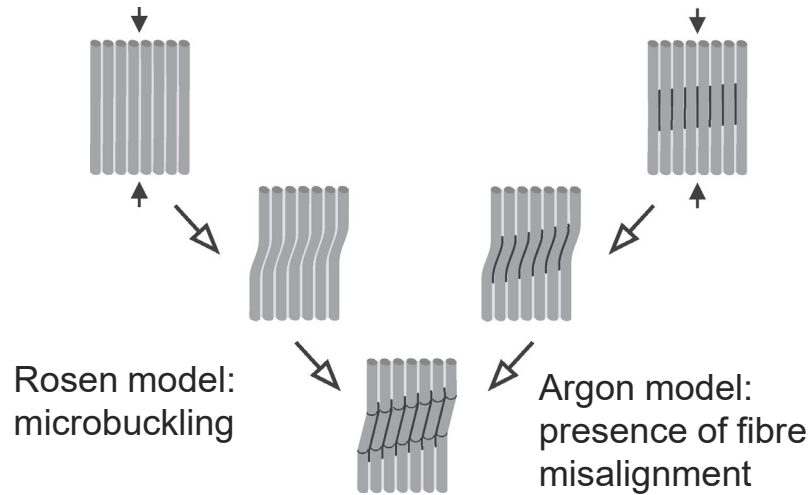


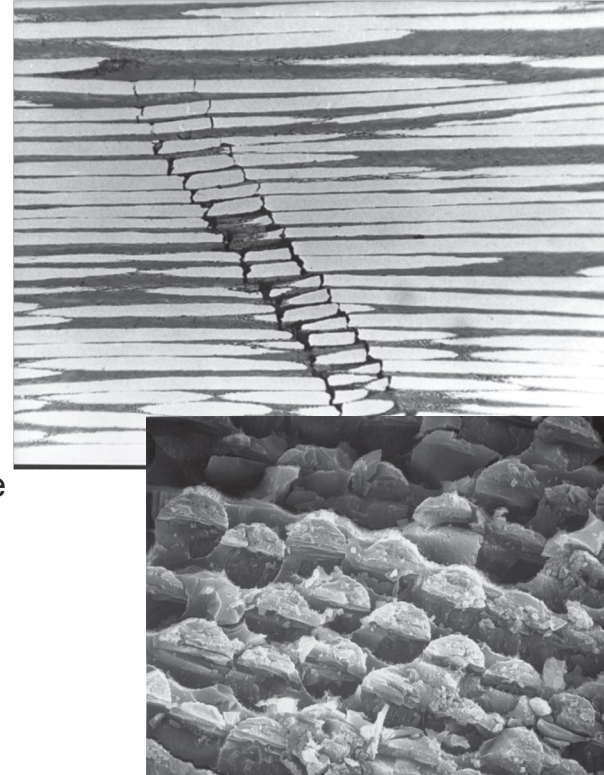
AN EXPECTED THIN-PLY EFFECT ON LONGITUDINAL COMPRESSIVE STRENGTH OF CFRP

Leif Asp, Professor, Department of Industrial and Materials Science

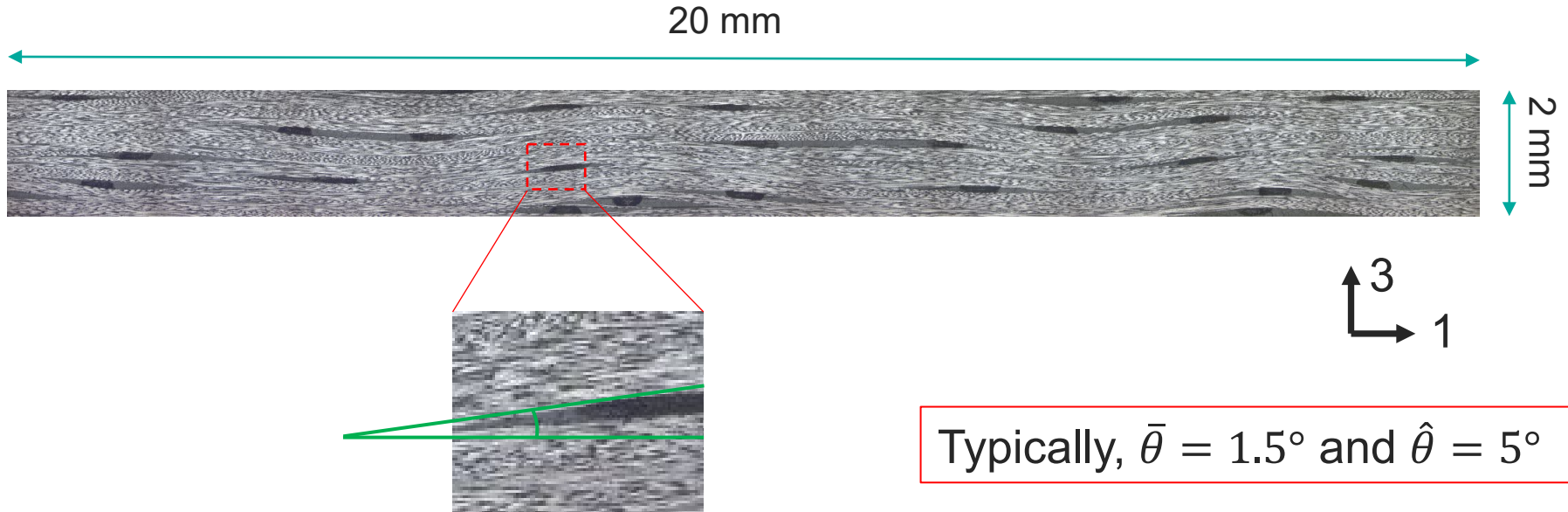
Longitudinal compression (fibre kinking)



Compression strength is dictated by the shear strength of the matrix!



