RTG Lecture Series

Analysis of dynamic flows in networks

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Schedule: MTW, 4-5:30PM, January 27-29, 2020 Location: Clements Hall 126

Lecture 1 Miscible flows: the graph wave equation

To describe the flow of a miscible quantity on a network, we introduce the graph wave equation where the standard continuous Laplacian is replaced by the graph Laplacian. This is a natural description of an array of inductances and capacities, of fluid flow in a network of ducts and of a system of masses and springs. The structure of the graph influences strongly the dynamics which is naturally described using the basis of the eigenvectors. Special nodes of the graph where an eigenvector has zero component play an important role in the dynamics. We illustrate this role in several examples.

Lecture 2 Periodic orbits in nonlinear wave equations on networks

We introduce the nonlinear graph wave equation to describe localized nonlinear oscillators on a network. Two different periodic solutions are studied. The first class corresponds to an extension of the standard linear normal modes in the nonlinear regime. The second type of periodic orbits are exponentially localized. We study the stability of these special solutions.

Lecture 3 Spectral solution of load flow equations

The load-flow equations are the main tool to operate and plan electrical networks. For transmission or distribution networks, these equations can be simplified into a linear system involving the graph Laplacian and the