Applications are demonstrated using data set from multiple sclerosis clinical trials.

MA 1801 – Denksport
Herman Servatius
WPI

The Mountaineer’s Equation

ABSTRACT: Fundamental to Mathematics is the action of thinking. Just like a PE course, where bodily activity enhances your physical fitness, Denksport will strengthen your brain muscle, enhance your self-esteem, and boost your immune system against the NR virus.

The equipment for Mountaineers and Mathematicians is usually quite different. In the mathematical sciences we rarely need fifty feet of rope or an ice axe, and a mountaineer rarely makes use the Fundamental Theorem of Algebra. For this Denksport, we will show how some of our mathematical gear could be of interest to a mountaineer.

Cleats not required.

Monday, October 1, 2018
11:00AM-11:50AM
Stratton Hall 304

Discrete Mathematics Seminar
Alex Nowak
Iowa State

Representation theory for certain combinatorial designs

ABSTRACT: In combinatorial design theory, Mendelsohn triple systems (sometimes referred to as cyclic triple systems) generalize Steiner triple systems, and in universal algebra, quasigroups are the so-called nonassociative groups. Mendelsohn triple systems may be realized as idempotent, semisymmetric quasigroups, which are quasigroups satisfying the identities x2 = x and y(xy) = x.

Exploiting this universal algebraic description, I will present a theory of modules over Mendelsohn triple systems. As in the group case, the module theory for these nonassociative algebras prompts questions regarding extension. I will address some of these extension problems, and if time permits, I will also discuss the interplay between representations of Steiner and Mendelsohn triple systems.

Tuesday, October 2, 2018
2:00PM-2:50PM
Stratton Hall 106

Joint Seminar on Numerical Methods and Statistics
Mikhail Zaslavsky
Schlumberger-Doll Research

Clustering of graph vertex subset via Krylov subspace model reduction

ABSTRACT: Clustering via graph-Laplacian spectral imbedding is ubiquitous in data science and machine learning. It provides a low dimensional parametrization of the data manifold which makes the subsequent clustering (with, say, k-means or any of its approximations) much easier. However, it becomes less efficient for large data sets due to two factors. First, computing the partial eigendecomposition of the graph-Laplacian typically requires a large Krylov subspace. Second, after the spectral imbedding is complete, the clustering is typically performed with various relaxations of k-means, which may lose robustness with respect to the initial guess, become prone to getting stuck in local minima and scale poorly in terms of computational cost for large data sets.

Normalized graph-Laplacian is intimately related to the random walk on the graph, and we will exploit this connection in our algorithms. In particular, we propose two novel algorithms for spectral clustering of a subset of the graph vertices (target subset) based on the theory of model order reduction. They rely on realizations of a reduced order model (ROM), that accurately approximates the transfer function of the random walk on the original graph for inputs and outputs restricted to the target subset. While our focus is limited to this subset, our algorithms produce its clusterization that is consistent with the overall
structure of the graph and thus with the full graph clustering if one would perform such. In particular, it preserves such parameters of the random walk on the full graph as diffusion and commute-time distances between subset nodes. Moreover, working with a small target subset reduces greatly the required dimension of Krylov subspace and allows to exploit the approximations of k-means in the regimes when they are most robust and efficient.

There are several uses for our algorithms. First, they can be employed on their own to clusterize a representative subset in cases when the full graph clustering is either infeasible of simply not required. Second, they may be used for quality control and filtering of noisy data, i.e., outliers. Third, as they drastically reduce the clustering problem size, they enable the application of more sophisticated and powerful approximations of k-means like those based on semi-definite programming (SDP) instead of the conventional Lloyd's algorithm. Finally, they can be used as building blocks of a divide-and-conquer type algorithm for the full graph clustering (in progress).

I'll provide the results of numerical experiments with synthetic data as well as real-world statistical data for companies email connections and for citations in ArXiv repository. Time permitting, I'll discuss preliminary results for ongoing project with financial statistics of the stock market data.

This is joint work with Vladimir Druskin (Worcester Polytechnic Institute) and Alexander Mamonov (University of Houston).

Thursday, October 4, 2018
11:00AM-12:00PM
Stratton Hall 203

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**Colloquium**

**Carolyn Mayer**

**WPI**

**Partial Erasure Channels**

**ABSTRACT:** Partial erasure channels model situations in which some information may remain after an erasure event occurs. These types of erasure events can happen in applications such as flash memory storage. After reviewing recently introduced partial erasure channels, we present results in two directions. First, we show how multilevel coding and multistage decoding may be applied to break partial erasure channels into simpler subchannels. Second, we consider Luby Transform (LT) codes, a class of codes without fixed rates, over partial erasure channels. We present a modified decoding process for these codes and compare their efficiency with standard LT codes on the q-ary erasure channel.

Friday, October 5, 2018
11:00AM - 12:00PM
Stratton Hall 203

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**Colloquium**

**Carolyn Mayer**

**WPI**

**Partial Erasure Channels**

**ABSTRACT:** Partial erasure channels model situations in which some information may remain after an erasure event occurs. These types of erasure events can happen in applications such as flash memory storage. After reviewing recently introduced partial erasure channels, we present results in two directions. First, we show how multilevel coding and multistage decoding may be applied to break partial erasure channels into simpler subchannels. Second, we consider Luby Transform (LT) codes, a class of codes without fixed rates, over partial erasure channels. We present a modified decoding process for these codes and compare their efficiency with standard LT codes on the q-ary erasure channel.

Friday, October 5, 2018
11:00AM - 12:00PM
Stratton Hall 203