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## Periodicity, spatial correlations, and waves in a probabilistic lattice model of the cardiac cell.

Cardiac cells have a surprisingly complex internal architecture, and dynamic instabilities of the calcium signaling within them may lead to ventricular fibrillation, the leading cause of sudden cardiac death. We study a system of locally-coupled stochastically-excitable elements in a 2D automata lattice that replicates physiological features of the cardiac cell, including threshold excitation, refractory period, global periodic forcing signal, and spatial nearest-neighbor interactions. We first derive a simple mean-field difference equation which models the expected excitation rate at each beat, and find conditions under which it can undergo a bifurcation to period-2 behavior (mimicking the pathological condition known as "alternans"). Using a local structure approximation to account for pairwise (and higher-order) correlation, we show these conditions are dependent on the nature of the neighbor-to-neighbor coupling, as well as the geometry of the cell itself. We finally consider the continuous-time case, which allows for cascading spatial interactions, resulting in the formation of excitation waves.