Automated Fibre Placement of Thermoplastic Carbon Fibre / Nylon Material

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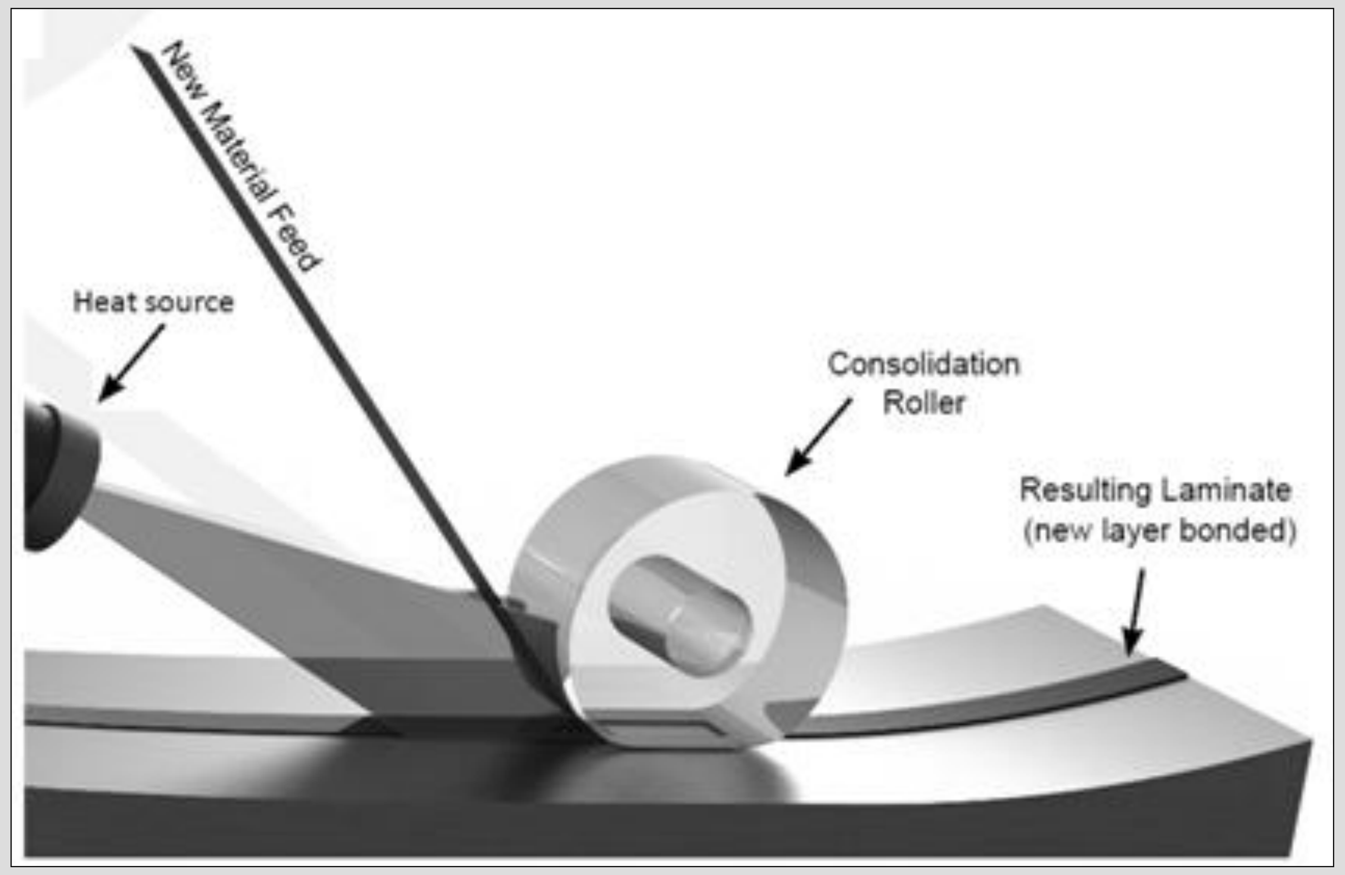
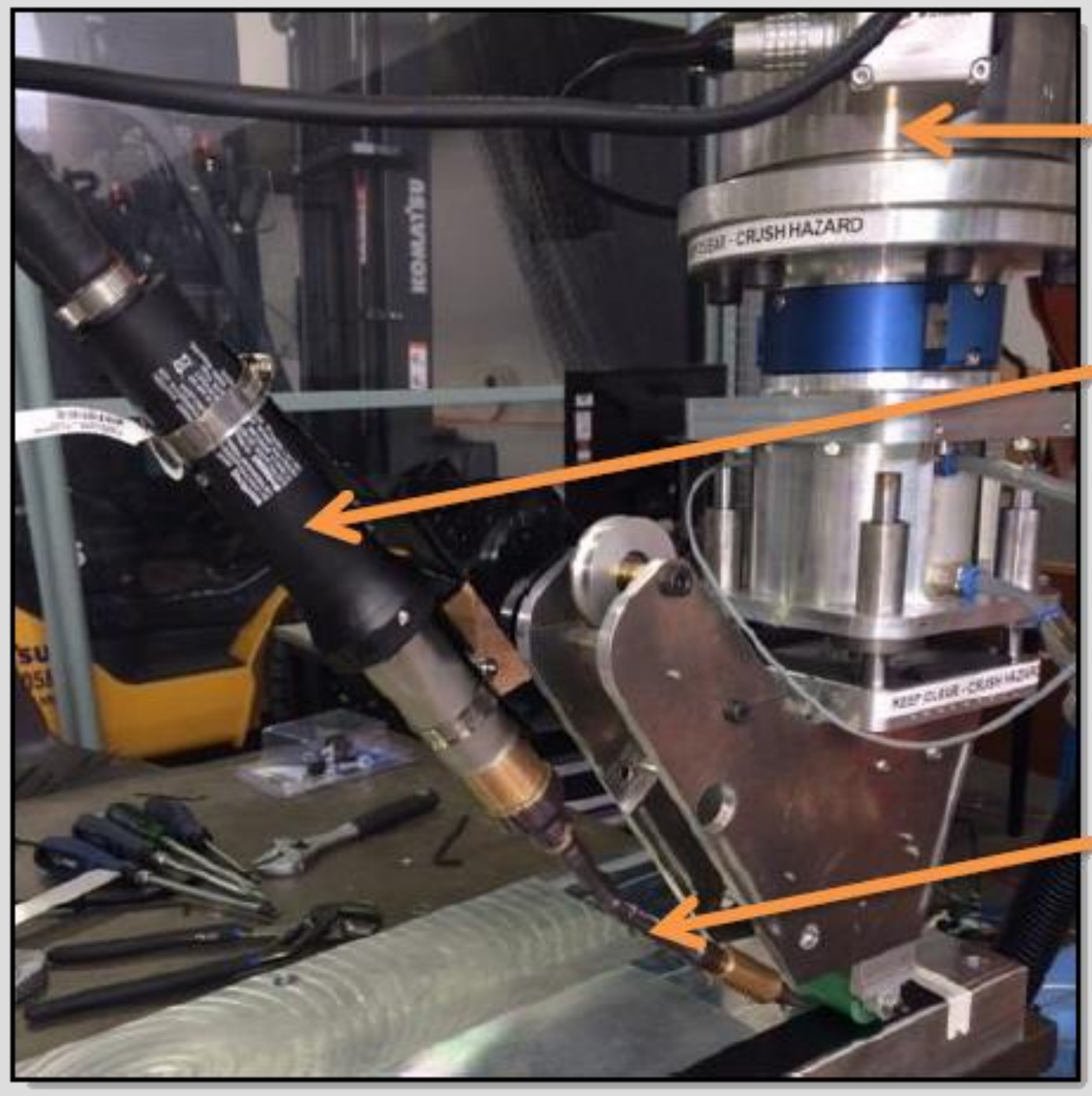
The Material: What is Thermoplastic Carbon Fibre / Nylon ?

