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Adaptive time-stepping in fusion plasma simulations with MFEM[1] MARK STOWELL, Lawrence Livermore Natl Lab, JEREMY LORE, DAVID GREEN, Oak Ridge Natl Lab — The simulation of magnetized plasma transport using the fluid approximation is ubiquitous in the study of fusion devices. However, the extreme anisotropy of the diffusion coefficients and their non-linear dependence on state variables make time-step selection both very important and non-trivial. The nature of the diffusion equation suggests that small time-steps are needed whenever small scale structure must be captured by the simulation and much larger time-steps can be appropriate as the solution approaches a steady state. Unfortunately, the non-linear character of the diffusion coefficients make these general rules-of-thumb difficult to use in practice. We investigate time-step selection based on a proportional-integral-derivative controller (PID controller) which is a type of feedback control system. The controller makes use of an estimate of the solution error and attempts to choose the largest time-step which restricts this error below some target. Here we present progress on using this technique coupled with a high-order finite element simulation of a non-linear advection-diffusion transport equation.

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