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The unstable manifold of an equilibrium point under discretization

The long-time behaviour of numerical approximations to the solutions of a semilinear parabolic equation near an equilibrium point is studied. It is shown that the phase portrait is correctly represented by a Runge-Kutta time discretization. In particular, the unstable manifold is approximated with higher order. The results are less favourable for linearly implicit methods. There, it is crucial that the numerical Jacobian is sufficiently accurate, and to obtain high-order convergence, the coefficients of the methods have to satisfy further conditions.

Reference: A. Ostermann, and F. Schwitzer, The dynamics of linearly implicit Runge-Kutta discretizations near equilibria, in preparation.