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Least-Squares Finite Element Method and Nested Iteration for Spatially Variable Temperatures in a Two-Fluid Plasma

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Previously, the authors introduced a scalable solution technique for an electromagnetic, two-fluid plasma (TFP) model that utilized least-squares finite elements, nested iteration, and adaptive mesh refinement [1]. The system under investigation used a naive adiabatic (constant) temperature model. Such an assumption was key in designing a scaling and modification of the TFP model to produce optimal finite element performance, and linear systems amenable to solution with Algebraic Multigrid (AMG). To efficiently focus computational resources, an adaptive mesh refinement scheme was used.

In this talk, we discuss the recent exploration of spatially variable temperature models. The motivation is twofold: (1) many fluid-based temperature closures can simply be lagged in nonlinear iteration or nested iteration with little overhead, and (2) the ability to provide a kinetic-based closure becomes viable. Without loss of generality, we focus on the former and consider how the previous solution technique is modified in order to handle such variability while maintaining scalability and efficiency.

[1] C. A. Leibs, T. A. Manteuffel, SIAM Journal on Scientific Computing, 37(5):S314-S333, 2015.