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MULTI-SCALE FLUID-STRUCTURE INTERACTION MODELS FOR INTEGRATED PACKAGING SYSTEMS

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The forming process of a carton-based package for liquid food is a difficult industrial problem to simulate. It involves a strong interaction between the filling fluid and the packaging material tube which undergoes large deformations. During the forming process, the cross-section of the carton tube changes abruptly, generating strong pressure waves which propagate along the tube.

In order to better understand the behavior of this complex fluid-structure interaction (FSI) problem and to improve the design capability of the industrial system, a simulation software based on both partitioned and monolithic FSI couplings [1, 2] have been developed and combined through a geometrical (3D-1D-0D) multi-scale approach [3]. All these numerical models have been tested on realistic industrial configurations and integrated with the control model governing the packaging system.

We discuss the stability properties of different FSI algorithms and the role that a multi-scale geometrical approach can play in this kind of problems. We also present the development framework (based on the Modelica language) for the integration of physical models and control systems.

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