

Laser Assisted Fibre Placement of Thermoplastic Composites

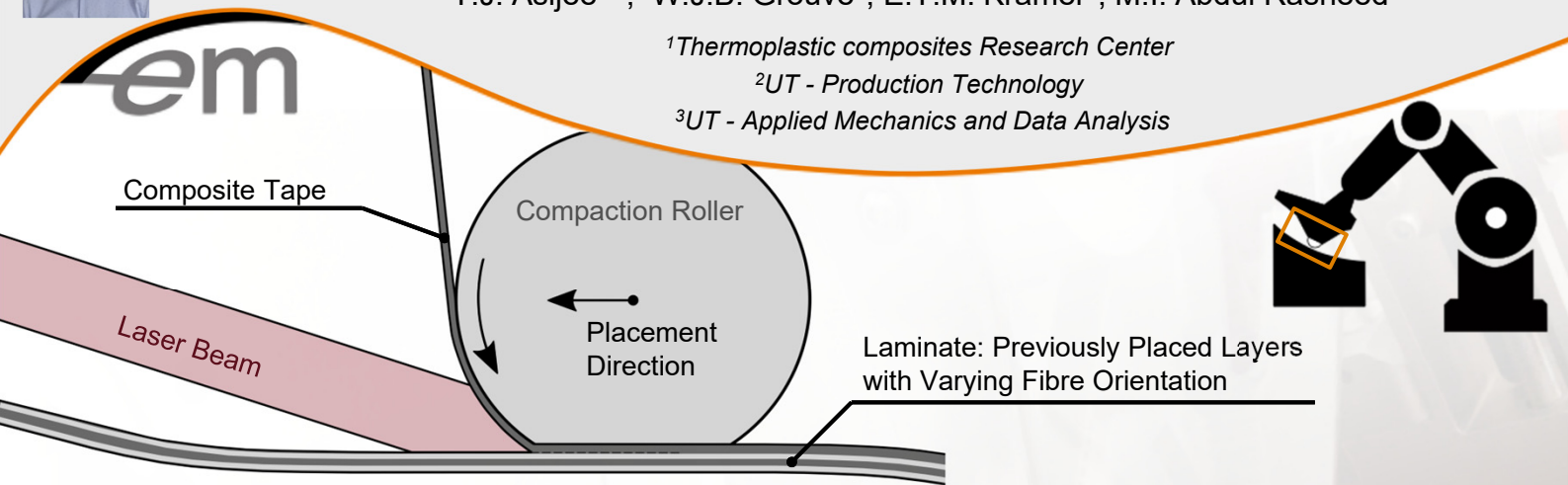
From the theory behind Disney movies to aircraft

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'3D Printing' of Large Composite Panels

Laser assisted fibre placement (LAFP) is an additive manufacturing process for thermoplastic composites. The process relies on a laser to melt a thermoplastic matrix.

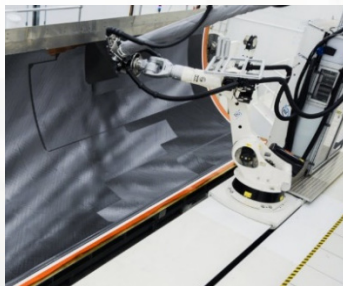


Figure 1: Robot system to produce an 8-meter-long thermoplastic composite fuselage section [1].

By better understanding the interaction of the laser light with the material, the reliability of this manufacturing process can be improved.

Measurement of Light Scatter

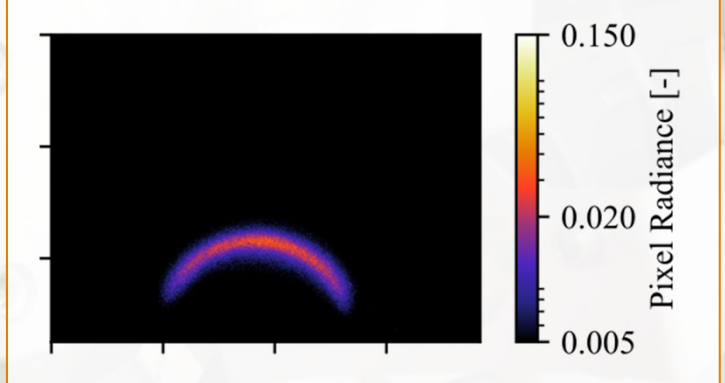


Figure 3: Radiance map for a composite sample with the laser direction aligned with the direction of the fibres.

Effect of Laser Light on a Composite Tape

The scattering behaviour of laser light is characterized experimentally using the setup below. Multiple images are processed into a radiance map using exposure fusion.

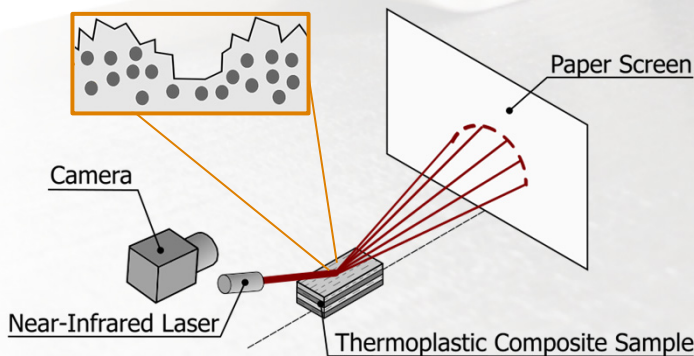


Figure 2: Schematic representation of the light scattering setup with a fibre-reinforced composite sample.

The scattering of light depends on:

- (1) surface roughness
- (2) fibre-matrix distribution
- (3) optical properties of the material

The intensity and direction of the scattered light shows the anisotropic nature of carbon fibre reinforced composites. Numerically, these effects can be captured using Bidirectional Reflectance Distribution Functions (BRDFs), which are widely used in graphics rendering for e.g. animated Disney movies.

Conclusions & Future Work

The measured patterns will be parametrized using a BRDF. This information can then be used to improve simulations of the laser assisted fibre placement process, where this BRDF can be used.

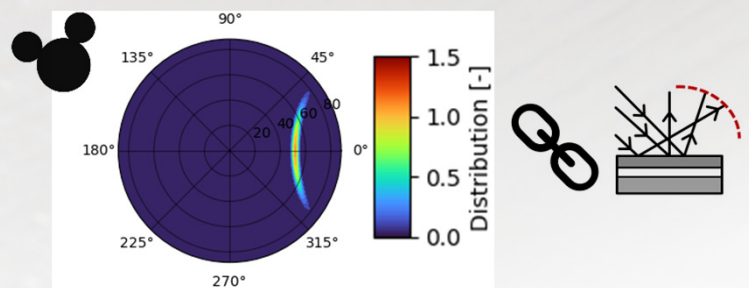


Figure 4: Example polar plot representing the intensity of a BRDF over the hemisphere

[1] G. Nehls, STUNNING project develops 8.5-meter thermoplastic fuselage skin, CompositesWorld, 2021

More information:

