

# MOSKIN

## MORPHING SKIN WITH A TAILORED NON-CONVENTIONAL LAMINATE

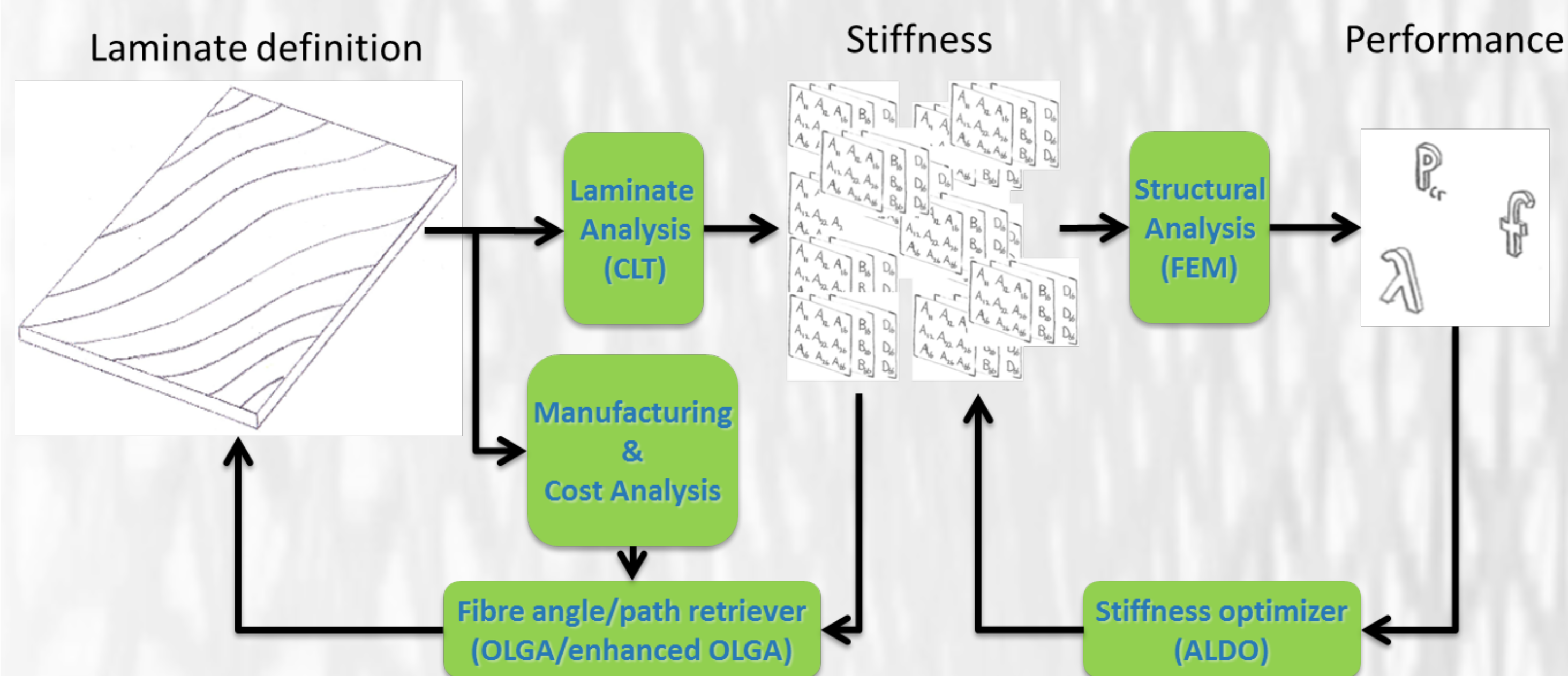
### ABSTRACT

Morphing skins are skins that undergo large deformations and change from one state to the other, mainly to optimally adapt the underlying structure to the real time flight requirements. The design of such skins, e.g. in the leading or trailing edge of an aircraft wing, is contradictory in the sense that the skin has to be flexible enough to be able to deform to the aerodynamically optimal configuration with the minimum required actuation energy and on the other hand has to be stiff enough to withstand aerodynamic loads. Combination of contradicting requirements puts fibre steered and/or variable thickness laminates as promising candidates.

