

Delays and dynamics in neural networks

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The last few years have seen a surge of activity on the analysis of delayed-differential equations representing neural and other regulatory networks. Much attention has been paid to so-called Hopfield networks, and the conditions on the structure of these networks that are necessary for stability of stationary solutions. We illustrate how the influence of time delays in the dynamical regulation of these networks naturally leads not only to the occurrence of periodic solutions, arising from Hopf bifurcations as one would suspect, but also, and equally naturally, to more degenerate bifurcations leading to invariant tori and co-existence of stable periodic solutions. In particular, a centre manifold construction is shown to be useful in identifying parameter values leading, in two different instances, to the interaction of a Hopf bifurcation with a pitchfork bifurcation.