Relative Periodic Solutions of the Complex Ginzburg-Landau Equation

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We consider the problem of numerically computing *relative periodic solutions* of chaotic partial differential equations (PDEs) with symmetries, that is, solutions that are periodic in time, up to a transformation by an element of the equations' symmetry group. In particular, we work with the complex Ginzburg-Landau equation (CGLE) with cubic nonlinearity in one spatial dimension, with periodic boundary conditions. A spectral-Galerkin method, where solutions are represented by truncated Fourier series modified to include the group element as an unknown, was used to discretize the CGLE in both space and time. Thus, the problem of computing solutions to the PDE was reduced to one of computing solutions of an underdetermined system of nonlinear algebraic equations. A large number of distinct relative periodic solutions were found in a chaotic region of the CGLE. These are new solutions and all have broad temporal and spatial spectra. The value of the time period for the relative periodic solutions found ranges between 0.02 and 0.46 and the value of the largest Lyapunov exponent of each solution varies from 1.88 to 17.20. The solutions exhibit a great deal of variety in their spatio-temporal profiles.
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[2]V. López, P. Boyland, M. Heath, and R. Moser. Relative periodic solutions of the complex Ginzburg-Landau equation. To appear in *SIAM Journal on Applied Dynamical Systems*. (Preprint: http://arxiv.org/abs/nlin.CD/0408018).