Poster Session

Agent Based Modeling for Stock Markets

Orhan Akal, *Florida State University*

The dynamics of a financial stock market is studied. Multiple independent agents trade in the simulated stock market, and each agent is provided with a simple decision rule based on past price history, either as a momentum trader, long-term investor or speculator. As a result of these interactions the model reproduces the complex, quasi-random dynamics of stock prices in actual markets.

Variants of Linear Poroelasticity Equation as Symmetric Positive Systems

Mohammad H Akanda, Yanzhao Cao, and A. J. Meir, *Auburn University*

A symmetric positive system, also known as Friedrich's system, is a system of first-order partial differential equations endowed with symmetry and positivity properties. By construction, the system immediately delivers existence and uniqueness results. A wide range of model problems can be accommodated into this framework. We prove that a few variants of linear poroelasticity equation with different base variables, belongs to symmetric positive systems. We will also present numerical results for each variant.

Compressed Sensing in a Multilinear Sparse System of Genomic Interactions

Alexandra Fry, *University of Alabama at Birmingham*

The application of multilinear systems and compressed sensing on a biological model of viral replication will be discussed. This problem is motivated by the mathematical study of interactions among genes in cells. We show that a tensor restricted isometry property (TRIP) is necessary to find the unique sparse solution in the multilinear system. This solution can aid in drastically reducing the number of experiments needed to assess combinations of genes are necessary for viral replication.

Symmetric Tensor Outer Product Decomposition

Christina Glenn, *University of Alabama at Birmingham*

Tensor decomposition methods that decrease tensor complexity while lowering computational costs are in high demand. Symmetric Outer Product Decomposition (SOPD) factors a fully (partially) symmetric tensor into a number of rank-one symmetric tensors. Few numerical methods exist for finding the SOPD. The standard method, Alternating Least Squares (ALS), often yields wrong solutions. We propose a new iterative method for SOPD called Partial Column-wise Least Squares (PCLS). Numerical examples are provided to compare the performance of PCLS to ALS for the SOPD.

A Recursive Iterative Preconditoner for Conjugate Gradient Algorithm

Ingyu Lee, *Troy University*

Consider a solution of systems of linear equations Ax=b when the matrix A is a symmetric positive definite. We solve the system of linear equations using a direct method (Cholesky Factorization) or a preconditioned iterative method (Preconditioned Conjugate Gradient). In this poster, we are presenting a new preconditioner based on the iterative recursion. Our limited experiments show that a recursive iterative preconditioner improves the convergence of a Conjugate Gradient algorithm.

Time-Domain Matched Iinterface and Boundary Methods for Transverse Electric Modes with Complex Dispersive Iinterfaces

Duc Nguyen, *University of Alabama, Tuscaloosa*

The material is dispersive when its permittivity or permeability are functions of frequency. Therefore, the dispersive material is often used to simulate the electromagnetic waves movements in the complex environment such as in soils, rock, ice, snow, and biological tissue. As a result, it plays an important role in numerous electromagnetic applications. For instance, the ground penetrating radar (GPR) and microwave imaging for early detection of breast cancer are involved in dealing with dispersive soil and dispersive tissue respectively. It is known that the transverse electric (TE) Maxwells equations with the presence of the dispersive media produce non-smooth and discontinuous solutions. We formulate the interface auxiliary differential equations (IADEs) to acquire evanescent changes of the field regularities along the interface. A novel matched interface boundary time-domain (MIBTD) based on the leapfrog scheme is proposed to rigorously implement the time-dependent jump conditions. Numerical tests indicate the second order of accuracy is achieved in both L_∞ and L_2 norms when dealing with the complex interfaces.

Global classical solutions to the vacuum free boundary problem of 1-D full Navier-Stokes equations with large initial data

Yaobin Ou, *Renmin University of China*

The global existence of classical solutions to the free boundary problems of one-dimensional full compressible Navier-Stokes equations with large initial data is established, when the density connects to the vacuum continuously. The novelty of this result is its global-in-time regularity in contrast to the previous results of global weak solutions.

An Unstructured Cell-Center Finite Volume Approach for Structural Dynamics

Mohamed Selim, *University of Alabama at Birmingham*

Most structural dynamics solvers are based on finite element method (FEM) while state-of-the-art fluid dynamics solvers are based on finite volume method (FVM). However, there is a multitude of physical problems combining fluid and solid mechanics where the use of the same numerical approach for both mediums would be beneficial. We will present a cell-centered FVM structural dynamics solver as a preface for coupling it with the in-house fluid dynamics solver targeting fluid-structure interaction applications.

Solving Differential Equations via An Exotic Integral Transform

John Vastola, *University of Central Florida*

Motivated by a problem in summation, we introduce an integral transform with properties similar to the Laplace and Fourier transforms. All entire functions, and large classes of continuous and meromorphic functions are transformable. Interestingly, because the transform of an entire function is related to the function's Taylor coefficients, analytic approximations of other functions can be constructed. Applications to differential equations, and physical problems (including some from classical mechanics, electrodynamics, and quantum mechanics) are considered.