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# Stability analysis of finite volume schemes on staggered grids

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In the field of nuclear energy, computations of complex two-phase flows are required for the design and safety studies of nuclear reactors. In general, there exists two families of numerical methods for the simulation of two-phase flows. Firstly, colocated schemes ([2]) are usually used on unstructured meshes where the unknowns are located in the same place (cell-centered). On the other hand, staggered schemes are mainly used on structured meshes with unknows located either on edges or cell centers. This category of schemes has a good behaviour for almost incompressible flows and is commonly used within Computational Fluid Dynamics softwares. However, there are few references for their stability analysis, [1, 3, 4].
This work is dedicated to the understanding of the theoretical properties of finite volume schemes on staggered grids. We develop a rigorous framework for the linear $L^2$-stability analysis of classical staggered schemes and propose a class of conservative $L^2$-stable staggered schemes. This question is addressed by analysing their numerical diffusion operator that gives a new insight into these schemes. In addition, we derive a class of conservative entropic staggered schemes. Some analytical numerical examples will be presented on the solution of the isentropic Euler equations with the purpose of illustrating the technique and its performance. Nevertheless, the procedure derived is very general and could be applied to two-phase flows models.

References

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