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Thermoforming simulation of multilayer composites with continuous fibres and thermoplastic matrix

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Abstract: Continuous Fibre Reinforced Thermoplastics (CFRTP) have made their way into the aerospace an automotive industries as structural components. Thermoplastic composites offer many advantages over thermoset composites such as low cycle time and recyclability .

The development of a thermoforming process is complex and expensive to achieve by trial/error. This can be favourably replaced by numerical analyses. A simulation approach for thermoforming of multilayer thermoplastic is presented. Each prepreg layer is modelled by semi-discrete shell elements. These elements consider the tension, in-plane shear and bending behaviour of the ply at different temperatures around the fusion point. The contact/friction during the forming process is taken into account using forward increment Lagrange multipliers. A lubricated friction model is implemented between the layers and for ply/tool friction. Thermal and forming simulations are presented and compared to experimental results. The computed shear angles after forming and wrinkles are in good agreement with the thermoforming experiment. It will be shown by the comparison of two simulations that the temperature field play an important role in the process success.

Keywords: A. Prepreg; B. Thermomechanical, C. Finite element analysis; E. Forming; Thermoforming;

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