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An advection-diffusion equation within a nonlinear degenerate thermal diffusion in a diffuse interface framework (part I)

mardi 24 octobre 2023 09:00 (1h 30m)

This study is motivated by the modeling of liquid-vapor flows with phase transitions, specifically focusing on the evolution of coolant within a heat exchanger, such as the core of a Pressurized Water Reactor. We investigate an advection-diffusion equation incorporating a degenerate and nonlinear thermal diffusion coefficient. The degeneracy arises from a liquid-vapor mixture at saturation, while the diffusion coefficient remains non-degenerate in pure phase regions. Our primary focus is on analyzing the impact of the diffusion coefficient within a simplified 1D configuration, allowing for some analytical computations. This examination unveils a surprising behavior in steady-state configuration and establishes an interesting link to the Stefan problem. To explore the richness of the transitory situation numerically, we initially consider a simplified equation of state. Subsequently, we delve into the complete model with a realistic equation of state, addressing the associated challenges and presenting some approaches to numerical approximation.

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