Atelier
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Numerical challenges in solving interface and boundary problems on regular Cartesian grids

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Problems involving complicated deforming time-dependent boundaries or interfaces (i.e. codim-1 surfaces) are ubiquitous in the modeling of physical systems. The resulting Partial Differential Equations (PDEs) often have irregular, and even discontinuous solutions along these surfaces. In turn, the solution of these PDEs couples back to the flow and hence deform the surfaces in question. The numerical approximation of such systems is notoriously challenging.

I will present several techniques to deal with the fundamental problem of achieving high-order numerical convergence for such systems. The common themes in these techniques is that they consider the interface (or boundary) as sharp, the computation is performed on a Cartesian grid, and special attention is given to computational efficiency.

Throughout the talk I will illustrate these approaches with simulations of various physical systems including problems from fluid dynamics (two-phase flow), electromagnetism, and solid.

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