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Stable drag extrapolation formulas for dispersed multiphase flow models

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Euler–Euler fluid models are used in various fields to describe multiphase dispersions. Each fluid in the system fulfils its own balance equations, all of which are interconnected through coupling forces. Among them, nonlinear drag forces play a central role in fluid–fluid and fluid–particle interactions. Fully implicit schemes are often prohibitive, as they force all phase equations into one large, complex, monolithic block. Therefore, extrapolated drag terms are computationally attractive: they can eliminate costly nonlinearities and interphase couplings. Yet explicit approximations must be carefully designed so as not to cause unstable energy growth. In this talk, we will see first- and second-order extrapolation formulas for the drag term and show how they can preserve desired dissipative properties and unconditional numerical stability. This enables the design of efficient, fully decoupled multiphase solvers without CFL conditions.

References

- [1] D.R.Q. Pacheco: Stable first- and second-order drag extrapolation formulas for Euler–Euler multiphase flows. *Journal of Scientific Computing*, 107(1) (2026), 27.
- [2] D.R.Q. Pacheco: A fully decoupled, iteration-free, unconditionally stable fractional-step scheme for dispersed multi-phase flows. *Computer Methods in Applied Mechanics and Engineering*, 436 (2025), 117712.