Invited Plenary Speakers

Peter Constantin, Princeton University
Irene Gamba, University of Texas at Austin
Ratnasingham Shivaji, University of North Carolina at Greensboro

Conference Venue
Martha T. Nesbitt Building
University of North Georgia-Gainesville
3820 Mundy Mill Rd,
Oakwood, GA 30566

For more information, visit
https://ung.edu/mathematics/searcde/index.php
Contact: searcde@ung.edu, 678-717-3757
Thirty-Eighth Southeastern-Atlantic Regional Conference on Differential Equations (SEARCDE 2018)

University of North Georgia - Gainesville
Oakwood, GA, USA

Program and Abstracts

October 6 – 7, 2018
Welcome!

We are delighted to welcome you to the “38th Southeastern-Atlantic Regional Conference on Differential Equations”. We hope you will have a great time here at University of North Georgia-Gainesville.

We would also appreciate any feedback and any suggestions you have. Please fill out the feedback form included in your registration materials or send comments to Ramjee Sharma (ramjee.sharma@ung.edu).

Sincerely,
SEARCDE 2018 Local Organizing Committee

Local Organizing Committee
Ramjee Sharma (Chair)
Jiahong Wu Jerrry Graveman Hashim Saber
Keshav Acharya Thomas Hartfield Alejandro Saria
Dhruba Adhikari Danny Lau Ryan Thompson
Alla Balueva Phong Luu Jennifer Williford
Benkam Bobga Kashi Neupane Ping Ye
Bikash Das Nham Ngo Meng Zhang
Rosamarie Gennuso Dipendra Regmi

Current SEARCDE Steering Committee
Keshav Acharya Dhruba Adhikari
Lorena Baciu Eric Numfor
Jaffar Ali Shaful-Hameed Ramjee Sharma

This conference is supported by
University of North Georgia, College of Science and Mathematics
University of North Georgia, Department of Mathematics
National Science Foundation (NSF)
### Summary of the SEARCDE 2018 Program

**Saturday, October 6**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00am – 6:00pm</td>
<td>Registration (Lobby)</td>
</tr>
<tr>
<td>12:45pm – 1:00pm</td>
<td>Opening Remarks (MTN 3110)</td>
</tr>
<tr>
<td>1:00pm – 2:00pm</td>
<td>Irene Gamba: <em>The Cauchy problem and BEC stability for the quantum Boltzmann-Condensation System at very low temperature</em> (MTN 3110)</td>
</tr>
<tr>
<td>2:00pm – 2:20pm</td>
<td>Plenary 1: Coffee Break (Lobby)</td>
</tr>
</tbody>
</table>

**PARALLEL SESSIONS**

| Room: MTN 3201 | Moderator: A. Balueva | Session 1A: J. Ford, P. Drabek, D. Wanduku | Session 1B: N. Fonseka, V. Cheruvu, Z. Denton | Session 1C: D. Wanduku, V. Cheruvu, Z. Denton | Session 1D: A. Balueva, P. Drabek, V. Cheruvu | Session 1E: D. Wanduku, V. Cheruvu, Z. Denton | Session 1F: A. Balueva, P. Drabek, V. Cheruvu |
| Session 1B: MTN 3203 | P. Drabek | 2:20pm – 2:40pm | 2:40pm – 3:00pm | 3:00pm – 3:20pm | 3:20pm – 3:40pm |
| Session 1C: MTN 3204 | D. Wanduku | 2:20pm – 2:40pm | 2:40pm – 3:00pm | 3:00pm – 3:20pm | 3:20pm – 3:40pm |
| Session 1D: MTN 3211 | V. Cheruvu | 2:20pm – 2:40pm | 2:40pm – 3:00pm | 3:00pm – 3:20pm | 3:20pm – 3:40pm |
| Session 1E: MTN 3212 | Z. Denton | 2:20pm – 2:40pm | 2:40pm – 3:00pm | 3:00pm – 3:20pm | 3:20pm – 3:40pm |
| Session 1F: MTN 3213 | D. Ramirez | 2:20pm – 2:40pm | 2:40pm – 3:00pm | 3:00pm – 3:20pm | 3:20pm – 3:40pm |

**Coffee Break (Lobby)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:00pm – 4:30pm</td>
<td>Peter Constant: <em>Singularities in Fluids</em></td>
</tr>
<tr>
<td>4:30pm – 5:00pm</td>
<td>Coffee Break (Lobby)</td>
</tr>
<tr>
<td>5:10pm – 6:10pm</td>
<td>Plenary 2: Coffee Break (Lobby)</td>
</tr>
</tbody>
</table>

