CENTRE FOR FUTURE MATERIALS

The Centre for Future Materials is collaborating closely with MEMKO Systems and Boeing Aerostructures Australia to develop enhanced workflows for the digitisation of composite manufacturing, inspection, and repair processes.

Central to this effort is the creation of digital twins, which have become a cornerstone in implementing digital solutions for composite structures. These technologies are already well advanced and widely adopted across the aerospace, energy, and automotive sectors.

The collaborative team aims to build on the progress made over the past 5–10 years by demonstrating a significant advancement through the transition to digital threads. Unlike digital twins, which represent a virtual model of a physical asset, digital threads encompass the entire lifecycle of a component. They enable seamless data integration from design and manufacturing through to assembly, in-service use, and maintenance, repair and overhaul records.

Achieving a fully integrated digital thread requires a comprehensive understanding of current technologies, particularly the software platform being utilised—Dassault Systèmes' 3DEXPERIENCE suite. These digital twin workflows will be applied in a case

study focused on composite component repair, aiming to streamline engineering and manual processes and enhance the efficiency of maintenance, repair, and overhaul (MRO) operations for future aircraft fleets.

The program is structured into several work packages, with staff and students exploring key elements of the digital thread, especially the interface between the physical and digital realms. The student team is using composite repair as a case study to develop a representative digital thread, divided into three core areas:

- Translating inspection data and other relevant information into a digital environment;
- Developing optimised processes for the design and manufacture of repair patches;
- Monitoring the repair process through in-situ methods to provide feedback into the digital thread.

In parallel, the postdoctoral team is pursuing multiple research avenues aimed at advancing digital tools for composite manufacturing. Their focus areas include:

- In-process monitoring of composite manufacturing using machine learning and AI algorithms;

- Advanced cure monitoring supported by novel sensor networks;
- Development of a comprehensive digital thread framework to identify existing tools and address current gaps that may hinder full implementation.

The Centre is internationally recognised for its pioneering research in engineered fibre composites, with a strong focus on industry-led R&D in advanced composite manufacturing. It houses a suite of automated composite manufacturing technologies, including filament winding, braiding, and automated fibre placement.

The Centre for Future Materials welcomes further collaborative opportunities in the field of advanced composite manufacturing. For more information about the initiatives outlined above or to learn more about the Centre's research capabilities, please contact Dr Tristan Shelley (Senior Research Fellow).

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