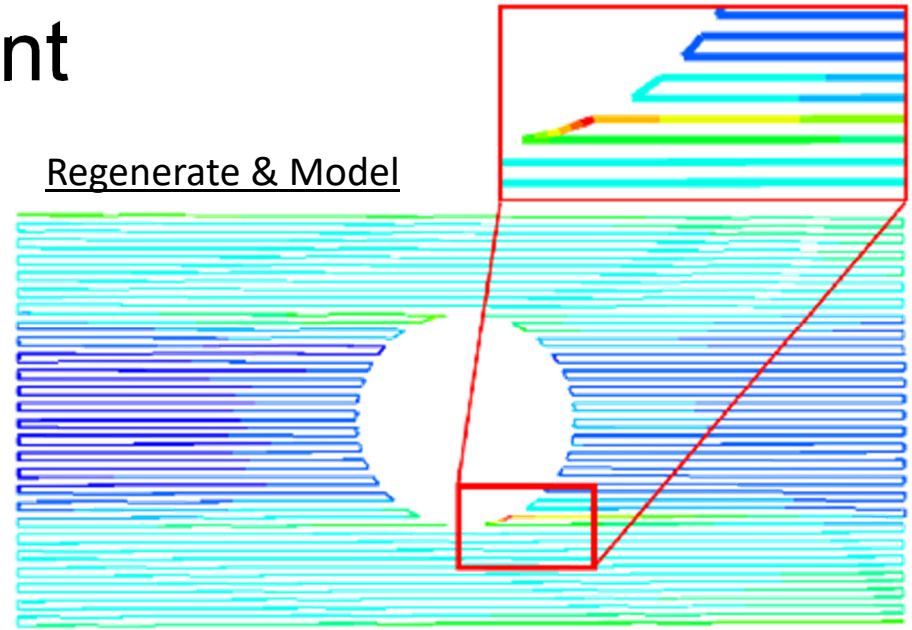
Implications & Future Development

Fibre Cross-section

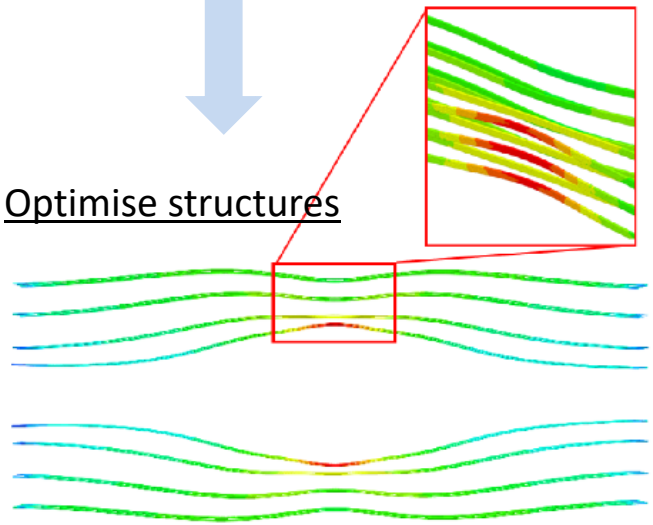




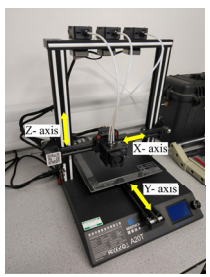
Regenerate & Model

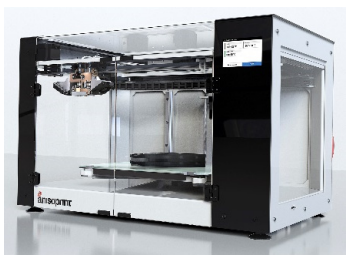


Optimise structures



Benchmarking & Maintenance





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