**Saturday, October 7**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30am – 11:00am</td>
<td>Registration (Lobby)</td>
</tr>
<tr>
<td>8:30am – 9:30am</td>
<td>Ratnasingham Shivaji: <em>Infinite Semipositone Problems</em> (MTN 3110)</td>
</tr>
<tr>
<td>9:30am – 9:50am</td>
<td>Coffee Break</td>
</tr>
</tbody>
</table>

**PARALLEL SESSIONS**

| Session 3B: MTN 3203 | T. Lamar | 9:50am – 10:10am | 10:10am – 10:30am | 10:30am – 10:50am | 10:50am – 11:10am | 11:10am – 11:30am | 11:30am – 11:50am |
| Session 3C: MTN 3204 | I. Aslan | 9:50am – 10:10am | 10:10am – 10:30am | 10:30am – 10:50am | 10:50am – 11:10am | 11:10am – 11:30am | 11:30am – 11:50am |
| Session 3D: MTN 3211 | D. Adhikari | 9:50am – 10:10am | 10:10am – 10:30am | 10:30am – 10:50am | 10:50am – 11:10am | 11:10am – 11:30am | 11:30am – 11:50am |
| Session 3E: MTN 3212 | M. Chhetri | 9:50am – 10:10am | 10:10am – 10:30am | 10:30am – 10:50am | 10:50am – 11:10am | 11:10am – 11:30am | 11:30am – 11:50am |
| Session 3F: MTN 3213 | G. Bhatt | 9:50am – 10:10am | 10:10am – 10:30am | 10:30am – 10:50am | 10:50am – 11:10am | 11:10am – 11:30am | 11:30am – 11:50am |

**Closing Remarks, Coffee Available (Lobby)**

---

**Moderator:** Maya Chhetri (MTN 3110)

---

**Opening Remarks:** Michael Bodri, Dean of the College of Science and Mathematics

**Closing Remarks:** Irene Gamba: "The Cauchy problem and BEC stability for the quantum Boltzmann-Condensation System at very low temperature"

---

**Reception Dinner:** Ratnasingham Shivaji: "Infinite Semipositone Problems"

---

**Moderator:** Maya Chhetri (MTN 3110)

---

**Coffee Break:** Peter Constantin: "Singularities in Fluids"

---

**Moderator:** Jiuhong Wu (MTN 3110)

---

**Light Breakfast and Coffee:** Ratnasingham Shivaji: "Infinite Semipositone Problems"

---

**Moderator:** Maya Chhetri (MTN 3110)

---

**Coffee Break:** Potnashang Shivaji: "Infinite Semipositone Problems"

---

**Moderator:** Maya Chhetri (MTN 3110)

---

**Closing Remarks:** Peter Constantin: "Infinite Semipositone Problems"

---

**Moderator:** Maya Chhetri (MTN 3110)

---

**Coffee Break**
Thirty-Eighth Southeastern-Atlantic Region Conference
on Differential Equations
University of North Georgia, GA

Program

Saturday, October 6

11:00am-6:00pm Registration (Lobby)
12:45 pm-12:55 pm Conference Opening (Room: MTN 3110)
  Opening-Ramjee Sharma
  Welcome-Michael Bodri, Dean of the College of Science and Mathematics

1:00 pm-2:00 pm Plenary 1 (Room MTN 3110)
The Cauchy problem and BEC stability for the quantum Boltzmann-Condensation System at very low temperature
Irene Gamba, University of Texas at Austin

Parallel Sessions 1A-1F

Session 1A (Room MTN 3201)

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:20pm – 2:40pm</td>
<td>John Ford</td>
<td>On the numerical estimation of parameters for a multi-part decision process</td>
</tr>
<tr>
<td>2:40pm – 3:00pm</td>
<td>Harish Bhatt</td>
<td>The Runge-Kutta based compact fourth-order implicit-explicit scheme for numerical solution of Kuramoto-Sivashinsky equation</td>
</tr>
<tr>
<td>3:00pm – 3:20pm</td>
<td>Alla V. Balueva</td>
<td>New Boundary Element Method for Solution of 3D Model for Crack Growth under Gas Diffusion</td>
</tr>
<tr>
<td>3:20pm – 3:40pm</td>
<td>S. S. Alzahrani</td>
<td>High-order time stepping Fourier spectral method for multi-dimensional space-fractional reaction-diffusion equations</td>
</tr>
</tbody>
</table>

Session 1B (Room MTN 3203)

