Eight Annual Front Range
Applied Mathematics Student Conference

March 3, 2012

Registration with light refreshments: 8:15 - 9:00

Morning Session I - NC1603
9:00 - 11:00

9:00 - 9:20	Per Sebastian Skardal *University of Colorado, Boulder*	Hierarchical Synchrony in Networks with Community Structure
9:25 - 9:45	Daniel B. Larremore *University of Colorado, Boulder*	Excited About Inhibition - the Surprising Collective E ect of Inhibitory Nodes in Simple Excitable Networks
9:50 - 10:10	Jennifer Diemunsch *University of Colorado, Denver*	Rainbow Matchings in Properly Edge-Colored Graphs
10:15 - 10:35	Nicole Look *University of Colorado, Boulder*	The Nonlinear Dynamics of Running: Symmetry, Stability, and the E ects of Amputation
10:40 - 11:00	Lenton McLendon *University of Colorado, Boulder/RES*	An Improvement of the Measure Corollate Predict Algorithm Using Arti cial Neural Networks

Morning Session II - Room NC1605
9:00 - 11:00

9:00 - 9:20	Henricus Bouwmeester *University of Colorado, Denver*	Tiled QR Factorization Algorithms
9:25 - 9:45	Eric Sullivan *University of Colorado, Denver*	A Numerical Model for Vapor Transport and Interface Dynamics in Micro Scale Evaporation
9:50 - 10:10	Jacob Pettine and Nutthavuth Tamang *University of Colorado, Boulder*	Numerical Solution for Small Angles of the Laplace-Young Capillary Equation
10:15 - 10:35	David Appelhans	Parallel Solution of Ea3(of)-333(Ime s)-12108(P)2aarU

10:40 - 11:00	Parvaneh Darafshi *University of Colorado, Denver*	The Lanczos Algorithm and Fermat's Factoring Method

Morning Session III - Room NC1607
9:00 - 11:00

9:00 - 9:20	Mark Mueller *University of Colorado, Denver*	One-Dimensional Averaging in Multiphase Systems
9:25 - 9:45	Volodymyr Kondratenko *University of Colorado, Denver*	Ignition from a Fire Perimeter in a WRF Wildland Fire Model
9:50 - 10:10	Lori Ziegelmeier, Michael Kirby, and Chris Peterson *Colorado State University, Fort Collins*	Locally Linear Embedding Clustering with an Application to Landscape Ecology
10:15 - 10:35	Zachary Mullen and Stephen Caan Taylor *University of Colorado, Boulder*	Least Squares Finite-Element Formulation of Non-Newtonian Fluids Exhibiting Shear-thinning and Yield Stress with Potential Applications to Hemorheology
10:40 - 11:00	Kannanut Chamsri *University of Colorado, Denver*	Modeling the Flow of PCL Fluid Due to the Movement of Lung Cilia

Break: 11:00 - 11:15

Plenary Address: 11:15 - 12:15, NC1130

Professor Michael Waterman, *University of Southern California*

Eulerian Graphs and Reading DNA Sequences

Lunch: 12:20 - 1:00

Afternoon Session I - Room NC1603
1:00 - 4:05

1:00 - 1:20	Eric M. Hanson *Colorado State University, Fort Collins*	Using Numerical Algebraic Geometry

1:25 - 1:45	Ryan D. Lewis *University of Colorado, Boulder*	A New Method for Designing Highly E cient Digital Filters
1:50 - 2:10	Tracy Babb *University of Colorado, Boulder*	Approximation of Power Functions Using Sums of Exponentials
2:15 - 2:25	10 Minute Break	
2:30 - 2:50	Brad Lowery *University of Colorado, Denver*	A New Algorithm for the Collective

3:20 - 3:40	Tommaso Buvoli *University of Colorado, Boulder*	Rogue Waves in Optics and Water
3:45 - 4:05	Marshall Carpenter *University of Colorado, Boulder*	Size and Duration of Avalanches in Complex Networks

Plenary Speaker

11:15 - 12:15, NC1130

Eulerian Graphs and Reading DNA Sequences

Michael Waterman
Professor of Biological Sciences, Mathematics, and Computer Science
University of Southern California

With the discovery of the double helix in 1953, it became clear that determining DNA sequences was an important goal. The Sanger experimental method was invented in 1975 and by 2001 re nements of that methods allowed sequencing of the human genome. Today an exciting new generation of sequencing technologies are rapidly increasing the speed of DNA sequencing. This lecture will consider the mathematical and computational challenges of sequencing DNA.

