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Computation and stability of patterns in second order evolution equations

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As a model example we consider in this talk traveling waves of a semilinear damped wave equation. We show how the freezing method generalizes from first to second order evolution equations by transforming the original PDE into a partial differential algebraic equation (PDAE). Solving a Cauchy problem via the PDAE generates a comoving frame in which the solution becomes stationary, and an additional variable which converges to the speed of the wave, provided the original wave has suitable stability properties. A rigorous theory of this effect is presented in one space dimension, building on recent nonlinear stability results for waves in first order hyperbolic systems. Numerical examples demonstrate the applicability of the method, and generalizations to rotating patterns in several space dimensions indicate its scope.