Mathematical and numerical analysis of a simplified model for boiling flows

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We study an homogenized model describing boiling flows. Such flows are described by an hyperbolic system of equations of Euler type with a source term that is defined as a discontinuous function of the unknown. Such a source models the heat injected in the system and the creation of vapor appearing only when the enthalpy is above a certain boiling threshold.

The discontinuity of the source leads to difficulties both at theoretical and numerical levels. At the theoretical level, "classic" theory is not sufficient when considering discontinuous function in the equation as it commonly requires a higher regularity to obtain well-posedness of the equations. At the numerical level, naive numerical schemes commonly create artifacts and fail to capture steady states. We investigate these issues on simplified models.

REFERENCES

[1] I. Toumi, A. Bergeron, D. Gallo, E. Royer and D. Caruge. Flica-4: A three-dimensional two-phase flow computer code with advanced numerical methods for nuclear applications. *Nuclear Engineering and Design*, vol. **200**, 2000.

[2] T. Pichard, Existence of steady two-phase flows with discontinuous boiling effects. *Proc. Hyp. 2018, AIMS on Appl. Math.*, Vol. **10**, pp. 603–610, 2020. T. P., , Proc. HYP conf. 2018, AIMS on Appl. Math., 10, pp. 603-610, pdf

[3] T. Pichard, N. Aguillon, B. Després, E. Godlewski and M. Ndjinga, Existence and uniqueness of generalized solutions to hyperbolic systems with linear fluxes and stiff sources. *J. Hyp. Diff. Eqt.*, Vol. **18**, pp. 653–700, 2021.