

ADVITAC: AUTOMATED MANUFACTURE OF 3-D REINFORCED AEROSPACE STRUCTURES

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Abstract

This study is part of the FP7 project ADVITAC, which focuses on the development of a novel composite tail cone. Innovative aspects concerning the manufacture of the component involve the use of automated dry fibre placement, its combination with through-the-thickness reinforcement via tufting and the online monitoring of the process via optical fibre sensors.

Robotic dry fibre placement is based on the use of bindered tows that allow process outcome quality comparable to that of the traditional prepreg/autoclave route in terms of fibre alignment and fibre volume fraction. The high quality achieved is accompanied by the capability to process using low cost routes such as infusion. This can then be combined with another robotic technology to enhance greatly the delamination cracking resistance of the structure via tufting. Application of through-the-thickness reinforcement is being explored in this project, since localised reinforcement is seen as necessary to achieve truly lightweight integrated composite structures of the future. Tufting causes minimal disturbance of fibre orientations in the in-plane directions, thus preserving the high mechanical performance resulting from dry fibre placement. The improvements in structural performance and process cost implied by these developments are accompanied by advances in the process quality guided by on-line monitoring. Fibre optic sensors are utilised to monitor the progress of critical stages of the manufacturing process, namely resin infusion and cure.

Keywords Automatic fibre placement; robot; tufting; 3D reinforcement; cure monitoring; optical fibre sensor.

1. Robotic dry fibre placement

Fibre placement constitutes a major automated technology for manufacturing a large variety of composites parts in aeronautics. Its advantage towards fabric or large tape lay-up (by hand or other equipment) is mainly the ability to place the fibre at the right place and with the correct angle regarding mechanical characteristics, especially for primary structures. Another advantage is the low level of wastage due to the ability of cutting each

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