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:20pm – 2:40pm</td>
<td>Nalin Fonseka</td>
<td>Classes of reaction diffusion equations where a parameter influences the equation as well as the boundary condition</td>
</tr>
<tr>
<td>2:40pm – 3:00pm</td>
<td>Pavel Drabek</td>
<td>Travelling waves in the Fisher-KPP equation with nonlinear diffusion and a non-Lipschitzian reaction term</td>
</tr>
<tr>
<td>3:00pm – 3:20pm</td>
<td>Adam Prinkey</td>
<td>Analysis of interfaces for the nonlinear double degenerate parabolic equation of turbulent filtration with absorption</td>
</tr>
<tr>
<td>3:20pm – 3:40pm</td>
<td>Roqia Jeli</td>
<td>Evolution of interfaces for the non-linear parabolic p-Laplacian type diffusion equation of non-Newtonian elastic filtration with strong absorption</td>
</tr>
</tbody>
</table>

Session 1C (Room MTN 3204)

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:20pm – 2:40pm</td>
<td>Divine Wanduku</td>
<td>A comparative stochastic and deterministic study of the permanence of malaria in a class of infectious disease models</td>
</tr>
<tr>
<td>2:40pm – 3:00pm</td>
<td>Saleheh Seif</td>
<td>Breast Cancer Detection through Electrical Impedance Tomography and Optimal Control Theory: Theoretical and Computational Analysis</td>
</tr>
<tr>
<td>3:00pm – 3:20pm</td>
<td>Morganne Igoe</td>
<td>A Discrete Age Structured Model of Hantavirus Among Rodents in Paraguay</td>
</tr>
<tr>
<td>3:20pm – 3:40pm</td>
<td>Roby Poteau</td>
<td>Identification of Parameters in Systems Biology</td>
</tr>
</tbody>
</table>

Session 1D (Room MTN 3211)

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:20pm – 2:40pm</td>
<td>Vani Cheruvu</td>
<td>Spectra of boundary integral operators defined on the unit sphere for the modified Laplace equation</td>
</tr>
<tr>
<td>2:40pm – 3:00pm</td>
<td>Ashok Aryal</td>
<td>Generalization of Mean Value Properties to Arbitrary Divergence Form Uniformly Elliptic Operators</td>
</tr>
<tr>
<td>3:00pm – 3:20pm</td>
<td>Matthew A. Fury</td>
<td>A unifying condition for well-posed approximations of ill-posed Cauchy problems in Banach space</td>
</tr>
<tr>
<td>3:20pm – 3:40pm</td>
<td>Ishwari J. Kunwar</td>
<td>TOPOLOGICAL DEGREES ON UNBOUNDED DOMAINS</td>
</tr>
</tbody>
</table>
### Session 1E (Room MTN 3212)

<table>
<thead>
<tr>
<th>Time</th>
<th>Presenter</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:20pm – 2:40pm</td>
<td>Zachary Denton</td>
<td>Quasilinearization Method for Finite Systems of Riemann-Liouville Fractional Differential Equations</td>
</tr>
<tr>
<td>2:40pm – 3:00pm</td>
<td>Jemal Mohammed-Awel</td>
<td>Mathematics of an epidemiology-genetics model for assessing the role of insecticides resistance on malaria transmission dynamics</td>
</tr>
<tr>
<td>3:00pm – 3:20pm</td>
<td>Min Wang</td>
<td>A fractional differential equation model for bike share systems</td>
</tr>
<tr>
<td>3:20pm – 3:40pm</td>
<td>Byungjae Son</td>
<td>An existence result for superlinear semipositone p-Laplacian systems on the exterior of a ball</td>
</tr>
</tbody>
</table>

### Session 1F (Room MTN 3213)

<table>
<thead>
<tr>
<th>Time</th>
<th>Presenter</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:20pm – 2:40pm</td>
<td>Diego Ramirez</td>
<td>Monotone iterative techniques for Caputo differential equations with bounded delay</td>
</tr>
<tr>
<td>2:40pm – 3:00pm</td>
<td>Amna Abu Weden</td>
<td>Interface Development for the Nonlinear Degenerate Multidimensional Parabolic Equations Modeling Reaction-Diffusion Processes</td>
</tr>
<tr>
<td>3:00pm – 3:20pm</td>
<td>Youssef Raffoul</td>
<td>Qualitative Analysis of Non convolution Volterra Summation Equations</td>
</tr>
<tr>
<td>3:20pm – 3:40pm</td>
<td>Sze-Man Ngai</td>
<td>Spectral dimension of fractal Laplacians and application to heat kernel estimates</td>
</tr>
<tr>
<td>3:40pm – 4:00pm</td>
<td></td>
<td>Coffee Break (Lobby)</td>
</tr>
</tbody>
</table>

