

Perturbation of a Simple Wave in a Domain Wall Model

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Abstract—A nonlinear hyperbolic partial differential equation similar to the sine-Gordon equation is considered; it models the dynamics of a domain wall in a weak ferromagnet. If the coefficients are constant, there is a solution in the form of a simple (traveling) wave. In particular cases, it is written in terms of elementary functions. For an equation with variable coefficients, the solutions cannot be written explicitly. In the case of slowly varying coefficients, an asymptotic solution is constructed. The leading order term of the asymptotics represents a simple wave, which is found as a solution to an ordinary nonlinear differential equation with slowly varying coefficients. Different methods for calculating the speed of such a wave are discussed and compared. It is found that the effectiveness of a certain method depends on the ratio between the coefficients of the original equation.

Keywords: simple wave, perturbation, small parameter, asymptotics.

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