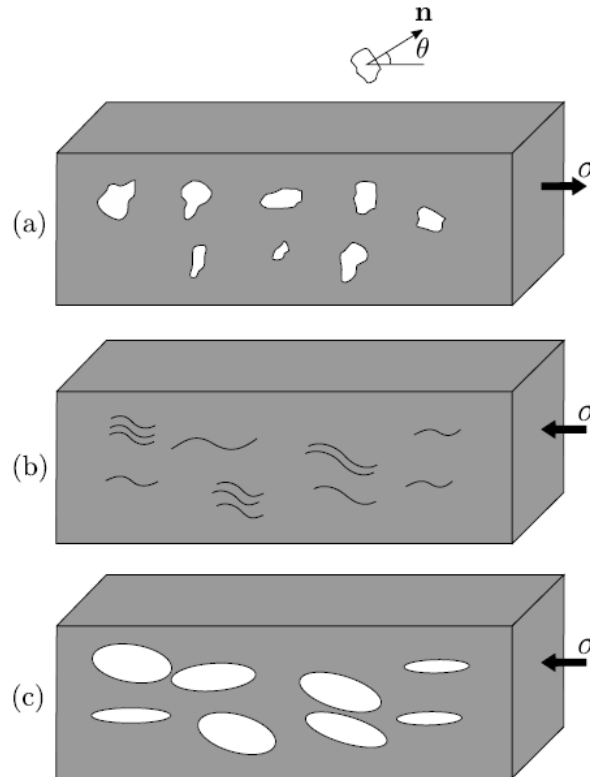
NCF-Example: Waviness out-of-plane



Typically, $\bar{\theta} = 1.5^\circ$ and $\hat{\theta} = 5^\circ$

Fibre misalignment angle from waviness

