

MECHCOMP7

7th International Conference on Mechanics of Composites

Faculty of Engineering, University of Porto, Portugal

1-3 September 2021

Book of Abstracts

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Welcome Address

The abstracts collected in this book represent the proceedings of the conference MECHCOMP7 (7th International Conference on Mechanics of Composites) , 1-3 September 2021. This book aims to help you to follow this Event in a timely and organized manner. Papers are selected by the organizing committee to be presented in virtual/physical format. Such arrangement is due to the effects of the coronavirus COVID-19 pandemic. The event, held at FEUP-Faculty of Engineering, University of Porto (Portugal), follows the success of the first six editions of MECHCOMP. As the previous ones, this event represents an opportunity for the composites community to discuss the latest advances in the various topics in composite materials and structures.

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Morphing of composites

Flexible joints based on corrugated composite laminates: numerical development and manufacturing

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abst. 2026
Room 3
Friday
September 3
09h40

Composite corrugated laminates have been proposed in the last years for many applications in the field of variable shape and adaptive structures. Indeed, the peculiar orthotropic properties of corrugated profiles make possible the development of structural concepts with large deformation capability in the elastic range in selected directions and significant stiffness and strength in other directions [1-3]. In this work, the properties of corrugated composite laminates are exploited to develop an innovative flexible joint concept based on the integration of corrugated composite tubes into a metallic frame. The composite corrugated elements carry torsional loads and sustain a system of relatively thin metallic stiffeners, which transmit axial loads through the flexible joint. The differentiation of load paths and the interaction between composite and metallic parts leads to high bending compliance, high torsional stiffness and remarkable load carrying capability in the axial direction. A series of preliminary numerical studies is reported to show that the structure proposed can be designed to achieve significant bending deflections in the elastic range, still carrying high compressive and torsional loads. The main design parameters are outlined, including the shape of the corrugated profile, the lay-up of the composite laminates and the design of the frame carrying the axial loads. Moreover, the manufacturing issues related to lamination and assembly processes are outlined. Thereafter, a specific application case is taken into consideration, related to a heavy duty transmission joint that must allow relative rotation between the connected elements while transmitting a torque in operational conditions. Moreover, the joint must not collapse under the action of the severe axial loads that arise in a given crash condition. The linear and non-linear models that led to the identification of a solution fulfilling the conflicting requirements of the application case are presented. Results are discussed pointing out the roles of the different parts and the fundamental role played by adhesive junctions, which were completely represented in the detailed models developed. The structural response in crash conditions are assessed through explicit finite element simulations. Finally, the manufacturing process of the joint is presented. The extensive use of elastomeric tools to accomplish composite lamination on double-curvature surfaces is documented. The tests performed on the element confirm that produced prototype met the requirement related to the bending stiffness, deflection capability in elastic range and compressive strength in operational conditions. References [1] Airoldi, A., Sala, G., Di Landro, L., Bettini, P., Gilardelli, A. (2018). Composite Corrugated Laminates for Morphing Applications. In: (a cura di): A. Concilio et al., *Morphing Wing Technologies - Large Commercial Aircraft and Civil Helicopters*. p. 247-276, Cambridge, MA: Butterworth-Heinemann, [2] Airoldi, D., Rigamonti, G., Sala, P., Bettini, E., Villa, A., Nespoli (2021). Development of an actuated corrugated laminate for morphing structures. *The Aeronautical Journal*, vol. 125, p. 180-204 [3] Thill, C., Etches, J.A., Bond, I.P., Potter, K.D., and Weaver, P.M. (2010) Composite corrugated structures for morphing wing skin applications, *Smart Mater. Struct.*, vol., 19

Development of intrinsically heated, interleaved composites with controllable flexural stiffness and shape memory capability

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abst. 2039
Room 1
Thursday
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17h10