Automated composites recycling : Removing the fasteners from the structure

Background

In recent decades, many composite aircraft have been produced. Recycling these composite materials at the end of aircraft's lifecycle is challenging, as they are often incinerated or sent to landfills. This thesis proposes a solution to extract these composite materials from the structures.

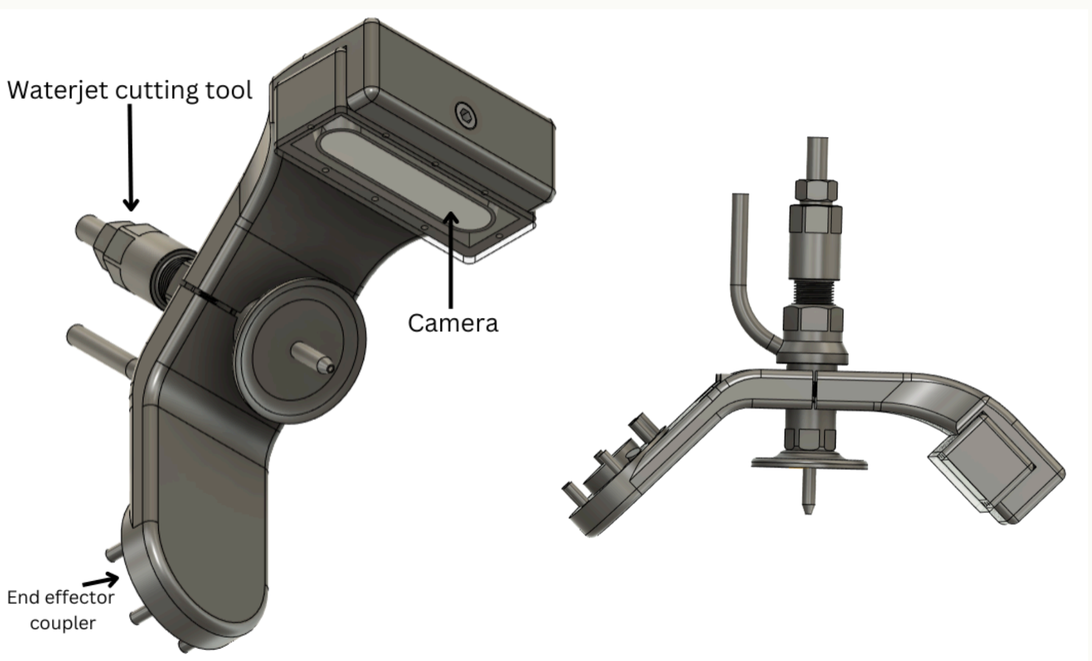
Photo taken at Air Salvage International

Aim and Objective

Research on the development of a robotic system to separate fasteners from an aircraft structure for recycling of composite material.

- Identifying the optimal state-of-the-art technology for cutting aircraft composites.
- Designing the robotic system
- Cost-effectiveness of the system

Design and technical discussion



The waterjet is positioned at 45° to the end effector coupler; camera is at 45° to the waterjet nozzle.

- The integrated camera module scans the workpiece and monitors the cutting process in real-time
- From the feedback of the scans, the waterjet tool cut the composite material around the fasteners

Methodology

- Utilize TRL methodology to structure project requirements and goals
- Conducting a comprehensive literature review on state-of-the-art technologies for optimal robotic system solution
- Conducting a site investigation to study current technology
- After evaluating various cutting technologies, abrasive waterjet cutting was selected for its advantages
- Modelling the end effector for the robotic arm
- Simulate the robotic system's operation

Business Discussion

- Cost of the proposed system: £25000 (Excluding software development and running costs)
- A second-hand robotic arm is considered to reduce system costs
- Cost of selling recycled carbon composites: $18 - $25 per KG [1]
- Return on investment in 2 years

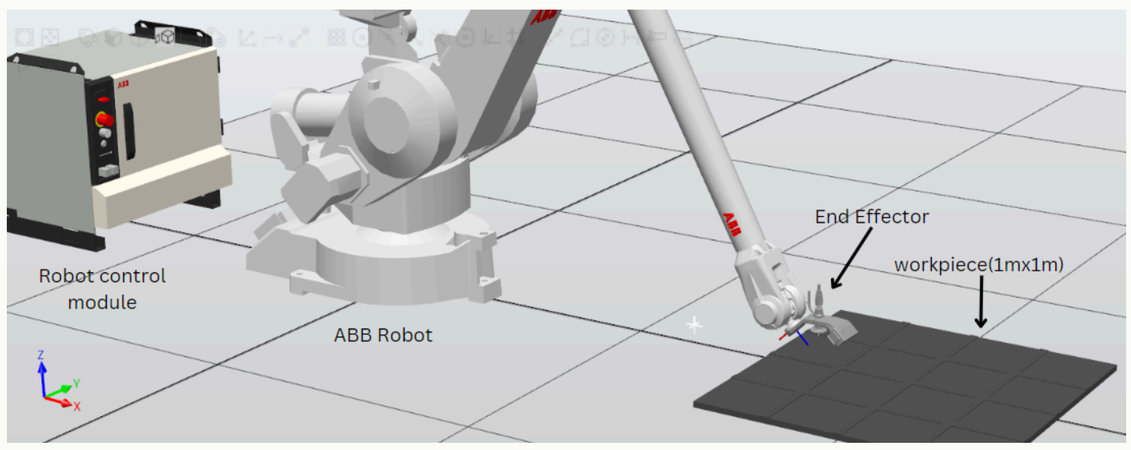


ABB RobotStudio simulation

Conclusion and Future Scope

Integrating waterjet technology with a robotic arm offers precise, efficient, and low-waste cutting of composite materials from decommissioned aircraft. This approach minimizes thermal damage and supports complex cuts, significantly enhancing decommissioning processes. Future developments could focus on AI-driven automation and more compact systems, broadening the technology's application in aerospace and other industries.

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[1] Shehab E, Meiirbekov A, Amantayeva A, Suleimen A, Tokbolat S, Sarfraz S. A Cost Modelling System for Recycling Carbon Fiber-Reinforced Composites. Polymers (Basel). 2021 Dec 1;13(23):4208. doi: 10.3390/polym13234208. PMID: 34883711; PMCID: PMC8659527.