

# HOPF-HOPF AND HOPF-PITCHFORK BIFURCATIONS IN COUPLED SYSTEMS

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When working with coupled oscillatory systems, it is quite common to face scenarios where isolated systems undergo a Hopf bifurcation. That is the case that occurs, for instance, in many coupled neuron models. Under this hypothesis, the appearance of additional degeneracies after the coupling may lead to Hopf-Hopf and Hopf-Pitchfork type bifurcations that are likely to become the germs of complex bifurcation diagrams. The non-resonant cases of codimension two and the strong resonances for Hopf-Hopf interactions (type 1:1) have been studied in the literature, both are present in many examples. Some specific properties linked to their emergence in coupled systems have been also discussed.

Many interesting questions arise in this context. We will deal with the classification of the Hopf-Hopf and Hopf-Pitchfork singularities that appear in a specific coupling problem: the case of a 4-dimensional system consisting of two coupled Fitzhugh-Nagumo equations. We will consider different types of coupling (symmetric and non-symmetric, involving only the membrane potential or also the interaction through the recovery variable) and discuss the dynamical consequences that may follow from the presence of these singularities.

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