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Exact coherent structures: from fluid turbulence to cardiac arrhythmias ROMAN GRIGORIEV, CHRISTOPHER MARCOTTE, GREGORY BYRNE, Georgia Institute of Technology — Ventricular fibrillation, a life threatening cardiac arrhythmia, is an example of spatiotemporally chaotic state dominated by multiple interacting spiral waves. Recent studies of weak fluid turbulence suggest that spatiotemporal chaos in general can be understood as a walk among exact unstable regular solutions (exact coherent states, ECS) of nonlinear evolution equations. Several classes of ECS are believed to play a dominant role; most typically these are equilibria and periodic orbits or relative equilibria and relative periodic orbits for systems with global continuous symmetries. Numerical methods originally developed in the context of fluid turbulence can also be applied to models of cardiac dynamics which possess translational and rotational symmetries and, indeed, allowed us to identify relative equilibria and periodic orbits describing isolated spirals with, respectively, fixed and drifting cores. In order to find regular solutions featuring multiple interacting spirals a new approach is required that takes into consideration the dynamics of slowly drifting cores associated with local, rather than global, symmetries. We describe how local symmetries can be reduced and more general types of ECS computed that dominate spiral wave chaos in models of cardiac tissue.

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