Recent Advances in Riccati-Feedback Stabilization of a Two-Phase Stefan Problem

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Our goal is the linear-quadratic feedback stabilization of a two-dimensional two-phase Stefan problem. The Stefan problem can model solidification and melting of pure materials and gets its name from the purely algebraic Stefan condition which describes the coupling between the temperature of the material and its melting process.

After linearization and discretization, the stabilization problem results in anon-autonomous differential Riccati equation (DRE) with differential-algebraic structure. The two phases in the domain evolve, which causes all coefficients of the resulting DRE to be time-varying. The problem specific collocation of Dirichlet conditions and outputs require special techniques for the finite element discretization.

Since all coefficients are time-varying, existing DRE solvers have to be adapted to this highly non-autonomous case which has significantly increased computational costs and memory requirements. We present the most recent techniques to tackle the difficulties and show first results of the application of our feedback stabilization.