### CONCEPT

**Composite software tool:** Based on a multi-step approach

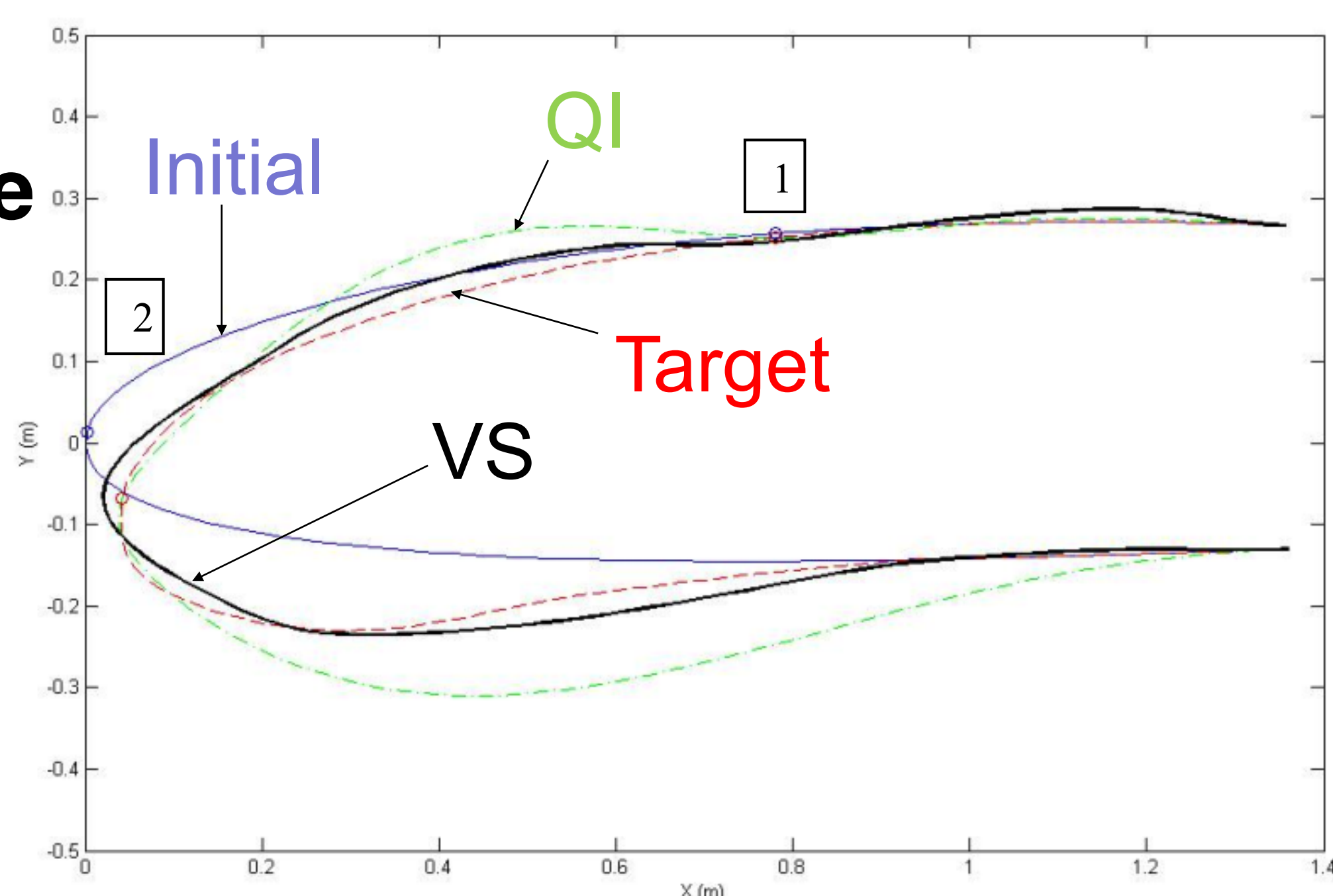
1. Conceptual stiffness design: ALDO
2. Real laminate design: OLGA (enhanced for fibre steering)



