Phase field systems with memory effects in the order parameter dynamics: convergence to standard phase field systems

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Abstract

We shall deal with two models arising in phase transition dynamics. The state of the system is described by the pair (θ, χ), where θ is the (relative) temperature and χ is the order parameter or phase field. The main difference between the two models relies on whether global constraints on χ are imposed or not: the resulting models will be called conserved or nonconserved, accordingly. Memory effects influencing both the heat flux and the dynamics of χ have been considered in a number of recent papers. Here we assume the Fourier law for the heat flux in the energy balance equation, while we consider memory effects in the order parameter dynamics. We show that solutions to the phase field problems with memory converge to the solution to the standard phase field model, when the memory kernels suitably converge to the Dirac mass. This is done for both the conserved and the nonconserved cases. Some error estimates are also obtained.

Keywords: phase field models, memory effects, integrodifferential equations, asymptotic analysis, error estimates.

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