Electrical networks and Lie theory

Thomas Lam
University of Michigan

Thursday, April 26, 2012
007 Kemeny Hall, 4:00 pm
(Tea 3:30 pm 300 Kemeny Hall)

Abstract

Electrical networks consisting only of resistors are modeled in combinatorics by undirected weighted graphs, where the weight of an edge is the resistance of a resistor. Some basic questions one asks are: (1) to compute the electrical properties of the network: for example what current flows through when certain voltages are applied at particular vertices, (2) when two electrical networks have identical electrical properties: for example two resistors in series or in parallel can be replaced by a single resistor, (3) to what extent an electrical network can be reconstructed if its electrical properties are known. This last "inverse problem" has a continuous analogue, known as electrical impedance tomography, with applications in medical imaging.

In this talk we will discuss the discrete problem in a combinatorial and algebraic context. In particular, I'll explain how certain simple combinatorial operations on electrical networks give rise to a Lie group action on the space of electrical networks, allowing one to apply ideas from Lie theory and representation theory.

This talk is based on joint work with Pavlo Pylyavskyy.

This talk should be accessible to undergraduate students