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Preface

The arbitrary Lagrangian–Eulerian (ALE) formulation is nowadays firmly established as an alternative to the classical Lagrangian and Eulerian kinematical descriptions of motion. ALE technology is mature enough to be implemented and successfully used by many commercial codes. At the same time, the ALE formulation is still an area of very active research, as this special issue clearly illustrates.

The ALE formulation was first developed in the context of computational fluid dynamics and fluid–structure interaction, and later extended to nonlinear solid mechanics. Due to its generality, it has been applied in a wide range of applications in those three fields.

The aim of the special issue is to offer a broad perspective of current research efforts on ALE methods. Once the fundamentals and basic issues of ALE are clear, more advanced topics are being addressed by researchers. In ALE fluid dynamics, for instance, a major concern is time-integration. Farhat and Geuzaine discuss robust time-integration schemes for the Navier–Stokes equations. Formaggia and Nobile analyze the stability of second-order schemes. Fourestey and Piperno propose a second-order scheme and apply it to wind engineering. Another critical issue, addressed by Margolin and Shashkov, is the mapping of variables after the mesh motion. In ALE fluid–structure interaction, the focus is on sophisticated approaches: Casadei and Potapov deal with nonconforming meshes: Hansbo, Hermansson and Svedberg, with space-time finite elements.

A current trend in ALE nonlinear solid mechanics, clearly reflected in the two-part contribution by Kuhl, Askes and Steinmann, is the use of hyperelastic (or, more generally, hyperelastoplastic) constitutive models. However, ALE hypoelastoplastic models are still the current choice of commercial codes and an active research topic. Gadala proposes a coupled approach for hypoelastoplasticity. Another open field is the treatment of contact, a key issue in the ALE simulation of forming processes. Benson and Okazawa analyze various contact approaches for the simulation of machining. Nackenhorst presents an ALE approach for rolling contact. Boman and Ponthot address the role of lubrication in contact.

The wide applicability of the ALE formulation is also illustrated in this special issue. Bellet and Fachinotti simulate solidification in casting processes. Pantalé, Bacaria, Dalverny, Rakotomalala and Caperaa present a model of metal cutting. Vande Voorde, Vierendeels and Dick develop a mesh generator for rotary flows. Wieckowski models silo discharge. Yamaguchi and Takushima simulate interfacial deformation in fluid layers.

As guest editors, we would like to close this foreward by thanking all the authors and reviewers that made this special issue possible.

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