SIMULATION OF MIXED FLOWS IN PIPES WITH A COMPRESSIBLE TWO-LAYER MODEL INCLUDING AIR POCKETS ENTRAPMENT

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Abstract. The present work focuses on air-water flows in pipes. In particular, it deals with the so-called mixed flows which occur in piping systems of several industrial areas such as nuclear and hydraulic power plants or sewage pipelines. This type of flow involves stratified regimes driven by *slow* gravity waves, pressurized regimes (pipe full of water or air) driven by *fast* acoustic waves and traveling air pockets. Due to the different nature of each regime, numerous modelling and numerical issues are tackled. In that context, an hyperbolic compressible two-layer model is proposed by the authors in [1] accounting for air-water interactions. Regarding the discrete level, classical explicit schemes bring large numerical diffusivity in the *slow* stratified regime. Thus, a fractional step method is derived to split the *slow* dynamics from the *fast* dynamics and adapt the numerical treatment. Furthermore, an implicit-explicit (IMEX) time discretization is also proposed to end up with a large time-step scheme and get accuracy in the stratified regime. The overall approach is driven by the fast pressure relaxation and the shallow-water structure of the system. Numerical experiments are performed considering firstly the academical dam-break problem. Laboratory test cases involving regime transitions and entrapped air pockets are then presented. Finally, the numerical results in a mixed flow configuration are confronted to experimental data recently provided in [4].

References

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