### Parallel Sessions 2A-2F

#### Session 2A (Room MTN 3201)

<table>
<thead>
<tr>
<th>Time</th>
<th>Presenter</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:30pm – 4:50pm</td>
<td>He Yang</td>
<td>Local discontinuous Galerkin methods for the Khokhlov-Zabolotskaya-Kuznetsov equation</td>
</tr>
<tr>
<td>4:50pm – 5:10pm</td>
<td>Balaram Ghimire</td>
<td>The closed form particular solutions for the Laplace operators using Oscillatory radial basis functions in 2D</td>
</tr>
</tbody>
</table>

#### Session 2B (Room MTN 3203)

<table>
<thead>
<tr>
<th>Time</th>
<th>Presenter</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:00pm – 4:30pm</td>
<td>Jiahong Wu</td>
<td>Two variants of the 2D Euler vorticity equation</td>
</tr>
<tr>
<td>4:30pm – 4:50pm</td>
<td>Qingshan Chen</td>
<td>On the well-posedness of inviscid quasi-geostrophic equations of large-scale geophysical flows</td>
</tr>
<tr>
<td>4:50pm – 5:10pm</td>
<td>Thomas Hagen</td>
<td>Volume scavenging of networked droplets</td>
</tr>
</tbody>
</table>

#### Session 2C (Room MTN 3204)

<table>
<thead>
<tr>
<th>Time</th>
<th>Presenter</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:00pm – 4:30pm</td>
<td>Suzanne Lenhart</td>
<td>Assessing the Economic Tradeoffs Between Prevention and Suppression of Forest Fires</td>
</tr>
<tr>
<td>4:30pm – 4:50pm</td>
<td>Buddhi Pantha</td>
<td>Modeling the macrophage- anthrax spore interaction: implications for early host-pathogen</td>
</tr>
<tr>
<td>4:50pm – 5:10pm</td>
<td>Zhan Chen</td>
<td>PDE based nonpolar multiscale solvation modeling, analysis and computation</td>
</tr>
</tbody>
</table>

#### Session 2D (Room MTN 3211)

<table>
<thead>
<tr>
<th>Time</th>
<th>Presenter</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:30pm – 4:50pm</td>
<td>Xiang Xu</td>
<td>An elementary proof of the Eigenvalue preservation for the co-rotational Beris-Edwards system</td>
</tr>
<tr>
<td>4:50pm – 5:10pm</td>
<td>Vijay Jung Kunwar</td>
<td>Solving Differential Equations in terms of Special Functions</td>
</tr>
</tbody>
</table>

#### Session 2E (Room MTN 3212)

<table>
<thead>
<tr>
<th>Time</th>
<th>Presenter</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:30pm – 4:50pm</td>
<td>Satbir Malhi</td>
<td>The long time behaviour of Energy norm of the Fractional Klein Gordon Equation</td>
</tr>
<tr>
<td>4:50pm – 5:10pm</td>
<td>Elliott Hollifield</td>
<td>Positive weak solutions of fractional Laplacian boundary value problems</td>
</tr>
</tbody>
</table>

#### Session 2F (Room MTN 3213)

<table>
<thead>
<tr>
<th>Time</th>
<th>Presenter</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:00pm – 4:30pm</td>
<td>Alex Himonas</td>
<td>Persistence of spatial analyticity for nonlinear evolution equations</td>
</tr>
<tr>
<td>4:30pm – 4:50pm</td>
<td>John Holmes</td>
<td>Recent progress on a Camassa-Holm type equation</td>
</tr>
<tr>
<td>4:50pm – 5:10pm</td>
<td>Raj Dahal</td>
<td>Monotonicity Results for the Operators on Discrete Fractional Calculus</td>
</tr>
</tbody>
</table>

#### Plenary 2 (Room MTN 3110)

<table>
<thead>
<tr>
<th>Time</th>
<th>Presenter</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>5:10pm – 6:10pm</td>
<td>Peter Constantin</td>
<td>Singularities in Fluids</td>
</tr>
</tbody>
</table>

6:20pm-8:20 pm | RECEPTION DINNER (Student Center Robinson Ballroom)
### Sunday, October 7

