

Long wavelength coherence in networks of coupled oscillators

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It has been observed that in networks of coupled oscillators groups of different oscillators start to coherently oscillate against each other. Such long wavelength coherent effects are well-understood in networks that consist of weakly-coupled well-defined areas. However, these oscillations have also been observed in well-connected large-scale networks. We are using tools from quantum mechanics such as matrix perturbation theory and phenomena like avoided crossings to show how these modes arise from the hybridization of the zero modes of each group and are protected against the influence of the higher modes. Finally, we are applying these techniques to real world applications such as inter-area oscillations in power grids, where groups of generators are oscillating against each other. These inter-area oscillations are problematic because they can lead to grid instabilities. It is therefore of utmost importance to understand better their properties, how they emerge, and how they can be controlled.