Convergence of the implicit-explicit Euler scheme applied to perturbed dissipative evolution equations

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We present a convergence analysis for the implicit-explicit (IMEX) Euler discretization of nonlinear evolution equations. The governing vector field of such an equation is assumed to be the sum of an unbounded dissipative operator and a Lipschitz continuous perturbation. By employing the theory of dissipative operators on Banach spaces, we prove that the IMEX Euler and the implicit Euler schemes have the same convergence order, i.e., between one half and one depending on the initial values and the vector fields. Concrete applications include the discretization of diffusion-reaction systems, with fully nonlinear and degenerate diffusion terms. The convergence and efficiency of the IMEX Euler scheme are also illustrated by a set of numerical experiments.