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A 0D/3D nodal-CFD method of cylindrical pressurized tanks[1]
ALIREZA MORADIKAZEROUNI, MEHDI VAHAB, KOUROSH SHOELE, Florida State University — The current study focused on developing a novel method for modeling a closed pressurized cylindrical tank driven by natural convection. The conventional techniques for capturing the physic and thermodynamic in such systems are the nodal model or computational fluid dynamics (CFD) model. A fully CFD model would be computationally expensive and restricted to short-duration response regimes, and the nodal model could be complicated and often not sufficient for certain but abundant flow conditions. We develop a unique 0D/3D approach by coupling the nodal-CFD models. Considering that the liquid domain is prone to greater complexity, the CFD method is used for the liquid and nodal models are employed for both tank structure and the gas domain. The CFD model considers the conservation of mass, momentum, and energy. A thermodynamic based nodal model is developed for the gas part. We explore different temporal and mass coupling of CFD and nodal models at their interfaces to capture the flow dynamics and temperature distribution of the pressurized cryogenic tanks. It is shown how the proposed method accounts for different flow dynamics and heat transfer in a self-consistent manner and can be employed to derive an adaptive low-dimensional performance model for different applications.

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