PHILIPPE BOISSE-UNIVERSITÉ DE LYON, FRANCE

FIBROUS SHELL APPROACH

FIBROUS SHELL APPROACH AND 3D SECOND GRADIENT MODELING FOR TEXTILE COMPOSITE DRAPING

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DECEMBER 09, 2021 at 11:00 AM US Eastern Standard Time

ABSTRACT

Composite manufacturing processes are often complex and process simulation is a way to avoid costly trial-and-error development. Simulations of composites textile reinforcements draping use shell finite elements for which the bending behavior is very particular. The fibrous composition of the reinforcements significantly reduces the bending stiffness compared to classical materials. Moreover, the kinematics of the deformation is strongly modified and does not follow classical theories such as Kirchhoff's. The objective of this presentation is to show that a fibrous shell approach based on the physics of deformation and especially on the quasi-inextensibility of the fibers makes it possible to correctly model the deformation during forming. In particular, the rotation of the material normal is simulated in good agreement with the forming experiments, which is not the case for the alternative approaches that have been proposed for composite draping. When the textile reinforcements of composites have a significant thickness, the simulations are carried out with 3D elements. It is shown that the classical approaches of Cauchy type (first gradient) are insufficient in the case of fibrous reinforcements. Approaches of second gradient or taking into account the curvature of the fibers can solve these difficulties.

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B I O

Philippe Boisse is a Professor of Mechanical Engineering at Université de Lyon, France. He obtained his PhD at University Paris 6. His fields of research are Composite forming, Textile composites, Mechanics of fibrous/textile materials, Finite element simulations for forming processes and Thermoforming of thermoplastic composites. He is currently President of the French Association for Composites Materials (AMAC). He has been President of the European Association for Material Forming ESAFORM from 2008 to 2012. He is the director of the GDR (Group of Research) CNRS on composite manufacturing. P. Boisse is Associated Editor of the International Journal of Material Forming (Springer). He is a member of the 'Institut Universitaire de France' (IUF).