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 am - 11:00 am</td>
<td>Registration (Lobby)</td>
</tr>
<tr>
<td>7:30 am - 8:30 am</td>
<td>Coffee (Lobby)</td>
</tr>
<tr>
<td>8:30 am - 9:30 am</td>
<td>Plenary 3 (Room MTN 3110) Infinite Semipositone Problems</td>
</tr>
<tr>
<td>9:30 am - 9:50 am</td>
<td>Ratnasingham Shivaji, University of North Carolina at Greensboro</td>
</tr>
<tr>
<td></td>
<td>Coffee (Lobby)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Session 3A (Room MTN 3201)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:50 am - 10:10 am</td>
</tr>
<tr>
<td>10:10 am - 10:30 am</td>
</tr>
<tr>
<td>10:30 am - 10:50 am</td>
</tr>
<tr>
<td>10:50 am - 11:10 am</td>
</tr>
<tr>
<td>11:10 am - 11:30 am</td>
</tr>
<tr>
<td>11:50 am - 12:10 pm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Session 3B (Room MTN 3203)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:50 am - 10:10 am</td>
</tr>
<tr>
<td>10:10 am - 10:30 am</td>
</tr>
<tr>
<td>10:30 am - 10:50 am</td>
</tr>
<tr>
<td>10:50 am - 11:10 am</td>
</tr>
<tr>
<td>11:10 am - 11:30 am</td>
</tr>
<tr>
<td>11:30 am - 11:50 am</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Session 3C (Room MTN 3204)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:50 am - 10:10 am</td>
</tr>
<tr>
<td>10:10 am - 10:30 am</td>
</tr>
<tr>
<td>10:30 am - 10:50 am</td>
</tr>
<tr>
<td>10:50 am - 11:10 am</td>
</tr>
<tr>
<td>11:10 am - 11:30 am</td>
</tr>
<tr>
<td>11:30 am - 11:50 am</td>
</tr>
<tr>
<td>11:50 am - 12:10 pm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Session 3D (Room MTN 3211)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:50 am - 10:10 am</td>
</tr>
<tr>
<td>10:10 am - 10:30 am</td>
</tr>
<tr>
<td>10:30 am - 10:50 am</td>
</tr>
<tr>
<td>10:50 am - 11:10 am</td>
</tr>
<tr>
<td>11:10 am - 11:30 am</td>
</tr>
<tr>
<td>11:30 am - 11:50 am</td>
</tr>
<tr>
<td>Time</td>
</tr>
<tr>
<td>--------------</td>
</tr>
<tr>
<td>9:50am – 10:10am</td>
</tr>
<tr>
<td>10:10am – 10:30am</td>
</tr>
<tr>
<td>10:30am – 10:50am</td>
</tr>
<tr>
<td>10:50am – 11:10am</td>
</tr>
<tr>
<td>11:10am – 11:30am</td>
</tr>
<tr>
<td>11:30am – 11:50am</td>
</tr>
</tbody>
</table>

**Session 3F (Room MTN 3213)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
<th>Title / Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:50am – 10:10am</td>
<td>Jaffar Ali Shahul Hameed</td>
<td>Multiple Positive Radial Solutions to Elliptic Equations in an Annulus</td>
</tr>
<tr>
<td>10:10am – 10:30am</td>
<td>G. Bhatt</td>
<td>The matrices of low mutual coherence</td>
</tr>
<tr>
<td>10:30am – 10:50am</td>
<td>John Gemmer</td>
<td>Most Probable Tipping Events in Noisy Piecewise Linear System with Periodic Forcing</td>
</tr>
<tr>
<td>10:50am – 11:10am</td>
<td>Maximilian Rezek</td>
<td>Isometric Immersions, Energy Minimization, Periodic Patterns, and the Geometry of Leaves</td>
</tr>
<tr>
<td>11:10am – 11:30am</td>
<td>Montgomery Taylor</td>
<td>The Diffusion Phenomenon for Damped Wave Equations with Space-Time Dependent Coefficients</td>
</tr>
<tr>
<td>11:30am – 11:50am</td>
<td>Akhil Kumar Srivastav</td>
<td>Spread of Zika Virus Diseases on Complex Network with Non-monotone Incidence Rate</td>
</tr>
</tbody>
</table>
1. Singularity in Fluids
Peter Constantin
Princeton University
const@math.princeton.edu

I will start by considering time dependent hypersurfaces immersed in Euclidean space and computing the evolution of geometric quantities such as the first and second fundamental form, curvatures, area and volume enclosed. I will give examples of geometric and hydrodynamic evolution. I will then present two recent results: a proof of an old conjecture regarding slender jet breakup, and a rigorous proof of finite or infinite time pinchoff in an equally old model of Hele-Shaw necks. Time permitting, I will also describe a recent result about the inviscid limit in the vortex sheet regime.

