Asymptotic preserving and energy stable numerical schemes for barotropic Euler equations

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The asymptotic preserving numerical methods for low Mach number Euler equations are becoming popular, due to their CFL time step restriction being independent of the small parameter (Mach number). Besides their asymptotic preserving properties that are crucial in order to obtain uniformly consistent and stable approximations of the Euler equations in their singular limit as the Mach number approaches zero, our aim is also to preserve discrete energy stability. A suitable acoustic/advection splitting approach combined with time implicit-explicit approximations is used to achieve the asymptotic preserving property. Different space discretisation strategies are considered, and their energy stability is studied for different values of Mach number. The asymptotic preserving and energy stability properties are validated by the numerical experiments.

1 References

1. Megala Anandan, Mária Lukáčová-Medvid'ová and S. V. Raghurama Rao, An asymptotic preserving scheme satisfying entropy stability for the barotropic Euler system, arXiv: 2503.07284, 2025.

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