Strength of brittle materials

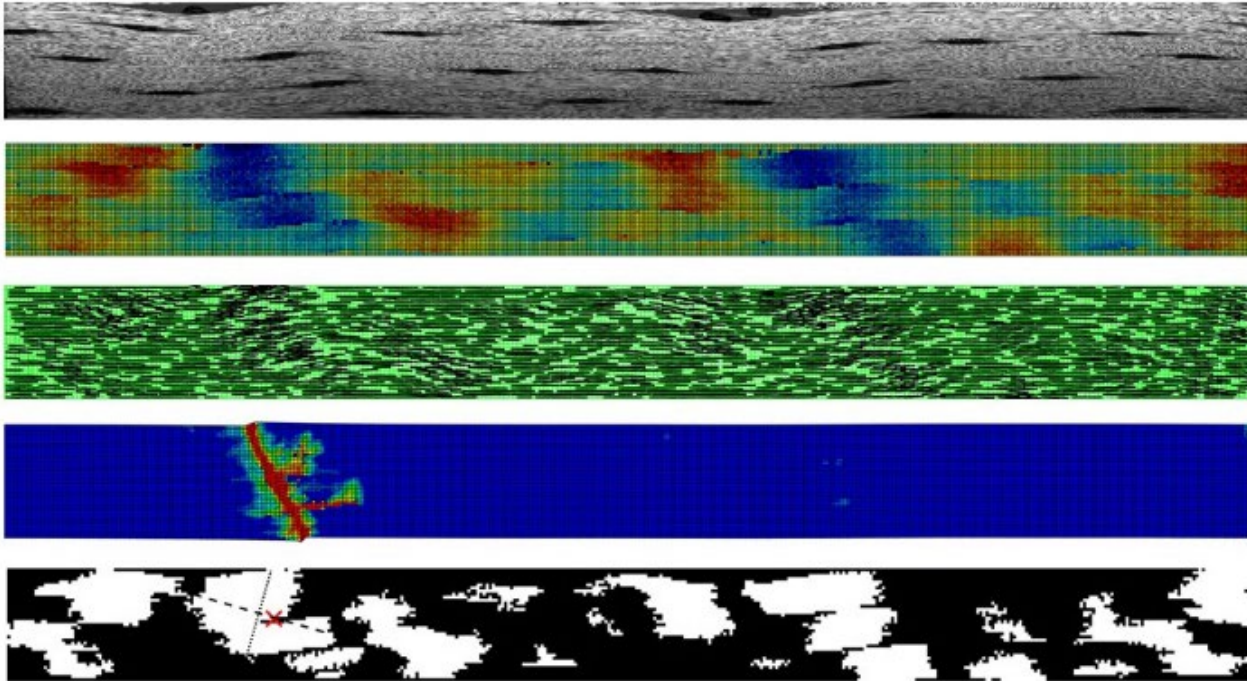


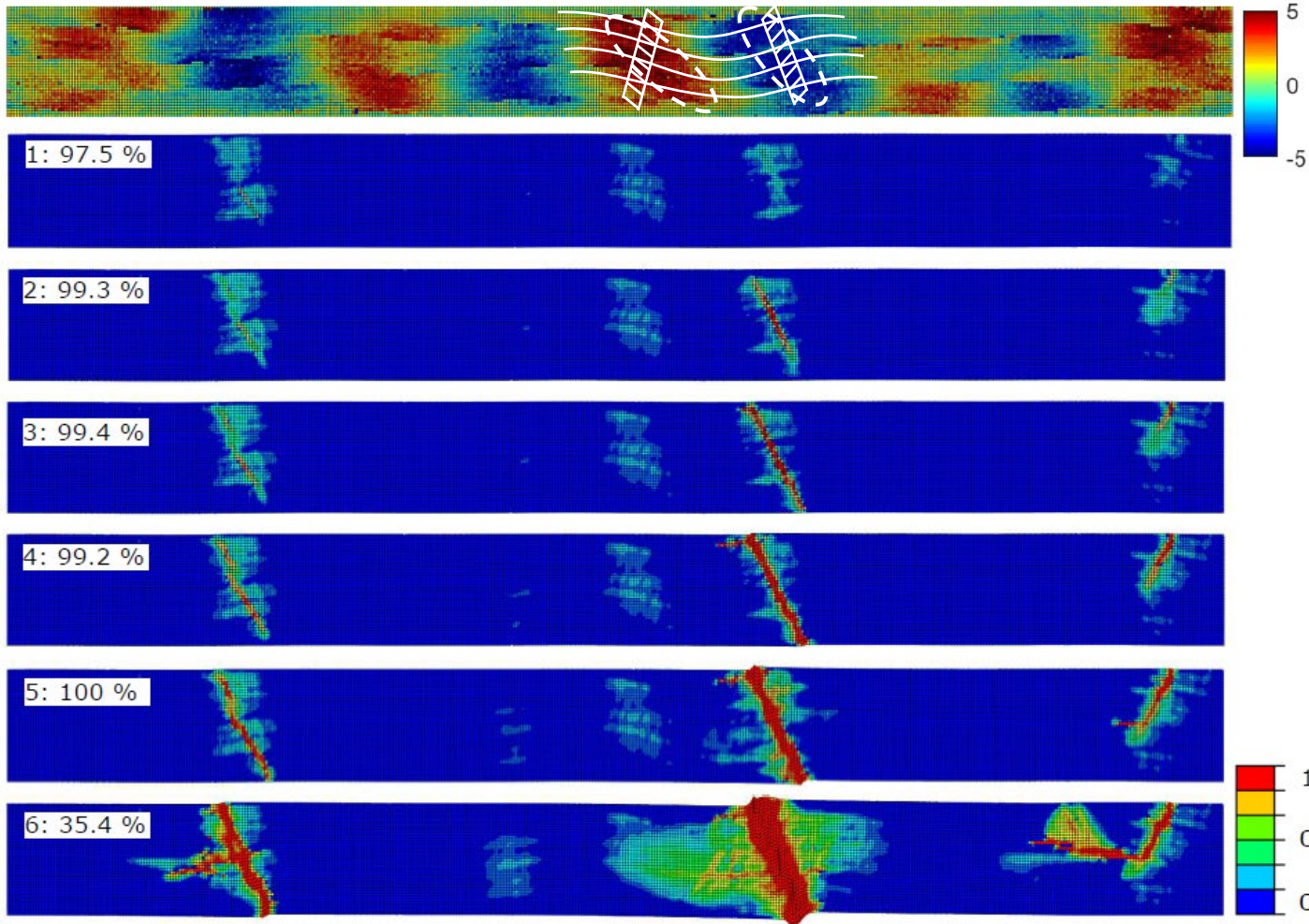
(a) A rectangular region of a brittle material containing defects,

