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Accuracy of discrete schemes for a class of abstract evolution inequalities

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Abstract

For a triple of Hilbert spaces {V, H, V*}, we study a discrete and a semidiscrete scheme for an evolution inclusion of the form u′(t) + A(t)u(t) + ∂φ{symbol}(t, u(t)) ∋ f(t), u(0) = u 0, t ∈ (0, T], where the pair {A(t), φ{symbol}(t, ·)} consists of a family of nonlinear operators from V into V* and a family of proper convex lower semicontinuous functionals with common effective domain D(φ{symbol}) ⊂ V. The discrete scheme is a combination of the Galerkin method with perturbations and the implicit Euler method. Under conditions on the data providing the existence and uniqueness of the solution of the problem in the space H1(0, T; V) ∩ W∞ 1(0, T;H), we obtain an abstract estimate for the method error in the energy norm of first-order accuracy with respect to the time increment. By way of application, we consider a problem with an obstacle inside the domain, for which we obtain an optimal estimate of the accuracy of two implicit schemes (standard and new) on the basis of the finite element method. © 2013 Pleiades Publishing, Ltd.

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