Erasmus Mundus Joint Master in Manufacturing 4.0 by intElligent and susTAinable technologies

MASTER's Degree Thesis

Robotic AFP Process Development for Smart Composite Manufacturing of Adaptive Aerospace Structures

Candidate: Cheong Yoo
Supervisors: *Prof. Damjan KLOBCAR (University of Ljubljana), Prof. Sampada Bodkhe (Polytechnique Montréal)*

Abstract:
The aerospace field aims for carbon neutrality by 2050, with adaptive structures reducing fuel use and noise. Achieving these systems requires materials that are lightweight, strong, and deformable, which conventional composites and actuators cannot fully provide. Additive Manufacturing enables smart material integration, while Automated Fiber Placement offers precision. This work develops a robotic AFP process combined with AM, implemented on a 6-axis FANUC robot with an AFP-XS toolhead to generate toolpaths and deposit dry glass fibers on AM-printed molds. Experiments compared actual fiber placement with simulated toolpaths, providing a qualitative check of placement and conformity. Results confirm the feasibility of robotic AFP as a scalable approach for manufacturing multifunctional adaptive aerospace structures. This outcome supports future developments in smart composite manufacturing.

Keywords: automated fiber placement, adaptive aerospace structures, smart composite manufacturing, robotic manufacturing

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