H2Crash: Influence of AFP features and low temperatures on delamination

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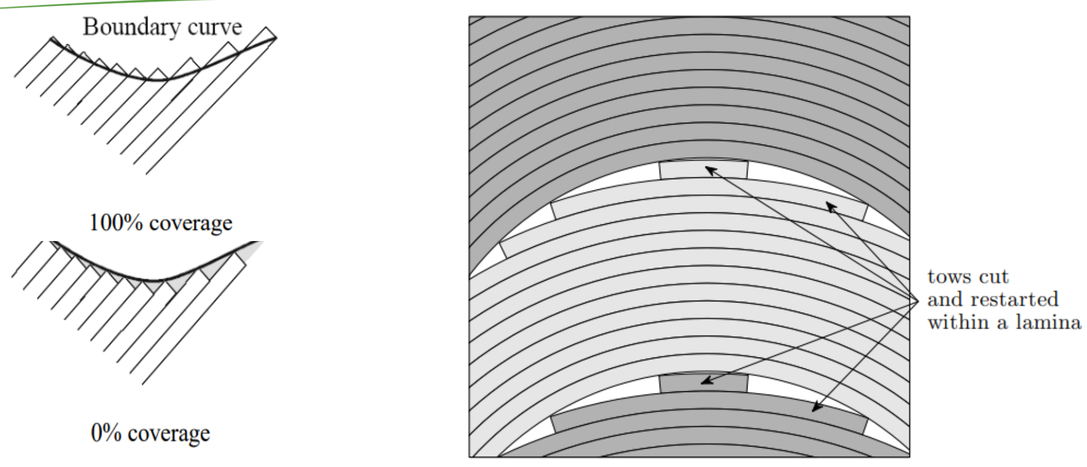
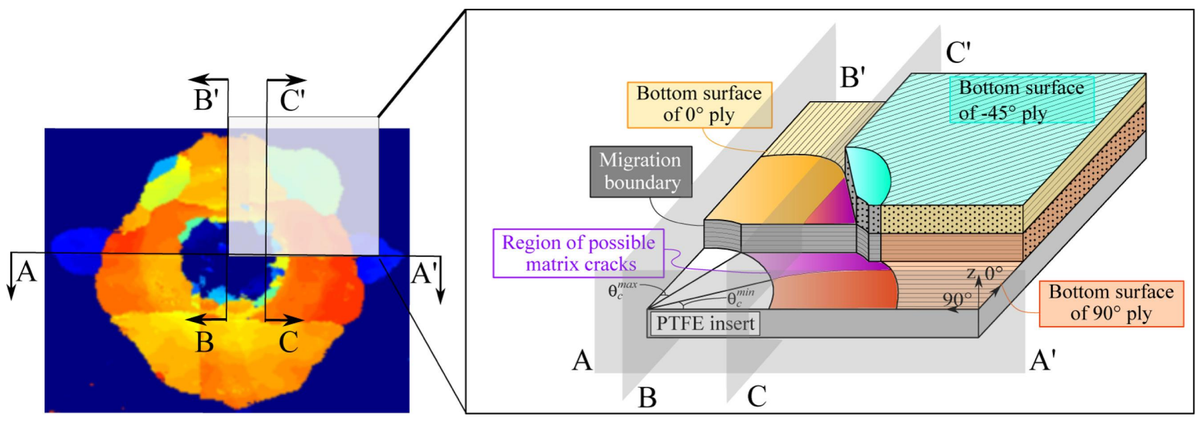
BACKGROUND



Gaps/overlaps in steered fiber laminates [1]



Schematic of typical planar delamination pattern [2]

HOW?

Single defect

Experimental study of delamination triggered by a single gap/overlap with different fiber direction/interface

Cryogenic temperature

Experimental study to assess the impact of cryogenic temperature on damage triggered by gaps/overlaps

Defect interaction

Numerical study of multiple features and how their interaction affect damage initiation

Design Guidelines

Developed from a comprehensive parametric study, both numerical and experimental

H2Crash WP1 : Crashworthiness of hydrogen-powered aircraft

The results of WP2 will be joined to Ioana Ciobotia's WP1

OBJECTIVE(S)

- Better understanding of how AFP induced features affect delamination in composites
- Establish the combined impact of cryogenic temperature and gaps/overlaps on damage tolerance

WHY?

- **Automated Fiber Placement:** AFP is increasingly used in composite manufacturing, but defects remain unavoidable despite process improvements
- **Hydrogen powered aircraft:** Transition to climate neutral aviation demand insight into how defects and cryogenic temperatures jointly affect structural integrity
- **Testing cost:** Better understanding of physics behind composite damage is essential to optimize design and lower testing cost
- **Computational challenges**: Multiscale simulations can be computationally intensive making parametric studies time consuming
- **Experimental challenges:** Conducting measurements in cryogenic temperature present a challenge due to the extreme environmental conditions
- **Material complexity:** Composite heterogeneity and variability introduces uncertainty in fracture behaviour, complicating predictions

RESULTS

The aim of the project is to develop design guidelines that integrates manufacturing defects from Automated Fiber Placement and cryogenic temperature conditions.

[1] A. W. Blom, "Structural performance of fiber-placed, variable-stiffness composite conical and cylindrical shells," PhD, department of aerospace engineering, TU Delft, Delft University of Technology, 2010.
[2] Wenjie Tu, John-Alan Pascoe, René Alderliesten, Planar delamination behaviour of CFRP panels under quasi-static out-of-plane loading,Composite Structures,Volume 339,2024

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