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Optimal Control of Thermo–Fluid Phenomena in Variable Domains OLEG VOLKOV, BARTOSZ PROTAS, McMaster University, Canada — This presentation concerns our continued research on adjoint–based optimization of viscous incompressible flows (the Navier–Stokes problem) coupled with heat conduction involving change of phase (the Stefan problem), and occurring in domains with variable boundaries. This problem is motivated by optimization of advanced welding techniques used in automotive manufacturing, where the goal is to determine an optimal heat input, so as to obtain a desired shape of the weld pool surface upon solidification. We argue that computation of sensitivities (gradients) in such free–boundary problems requires the use of the shape–differential calculus as a key ingredient. We also show that, with such tools available, the computational solution of the direct and inverse (optimization) problems can in fact be achieved in a similar manner and in a comparable computational time. Our presentation will address certain mathematical and computational aspects of the method. As an illustration we will consider the two–phase Stefan problem with contact point singularities where our approach allows us to obtain a thermodynamically consistent solution.

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