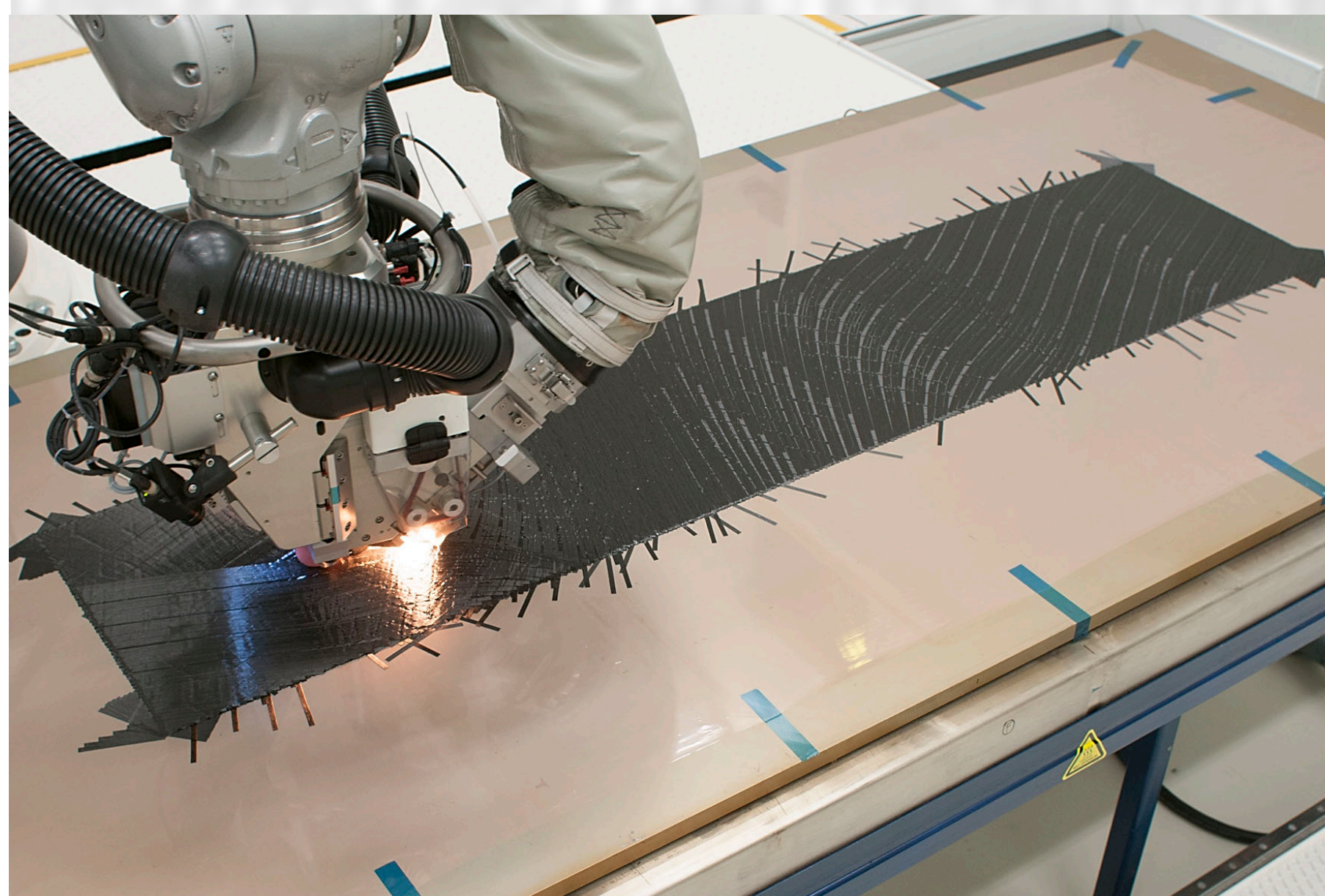
**Conceptual stiffness design:** The requirement for aerodynamic analysis is eliminated by pre-selecting a target shape.

