Space-time methods for compressible flow on moving domains

Patrick Antony[1,*], Norbert Hosters[1] and Marek Behr[1]

[1] Chair for Computational Analysis of Technical Systems (CATS)
Center for Simulation and Data Science (JARA-CSD)
RWTH Aachen University
Schinkelstr. 2 52062 Aachen
{antony,hosters,behr}@cats.rwth-aachen.de, www.cats.rwth-aachen.de

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Compressible flows in moving domains occur in industrial applications such as sealing rings in internal combustion engines, opening and closing valves and many other.

Space-time discretizations can capture moving domains accurately, avoiding additional modeling of domain boundary velocities.

This work uses the combination of a stabilized space-time finite element formulation for compressible flow with the virtual elastic mesh update method established in [1]. The mesh update method offers a way to move interior mesh nodes without expensive re-meshing and projection of the solution. However, for large deformation of interior nodes, tangled elements can occur, compromising mesh conformity. This is a concern especially for complex domain movement, such as topology changes approximated with a residual gap approach [2]. Effectiveness of remedies for the latter, such as additional constraints for the node movement are discussed and performance of the overall approach is evaluated. We present results for mass transport through a sealing ring pack.

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