**Submittee:** Vasudevan Kris
**Date Submitted:** 2015-04-20 14:15
**Title:** Spectral Graph Theory (Distinguished Visitor)
**Event Type:** Lecture-Seminar-Series

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**Location:**
University of Calgary

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**Dates:**
March 12-13, 2015

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**Topic:**
The PIMS/UC Distinguished Colloquium covered a topic in Markov chains, namely, optimising the Kemeny constant. The Combinatorics & Discrete Geometry Seminar dealt with a sensitivity analysis for perfect state transfer in quantum spin networks.

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**Methodology:**
One invited speaker, Steve Kirkland, gave two 50 minutes lectures. Research meetings were also held during the day to discuss how to apply the Kemeny constant to a problem in earthquake sequencing.

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**Objectives Achieved:**
The purpose is to bring to the University of Calgary a distinguished individual, Professor Stephen Kirkland, who has made outstanding contributions in the fields of spectral graph theory and Markov chains. This created opportunities for the members of the combinatorics and discrete geometry group to participate actively in discussions and gave them ample opportunity to discuss both the theory and its applications and foster future collaboration. Some research was completed linking the Kemeny constant to a problem in earthquake sequencing.

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**Scientific Highlights:**
Main collaborations were between Prof Kirkland, Kris Vasudevan and Mike Cavers. A new joint project was started and results are currently in progress.

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**Organizers:**
Vasudevan, Kris, Dept of Mathematics and Statistics, University of Calgary;
Cavers, Mike, Dept of Mathematics and Statistics, University of Calgary.

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**Speakers:**

Speaker: Kirkland, Steve, Dept of Mathematics, University of Manitoba. //
Talk: Combinatorics & Discrete Geometry Seminar //
Title: Sensitivity Analysis for Perfect State Transfer in Quantum Spin Networks //
Abstract: In 2003, Bose proposed the idea of using a network of interacting spins as a quantum wire to transfer information within a quantum computer. Associated with the network is a matrix M whose rows and columns are indexed by the spins, and whose entries represent the strengths of the couplings between the various spins in the network. Once all of the dust settles on the physics side, a key quantity to consider is the so-called fidelity of transfer: setting U(t) = e^(itM), and selecting distinct indices s and r, the fidelity of transfer from s to r at time t is given by p(t) = |u_{s,r}(t)|^2. It is straightforward to show that 0

As one might expect, a number of things - for instance the readout time t0, the pairs of spins that interact, and the coupling strengths - have to line up just right in order for PST to hold. In view of that observation, it is natural to wonder how sensitive the fidelity of transfer is to small changes in either the readout time or the coupling strengths, and in this talk, we address both of those questions. Using techniques from matrix analysis, we derive formulas for the derivatives of the fidelity of transfer with respect to the readout time and with respect to the coupling strengths.

The results may help to inform the design of spin networks that not only exhibit perfect state transfer but also offer some forgiveness to errors in readout time and/or spin interactions. This talk may also answer another question: can a humble matrix theorist with an infinitesimal knowledge of physics still contribute something to the analysis of PST?
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Speaker: Kirkland, Steve, Dept of Mathematics, University of Manitoba. //
Talk: PIMS/UC Distinguished Colloquium //
Title: Optimising the Kemeny Constant for a Markov Chain //
Abstract: Markov chains are a much-studied class of stochastic processes, and it is well known that if the transition matrix A associated with a Markov chain possesses a certain property called primitivity, then the long-term behaviour of the Markov chain is described by a particular eigenvector of A (known as the stationary distribution vector). Rather less well-known is the Kemeny constant for a Markov chain, which can be interpreted in terms of the expected number of time steps taken to arrive at a randomly chosen state, starting from initial state i. In particular, if the Kemeny constant is small, then we can think of the Markov chain as possessing good mixing properties.

That observation motivates our interest in identifying transition matrices for which the Kemeny constant is as small as possible. In this talk, we will give a short overview of the Kemeny constant, and discuss some results dealing with the problem of minimising the Kemeny constant over transition matrices that are subject various constraints. In particular, we will find the minimum value of the Kemeny constant for transition matrices having a specified stationary distribution vector, and characterise those transition matrices yielding that minimum value.

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**Links:**

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