- Objective: Match the target deformation and/or curvature
- Constraints: Maximum allowable strain

**Leading edge stiffness design:** two actuation loads at points 1 & 2



### DEMONSTRATION CASE: flat panel



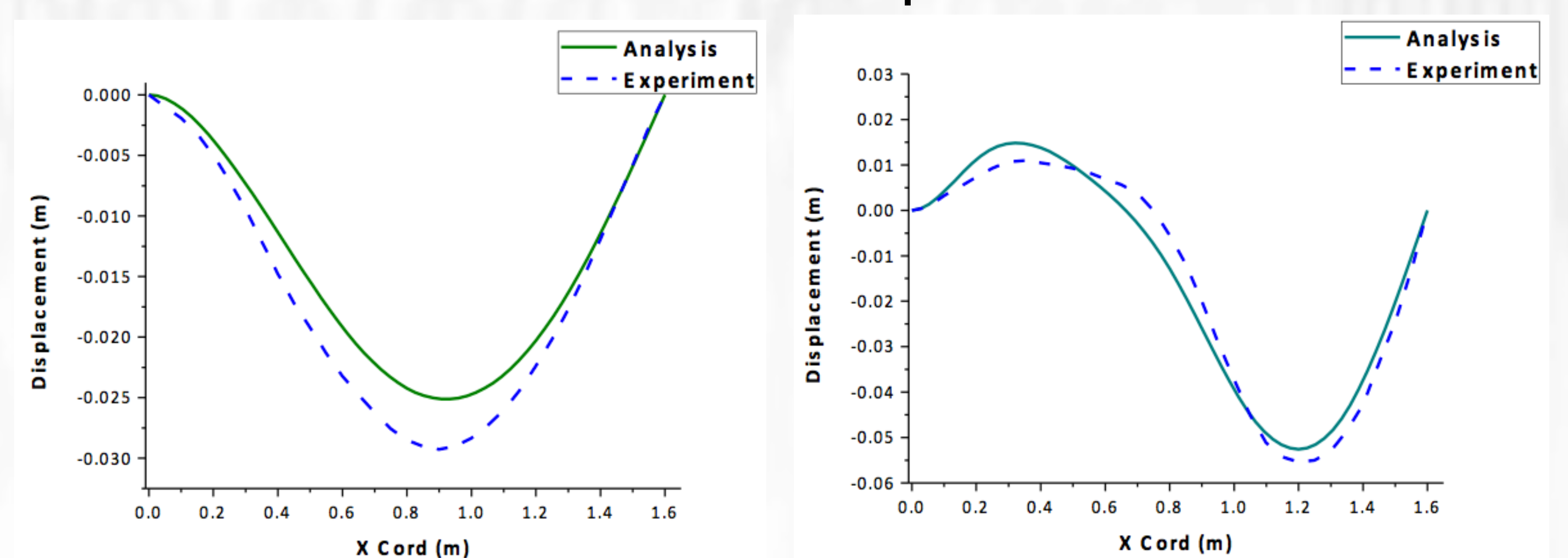
**Manufacturing:**  
Automated Fibre Placement (AFP)  
at NLR

**Testing:** Using electromechanical actuators and weight of sand bags for service loads at UPAT



**Results:** The measured deflections from the test are very close to the finite element analysis results. The discrepancy could be assigned to

- manufacturing strategies and defects
- testing apparatus
- numerical simulation assumptions



a) Under self-weight

b) under weight, actuation and service loads