(b) Wavy fibres of different waviness distributions within a polymer matrix UD composite,

(c) White ellipses are regions of the composite influenced by the presence of the wavy fibres shown in (b).

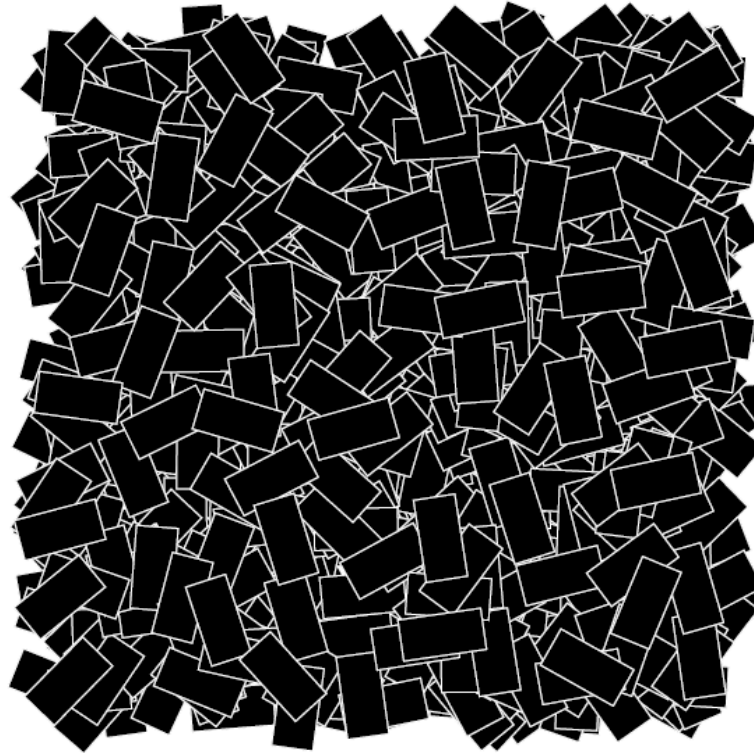
Defect severity in NCF composites



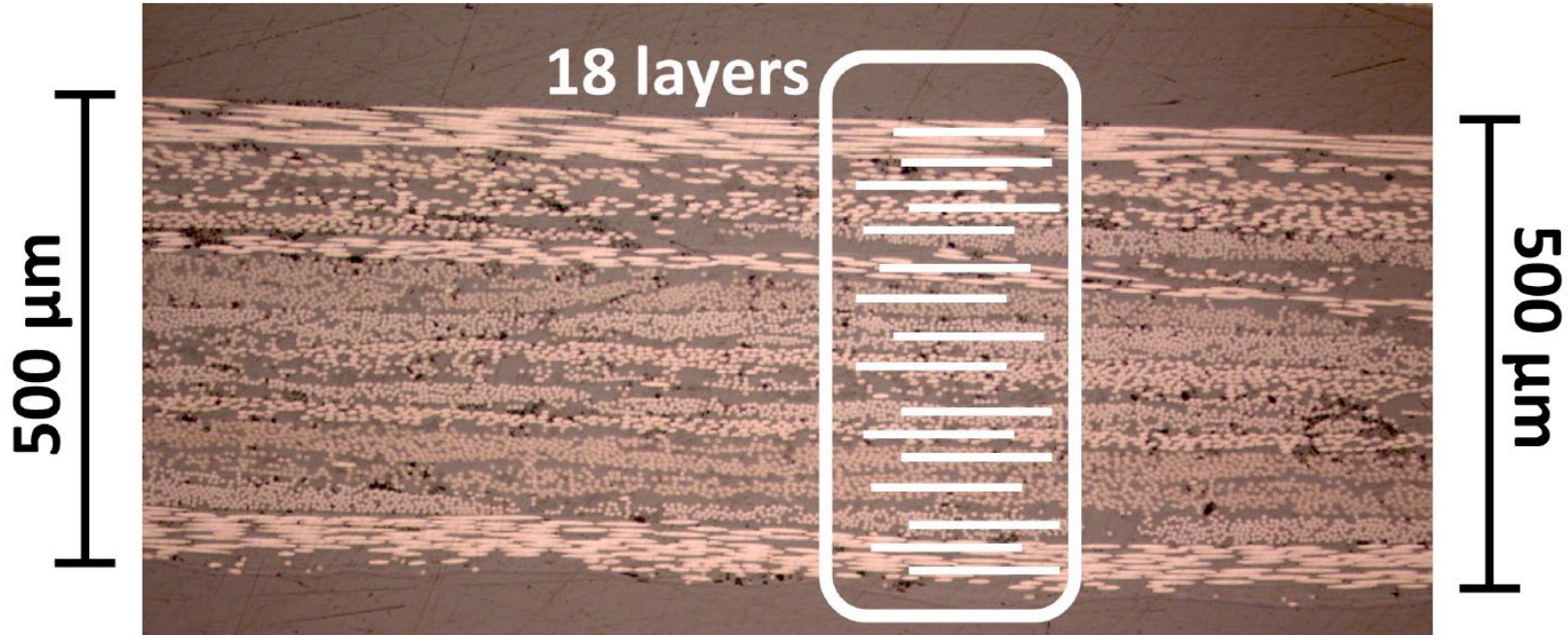


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Thin discontinuous tape-based composites – TBDC

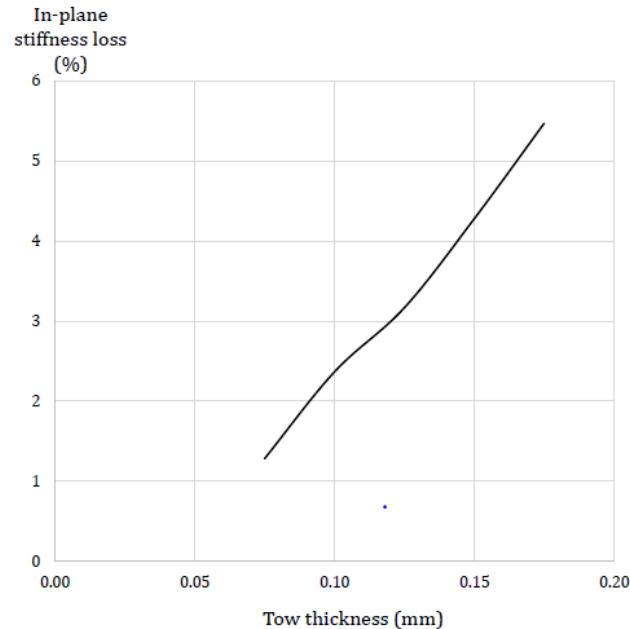


TBDC – for reduced fibre misalignment



Low fibre misalignment – low loss in stiffness and strength!

Equivalent laminate vs. random composite



Graph from Pimenta S., 2017

Conclusions

Compressive failure of UD-composites is driven by fibre kinking. The failure is brittle, and the critical defect is characterized by:

- Maximum fibre misalignment in the defect area (100 % influence)
- Defect extension through-the-thickness (50 % influence)
- Defect zone area (25 % influence)

Thin-ply composites expected to have high compressive strength as they have

- Low out-of-plane fibre misalignment
- Very small through-the-thickness extension
- Small defect zone area

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