Fibre reinforced polymer composites offer high specific strength and stiffness, enhanced fatigue properties and increased design flexibility when compared to metallic counterparts. They are becoming increasingly used in a variety of industries ranging from aerospace and automotive to renewable energy. In particular, thermoplastic composite materials, such as carbon fibre/nylon, are gaining popularity as they can be manufactured without long cycle times (curing in a matter of seconds) and with low levels of emissions.

The Method: What is Automated Fibre Placement (AFP) ?

Automated Fibre Placement (AFP) is an automated manufacturing process consisting of placing composite strips, called tows, which have unidirectional fibers pre-impregnated with resin. The composite tow bands are collimated on an AFP head mounted on an industrial robot and placed on a tool or mold. During placement, the material is delivered to a compaction roller where heat and force are applied to the material.





The Apparatus: How is AFP used at the ANU?

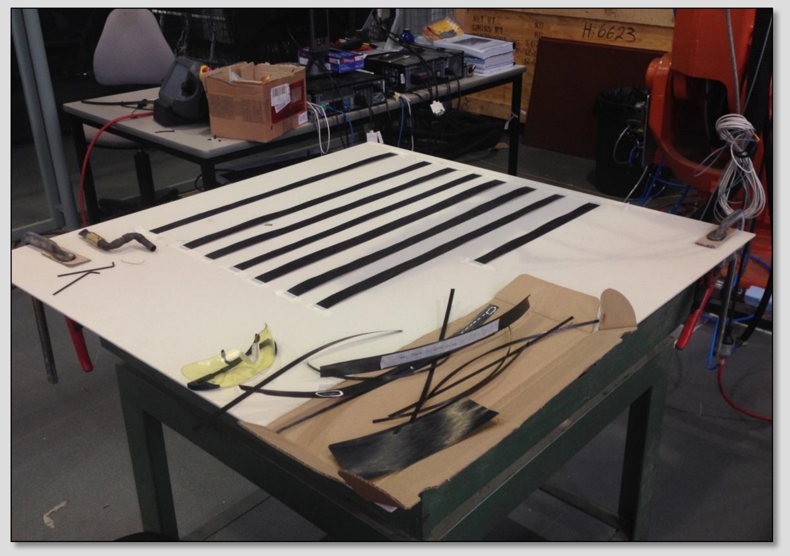
The experimental apparatus at the ANU consists of an ABB IRB6600 industrial robot (2.55m reach and 175kg handling capacity) which is placed in a fixed position within an enclosure.

An AFP head was built and mounted on the robot. It features a heat gun, a cutting system, a tension roller, a custom-made nozzle and a conformable roller. Thermoplastic prepreg tape (carbon fibre/nylon) is fed through a channel and placed under the conformable roller where compaction force and heat are applied for placement on a mould.

The Project: Optimising AFP parameters for Thermoplastic Aerospace Parts

The quality of the materials produced using AFP is highly dependent on the consistency of process parameters. This project focuses on optimising key process parameters by using an off-the-shelf heat gun and a force sensor to set and monitor compaction force.

Operational parameters such as robot velocity, contact force, and applied heat were optimised and resulted in a set of process parameters allowing ANU to produce carbon fibre/nylon parts at a significantly reduced cost compared to commercial turn-key systems. This setup is now being used to investigate manufacturing of prototype aerospace thermoplastic parts for Boeing.



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