MORNING SESSION I

HIERARCHICAL SYNCHRONY IN NETWORKS WITH COMMUNITY

THE NONLINEAR DYNAMICS OF RUNNING: SYMMETRY, STABILITY, AND THE EFFECTS OF AMPUTATION

Nicole Look[1]

and low communication requirement. The need

in a WRF wildland re model, Paper 9.6, 12th WRF Users Workshop, National Center for Atmospheric Research, June 20-24, 2011.

LOCALLY LINEAR EMBEDDING

AFTERNOON SESSION I

USING NUMERICAL ALGEBRAIC GEOMETRY

Eric M. Hanson
Colorado State University, Fort Collins

and actual results obtained by Braess and Hackbusch. Applications of the approximation exist in quantum chemistry, quantum physics, convolution integrals, wavelet applications, and many other fields. Finally, the theory in this algorithm can also be used to find an approximation of rational functions.

A NEW ALGORITHM FOR THE COLLECTIVE COMMUNICATION OPERATION, REDUCE (ALL-TO-ONE)

to consider an undamped, free Hamiltonian system. Viewing the damped free system as a perturbation of the Hamiltonian system, approximate solutions to the damped, free oscillator are derived using the method of averaging. Subsequently, a variational method is used to treat the damped, driven regime, which is considered to be a perturbation of the damped, free system. Finally, using a resonance condition, the Melnikov functions are de ned, the zeros of which correspond to approximate periodic orbits of the damped and driven oscillator.

THE FRONTIER BETWEEN MATHEMATICS, PHYSICS, AND MEDICINE: MATHEMATICAL TECHNIQUES FOR SOLVING MAXWELL RELATIONS FOR TM RESONANCE OF SURFACE PLASMONS TO AID BIOPHYSICS

Jewell Anne Hartman
University of Colorado, Colorado Springs

The frontier that exists between biology/medicine and physics, known as biophysics, requires sophisticated tools and techniques of applied mathematics to aid its discoveries. The fundamental questions of biophysics involve matrices, dispersion relations, di erential equations (ODEs and PDEs, linear and nonlinear), in addition to dispersion relations and boundary conditionsall situations which require advanced applied mathematics.

Metamaterials are materials whose fundamental electric and/or magnetic qualities (permittivity and permeability, respectively) are arti -cially dictated. As a result, there exist three-fourths more materials than previously known. The properties of these materials and consequently, their applications, have remained largely unknown until recently. In order to discover their properties, Maxwell relations and Fresnel coe cients must be re-solved. This requires strong application of varying techniques in applied mathematics. Non-linearity arises in many situations, further complicating the equations and requiring the applied mathematics. Additionally, dispersion relations need to be solved in order to explain the plasmon resonance occurring at the boundary between a metal (usually a nanoparticle) and a dielectric. Consequently, highly non-

AN EFFICIENT SPECTRAL GALERKIN METHOD FOR A STOCHASTIC GINZBURG LANDAU MODEL

Ty Thompson
Colorado School of Mines

The Ginzburg Landau (GL) model of superconductivity is a classic example of success in using a phenomenological approach when studying systems whose underlying theory is either complex or incomplete. Its predictions of vortex con gurations in superconductors have been theoretically justi ed, numerically veri ed, and physically observed in many contexts, however, less is understood about their evolution from typical initial states. The Langevin extension of the GL equations o ers a natural phenomenological context for the modeling of such dynamics in symmetric superconductors, and while its simulation has traditionally been computationally prohibitive, the ever increasing availability of large scale computing power motivates us to reexamine its utility. With the goal of mitigating the computational challenges of large stochastic dimension, we use a generalized spectral decomposition (GSD) in a fully discrete Galerkin method for a stochastic GL model on thin, cylindrically symmetric superconductors. Our implementation relies upon highly e cient computational algorithms for the deterministic version of the problem, and supports intuitive perspectives of vortex nucleation and motion associated with spatial symmetry breaking.

ROGUE WAVES IN OPTICS AND WATER

Tommaso Buvoli
University of Colorado, Boulder

In recent years, large amplitude "rogue" waves have been studied in water waves and nonlinear optics. These large waves occur more frequently than suggested by conventional linear models and there is widespread belief that nonlinear phenomena are responsible for such large waves.

It is widely known that modulational instability causes solutions of the linearized nonlinear Schrdinger equation to experience exponential growth. We extend this result by performing stability analysis on several NLS type equations used in the study of light waves. We determine explicit formulas describing growth rates and mode growth. To con rm the validity of our analytical formulas, we run numerical experiments and look for growth in each mode. We conclude by numerically verifying that rogue waves occur in several of these equations.