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Time delays, Hopf bifurcation and synchronization

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We consider networks of oscillator nodes with time delayed, global circulant coupling. We first study the existence of Hopf bifurcations induced by coupling time delay, and then use symmetric Hopf bifurcation theory to determine how these bifurcations lead to different patterns of phase-locked oscillations. We apply the theory to a variety of systems inspired by biological neural networks to show how Hopf bifurcations can determine the synchronization state of the network. Finally we show how interaction between two Hopf bifurcations corresponding to different oscillation patterns can induce complex torus solutions in the network.