Twenty-Fifth Annual University of Alabama System Applied Mathematics Meeting

Saturday, November 3, 2012

University of Alabama in Huntsville

All sessions will be held in the Shelby Center for Science and Technology on the campus of the University of Alabama in Huntsville

9:30 – 10:00	Refreshments	Room 107
10:05	Welcoming remarks	Room 107
10:10	Stable Elliptic Systems and Fourth Order Scalar Problems via Second Order Scalar Stability, Dr. Craig Cowan (UAH)	Room 107
10:50	The Tensor Revolution: Mining and Computing with Modern Data, Dr. Carmeliza Navasca (UAB)	Room 107
11:30	Lunch	Area Restaurants
1:10	A Pseudo-Time Coupled Nonlinear Model for Biomolecular Solvation Simulations, Dr. Shan Zhao (UA)	Room 107
1:50	Stable Regimes for Hard Disks in a Channel with Twisting Walls, Mr. Alexey Korepanov (UAB)	Room 107
2:10	Traveling Wave Solutions in an SIRS Model, Ms. Reem Albashaireh (UAH)	Room 107
2:30	Positivity of Lyapunov Exponents for the Anderson Model and a Random Block Operator Model, Mr. Jacob Chapman (UAB)	Room 107
2:50	Refreshments	Room 107
3:15	Faculty discussion	Room 107
3:15	Student discussion	Room 105

Abstracts

***Stable Elliptic Systems and Fourth Order Scalar Problems via Second Order Scalar Stability*, Craig Cowan (UAH)**

We are interested in stable solutions of either fourth order scalar elliptic partial differential equations or second order elliptic systems. More particularly, we are interested in the regularity of stable solutions on bounded domains and Liouville type theorems on the full space. For either of the above equations it is not clear how to utilize stability in a meaningful way. We obtain an inequality, valid for stable solutions, which allows one to use the standard "second order scalar technique" to obtain any results. Portions of this work is joint with Nassif Ghoussoub.

***The Tensor Revolution: Mining and Computing with Modern Data*, Carmeliza Navasca (UAB)**

In the past decades, engineering and sciences have benefited from advances in numerical linear algebra. Now, numerical multilinear algebra aims to develop tensor-based numerical methods for high dimensionality problems and modern massive data sets. Numerical multilinear algebra aims to find useful decompositions of a given tensor into sums of simple (e.g. rank one) tensors. These tools lead to efficient data analysis and compression, source identification and numerical computation of high dimensional PDEs.

In this talk, I will introduce tensor and several decomposition methods. In addition, I will include some applications in signal and video processing as well as discuss Strassen's algorithm in the framework of tensors and algebraic geometry.

***A Pseudo-Time Coupled Nonlinear Model for Biomolecular Solvation Simulations*, Shan Zhao (UA)**

Recently, we have introduced a pseudo-time coupled PDE model for biomolecular solvation analysis. A smooth solvent-solute interface is considered to characterize the dielectric boundary between macromolecules and the surrounding aqueous environment. A nonlinear Poisson-Boltzmann (NPB) equation is used for representing the nonlinear electrostatic effect. To speed up, we propose to solve the time-transient NPB equation by using operator splitting based alternating direction implicit (ADI) schemes. With an analytical treatment of nonlinear term, the proposed ADI schemes are found to be unconditionally stable for solving NPB equation. In solving coupled PDEs for chemical compounds and proteins, the proposed numerical schemes are very efficient, because large time increments are allowed

***Stable Regimes for Hard Disks in a Channel with Twisting Walls*, Alexey Korepanov (UAB)**

We study a gas of N hard disks in a box with semi-periodic boundary conditions. The unperturbed gas is hyperbolic and ergodic (these facts are proved for N=2 and expected to be true for all N>2). We study various perturbations by twisting the outgoing velocity at collisions with the walls. We show that the dynamics tends to collapse to various stable regimes however we define the perturbations and however small they are.

Traveling Wave Solutions in a SIRS Model, Reem Albashaireh (UAH)

Spatially structured epidemic models are useful tools in the study of geographic epidemic spread. In particular, traveling wave solutions of these models have been used to describe the spatial spread of infectious diseases that travel geographically around a continent or country. Two types of spatial epidemic models have been generally studied and analyzed: reaction-diffusion equations models and integro-differential equations models. In this talk we discuss an integro-differential equations model (a spatial analog of a basic SIRS model) and its traveling waves.

***Positivity of Lyapunov Exponents for the Anderson Model and a Random Block Operator Model*, Jacob Chapman (UAB)**

We will define the discrete Anderson model and the transfer matrices arising from the associated eigenvalue equation, and then give a summary of the proof of positivity of the Lyapunov exponent, one of the trademarks of localization. Next we will derive the transfer matrices for a random block operator which is closely related to the Anderson model and which arises out of the study of quantum spin systems. Results on positivity of the Lyapunov exponents of this model will then be presented.