2. The Cauchy problem and BEC stability for the quantum Boltzmann-Condensation System at very low temperature
Irene Gamba
University of Texas at Austin
gamba@math.utexas.edu

After a short review of classical kinetic collisional theory from a probabilistic viewpoint, we discuss a new model for a coupled quantum Boltzmann-Condensation system that describes the evolution of the interaction between a well formed Bose-Einstein Condensate (BEC) and the quasi-particles cloud. The kinetic part of the model, derived as weak turbulence kinetic model from a quantum Hamiltonian, is valid for a dilute regime at which the temperature of a bosonic gas is very low compared to the Bose-Einstein condensation critical temperature. In particular, the system couples the density of the condensate from a Gross-Pitaevskii type equation to the kinetic equation through the dispersion relation in the kinetic model and the corresponding transition probability rate from pre to post collision momentum states.

We show the well-posedness of the Cauchy problem to the system for bounded solutions with a sufficiently large number of statistical moments, find qualitative properties of the solution such as instantaneous creation of exponential tails, and prove the condensate uniform stability related to the initial mass ratio between condensed particles and quasi-particles. This stability result leads to global in time existence of bounded, finite energy solutions to an initial value problem for the quantum Boltzmann-Condensation system.

This is work in collaboration with Ricardo J. Alonso and Minh Binh Tran.

3. Infinite Semipositon Problem
Ratnasingham Shivaji
The University of North Carolina Greensboro
r_shivaj@uncg.edu

In this talk results for positive solutions will be presented to B.V.P.s of the form:

\[
\begin{cases}
-\Delta u = \lambda f(u); & \Omega \\
 u = 0; & \partial \Omega
\end{cases}
\]

where \( \Delta \) is the Laplacian, \( \lambda > 0 \), \( \Omega \) is a bounded domain in \( \mathbb{R}^n \); \( n \geq 1 \) and \( f : (0, \infty) \to \mathbb{R} \) is \( C^1 \) such that \( \lim_{s \to 0^+} f(s) = -\infty \).
Contributed Talks

1. On spectral theory of linear relations in a Hilbert space
   Keshav Acharya
   Embry-Riddle Aeronautical University
   ACHARYAK@erau.edu

   We will discuss some results on spectral theory of linear relations in a Hilbert space. More specifically, a series analogous to a Neumann series of linear operator in a Hilbert space will be established. In addition, we will discuss on some spectral properties of a compact linear relation in a Hilbert space.

2. A Topological Degree for Quasibounded Multivalued \((\tilde{S}_+)^{-}\)-Perturbations of Maximal Monotone Operators
   Dhruba Adhikari
   Kennesaw State University
   dadhikar@kennesaw.edu

   Let \(X\) be an infinite dimensional real reflexive Banach space with dual space \(X^*\) and \(G \subset X\) open and bounded. Let \(T : X \supset D(T) \to 2^{X^*}\) be a maximal monotone operator with \(0 \in D(T)\) and \(0 \in T(0)\), and let \(C : X \supset D(C) \to 2^{X^*}\) be densely defined strongly quasibounded and of type \((\tilde{S}_+)\). A topological degree theory is introduced for the sum \(T + C\). The main existence results of Browder and Hess are obtained via the new degree theory and some of their existence results are extended. An application of the theory to elliptic partial differential inclusions in general divergence form is included.

3. Computing Eigenvalues of Fourth Order Sturm-Liouville Problems to High Accuracy
   Ahmad Alalyani
   Florida Institute of Technology
   aalalyani2013@my.fit.edu
   Coauthors: Charles T. Fulton

   Greenberg and Marletta produced a FORTRAN code [see Greenberg and Marletta, Algorithm 775: The Code SLEUTH, ACM Trans Math Software 23 (4), 1997, 453-493] for computing the eigenvalues of fourth order self-adjoint differential operators, with regular endpoints. The basic shooting algorithm employed was based on using a piecewise constant approximation to the coefficient functions on each mesh interval, similarly to the Pruess method for second order equations. Here we consider the self-adjoint differential operators which arise from the fourth order differential equation
   \[
   L(y) = y^4(x) - (s(x)y'(x))' + q(x)y(x) = \lambda y(x), \quad a \leq x \leq b
   \]
   when separated self-adjoint boundary conditions are imposed at each of the two regular endpoints \(x = a\) and \(x = b\) with \(q(x), s(x), \) and \(s'(x)\) be continuous. We develop a \(7 \times 7\) first order linear system, \(S' = A(x, \lambda)S\) in the usual way, which can be integrated over \([a, b]\) to produce the determinants at \(x = b\) whose zeros are the eigenvalues of the Sturm-Liouville problem with 4 choices of boundary conditions at \(x = a\), together with 4 more choices of boundary conditions at \(x = b\). We discuss the performance of this approach on several problems, including squares of second order Sturm-Liouville equations, and compare with the SLEUTH code.

