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**Automated braiding of a complex aircraft fuselage frame using a non-circular braiding model**

Philippe Monnot[1, *], Jonathan Lévesque[2], Louis Laberge Lebel[1]

[1] Polytechnique Montréal, Department of Mechanical Engineering, C.P. 6079, Succ. Centre-ville, Montréal, H3C 3A7, Québec, Canada (philippe.monnot@polymt.ca, lll@polymtl.ca)

[2] Groupe CTT, 3000, avenue Boullé, Saint-Hyacinthe, J2S 1H9, Québec, Canada (JLevesque@gcttg.com)

[*] Corresponding author

**Abstract**

Braided structural composites have the potential to replace aerospace primary structure traditionally manufactured with preimpregnated fabrics and cured in autoclave. An improved braiding model was developed and applied to a complex fuselage frame technological demonstrator. Numerical case studies were performed in order to assess their effectiveness and to determine the best braiding parameters. A radial braiding machine was coupled to an industrial robot. The fuselage frame demonstrator mandrel was overbraided with carbon fiber yarns. Measured braid angles showed a greater difference than what was expected between the web and the flange faces. Yarn friction and interlacing forces caused the yarns to curve near the edges of the face, therefore causing the measured braid angles to vary along the face width. Moreover, discrepancies in the model's outputs prevented the braid fell front to conform around the severe cross-section variations as well as causing yarn slip over the corners.

**Keywords**

A. Preform, C. Process Modeling, E. Automation, E. Braiding

**1. Introduction**

In the mid 80's, a major development effort was made by NASA and aircraft manufacturers to replace conventional laminated composites by textile structural composites [1]. The highly automated manufacturing processes developed by the textile industry were adapted to produce new cost-effective composites. Weaving, braiding, knitting, and stitching were used to manufacture near-net-shape carbon fiber textile preforms and used as reinforcements for resin transfer molding RTM [2]. Their high damage tolerance properties and cost-saving advantages made them attractive for aircraft primary structures [1, 2]. Thirty years later, prepregs cured in autoclave are still the dominant manufacturing process to produce composite parts in the aerospace industry [3, 4]. The ability to apply high pressure, process a wide variety of materials and obtain high quality parts are well-known. However, low prepreg laydown rates and