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FAST SOLVERS FOR TIME DEPENDENT THERMAL FLUID-STRUCTURE INTERACTION

Philipp Birken[1], Tobias Gleim[2], Detlef Kuhl[2] and Andreas Meister[3]

[1] University of Lund, Centre for the Mathematical Sciences, Box 118, 22100 Lund, Sweden, philipp.birken@na.lu.se and http://www.maths.lu.se/staff/philipp_birken
[2] University of Kassel, Institute of Mechanics and Dynamics, Mönchebergstr. 7, 34109 Kassel, Germany, gleim,kuhl@uni-kassel.de, http://www.uni-kassel.de/fb14bau/en/institute/ibsd/baumechanikbaudynamik
[3] University of Kassel, Institute of Mathematics, Heinrich-Plett-Str. 40, 34132 Kassel, Germany, meister@mathematik.uni-kassel.de, http://www.mathematik.uni-kassel.de/ meister

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We consider thermal fluid structure interaction to model industrial gas quenching in steel forging, where hot steel is cooled using cold high pressured gas. This allows to define properties of the finished steel part locally at low cost and without environmental problems.

For the numerical simulation, a partitioned approach via a Dirichlet-Neumann coupling and a fixed point iteration is employed. In time, previously developed efficient time adaptive higher order time integration schemes are used [1]. The respective models are the compressible Navier-Stokes equations and the nonlinear heat equation, where the parameter functions are obtained from measurements on a specific steel. To validate the method, results are compared to inhouse experiments, where a heated plate is placed in the local wind tunnel and subsequently cooled by the crossflow.

Furthermore, the use of different vector extrapolation methods for convergence acceleration techniques of the fixed point iteration is analyzed [2]. In particular, Aitken relaxation and minimal polynomial extrapolation (MPE) are considered. Finally, we consider the use of extrapolation inside the time integration scheme to find a suitable initial guess for the nonlinear systems.

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