4. Lyapunov-Razumikhin Theorems for Sufficient Conditions to Prove Asymptotic Stability of PEEC NFDE’s
   H. Michael Allison
   The Florida Institute of Technology
   hallison2007@my.fit.edu

   A. Ruelhls Partial Element Equivalent Circuit (PEEC) Model is used to solve Electrical Field Integral Equations (EFIE) for conductors in 3-dimensional space such as traces in a circuit board. For modern high-speed digital circuits operating in the GHZ frequencies, time delays must be added to the model which result in Neutral Functional Differential Equations. This paper provides 2 theorems for proving sufficient conditions for asymptotic stability of the PEEC NFDEs using Lyapunov-Razumikhin function methods in contrast to published Lyapunov-Krasovskii functional methods. For the linear autonomous case a form is given which allows straightforward calculations from system parameters.
5. **High-order time stepping Fourier spectral method for multi-dimensional space-fractional reaction-diffusion equations**  
S. S. Alzahrani  
*Middle Tennessee State University*  
ssa3g@mtmail.mtsu.edu  
Coauthors: A. Q. M. Khaliq

We introduce a high-order time stepping scheme, that is based on using Fourier spectral in space and a fourth-order diagonal Padé approximation to the matrix exponential function for solving multi-dimensional space-fractional reaction-diffusion equations. The resulting time stepping scheme is developed based on an exponential time differencing approach such that it alleviates solving a large non-linear system at each time step while maintaining the stability of the scheme. The non-locality of the fractional operator in some other numerical schemes for these equations leads to full and dense matrices. This scheme is able to overcome such computational inefficiency due to the full diagonal representation of the fractional operator. It also attains spectral convergence for multiple spatial dimensions. The stability of the scheme is discussed through the investigation of the amplification symbol and plotting its stability regions, which provides an indication of the stability of the method. The convergence analysis is performed empirically to show that the scheme is fourth-order accurate in time, as expected. Numerical experiments on reaction-diffusion systems with application to pattern formation are discussed to show the effect of the fractional order in space-fractional reaction-diffusion equations and to validate the effectiveness of the scheme.

6. **Analysis of Interfaces for the Nonlinear Degenerate Diffusion Equation with Convection**  
Lamees K. Alzaki  
*Florida Institute of Technology*  
lalzaki2013@my.fit.edu  
Coauthors: Ugur G. Abdulla

We present full classification of the short-time behavior of interfaces and local structure of solutions near the interfaces in the Cauchy problem with compactly supported initial function for the nonlinear degenerate second order parabolic PDE

\[
    u_t = (u^m)_{xx} + b(u^\gamma)_x, \quad m > 1, \gamma > 0, b \in \mathbb{R}
\]

modeling diffusion-convection processes arising in fluid or gas flow in a porous media, plasma physics, population dynamics in mathematical biology and other applications. Due to the property of the finite speed of propagation the problem develops interfaces or free boundaries separating the region where solution is positive from the region where it vanishes. The interface may expand, shrink, or remain stationary as a result of the competition of the diffusion and convection forces near the interface, expressed in terms of the parameters \(m, \gamma, \text{sign } b\), asymptotics of the initial function near its support, and whether interface is the right or left boundary curve. In all cases, we prove the explicit formula for the interface and the local solution with accuracy up to constant coefficients. The methods of the proof are based on nonlinear scaling laws, and a barrier technique using special comparison theorems in irregular domains with characteristic boundary curves.

7. **Generalization of Mean Value Properties to Arbitrary Divergence Form Uniformly Elliptic Operators**  
Ashok Aryal  
*Minnesota State University Moorhead*  
ashok.aryal@mnstate.edu  
Coauthors: Ivan Blank

The Mean Value Theorem (MVT) for harmonic and sub/super-harmonic functions is a cornerstone in the theory for elliptic PDE. Caffarelli stated a generalization of that theorem for the solid case to arbitrary divergence form uniformly elliptic operators and recently, Blank and Hao filled in the details of the proof. On the other hand not much is known about the geometry and topology of the family of sets given in that theorem. In this talk I will introduce MVT for Laplacian and weakly subharmonic functions, and describe the generalized MVT and some results extending our understanding on the underlying sets in generalized MVT.

