Chaotic dynamics on networks

Proscovia Namayanja
University of KwaZulu-Natal, Durban, South Africa

In this talk, we consider an infinite network modeled by a directed graph. We show that if flow of a substance along the edges is described by a system of transport equations with Kirchoff-type boundary conditions, then the dynamics of the system is dependent on the structure of the physical network. Specifically, we show that if the adjacency matrix of the network is chaotic, then the dynamics of the system will be chaotic as well, and that the adjacency matrix operator is hypercyclic if and only if the flow problem is hypercyclic on the space of weighted summable sequences. These results are also extended to birth-and-death processes without proliferation where it is shown that chaos can still occur but only on a subspace of ℓ^1_s. Furthermore, we show that if the underlying graph of the line-graph of the network is cyclic with $d > 1$, where d is the greatest common divisor of all cycle lengths, then the eigenfunctions of the adjacency matrix of the linegraph divide the complex plane into d non-overlapping subspaces so that the flow cannot be chaotic on the entire space ℓ^1_s but only on subspaces of the space.

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