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1:2 resonance in a delay differential system of two coupled neurons

In this talk, I will present a bifurcation study of a delayed system of differential equations modeling two coupled neurons: one is excitatory, the other is inhibitory. The study involves both the stability and bifurcations of the trivial equilibrium. Using center manifold theory for delay differential equations, we develop the universal unfolding of the system at the trivial equilibrium point with a double zero eigenvalues. Our study shows that the dynamics on the center manifold are characterized by a planar system whose vector field has the property of 1:2 resonance. We carry out the bifurcation study of the 1:2 resonance. As complicated as it is, we observe the Hopf bifurcation, homoclinic bifurcation, and pitchfork bifurcation, as well as double-homoclinic bifurcation. This is a joint work with Dr. Guihong Fan.