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A Semi-Sharp Phase Field Method for Quantitative Phase Change Simulations

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The phase field method has become very popular for simulating solidification phenomena, such as the evolution of dendrites or other microstructures. The essential idea of the method is to treat the interface as having a finite width, represented as a rapid but continuous transition in a scalar variable. However, in order to connect the model parameters to the sharp interface parameters, the standard model requires an asymptotic analysis in a vanishing interface width, which has hampered the quantitative usefulness of the method. In this talk the method is simplified to the point that the relevant reduced problem can be solved analytically, allowing the sharp and phase field parameters to be identified, in principle without restrictions on the model parameters. The scheme is tested for standard cases of two-dimensional solidification, showing excellent agreement with sharp interface kinetics. Further examples and applications are presented as time and results allow.

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