8. **Search for periodic solutions in discrete dynamical systems**  
Aleh Asipchuk  
*Georgia Southern University*  
aa07144@georgiasouthern.edu  
Coauthors: Dmitriy Dmitrishin, Alex Stokolos, and Mihai Tohaneanu

We present a new method to detect periodic solutions in discrete dynamical systems. Some numeric simulations are included.
9. Impulse model of Leptospirosis in Cattle
Ibrahim Aslan
University of Tennessee Knoxville
iaslan@vols.utk.edu

As one of the most widespread zoonotic disease, Leptospirosis became endemic particularly in tropical and subtropical regions where the environment provides favorable conditions for propagation of the disease. It causes large economic loss in livestock industry. In this talk, we introduce a SVIR dynamical system of ordinary differential equations with impulse action of vaccination at certain times in order to investigate whether the disease can be controlled with current vaccine schedules. Some analytical and numerical results will be presented.

10. On Two Fractional q-Derivative Inclusions
S.Melike Aydogan
Istanbul Technical University, Mathematics Department, Maslak Campus,
melikeaydogan43@gmail.com

There are a lot of works on fractional differential equation. One of the fractional derivations is q-difference type. On the other hand, fractional differential inclusions are strong generalization for fractional differential equations. In this talk, we investi- gate the existence of solution for two fractional q-derivative inclusions.

11. New Boundary Element Method for Solution of 3D Model for Crack Growth under Gas Diffusion
Alla V. Balueva
University of North Georgia, Mathematics Department, P.O. Box 1358, Gainesville, Georgia, 30503, USA
Alla.Balueva@ung.edu

We consider the slow growth of normal tension cracks as quasi-brittle behavior under hydrogen embrittlement conditions. Experiments show that the cracking resistance of the material in such cases is not a constant of the material, but is characterized by some function that relates the rate of crack-growth to the stress intensity factor along the crack contour. Thus, the problems under consideration model the fracture phenomena inherent to structures (e.g. pressure vessels, pipelines) that operate in an aggressive medium and particularly in hydrogen environment. In such problems it is necessary to calculate the pressure variation inside the crack as a result of gas diffusion and crack growth under this pressure. Hence, it is necessarily to solve problems of diffusion theory and elasticity theory for a cracked medium together with some additional conditions that provide the link between these two fundamental problems. We study an infinite medium containing a crack, which occupies a plane domain of arbitrary shape. Both, elasticity and diffusion problems are three-dimensional mixed Dirichlet - Neumann problems, which are reduced to two-dimensional integro-differential equations in the crack domain. The integro-differential equation of the elasticity problem about the crack is solved by new developed Boundary Element Method (BEM) with Asymptotic Formula for its Boundary Elements, which dramatically reduces the calculation time. The crack spreading is then calculated based on the Method of Refining Nets along the crack contour. Then the BEM is used to solve the integro-differential equation for diffusion-into-crack problem similar to the analogous problem of filtration of the fluid into a crack, with Asymptotic Boundary Elements calculation as well.

12. The matrices of low mutual coherence
Ghanshyam Bhatt
Tennessee State University
gbhatt@tnstate.edu

The matrix with low mutual coherence arise in applications in signal processing. The lowest mutual coherence provides the equiangularity among the columns. Householder matrices are used in this paper to construct matrices that form finite tight frames and have low mutual coherence. In some cases the algorithm also produces finite equiangular tight frames. In cases when the equiangular frames do not exit, it produces tight frames of approximately unit norm. A pair of orthogonal tight frames can be constructed from the resulting frames as well.
13. The Runge-Kutta based compact fourth-order implicit-explicit scheme for numerical solution of Kuramoto-Sivashinsky equation
Harish Bhatt
Savannah State University
bhatt@ savannah state.edu
Coauthors: Abhinandan Chowdhury

In this talk, we introduce a fourth-order Runge-Kutta based implicit-explicit scheme in time along with compact fourth-order finite difference scheme in space for the solution of a one-dimensional Kuramoto-Sivashinsky equation. The proposed scheme takes full advantage of the method of line and partial fraction decomposition techniques; therefore, it just needs to solve two backward Euler-type linear systems at each time step to get the solution. Performance of the scheme is investigated by testing it on some test examples and comparing the numerical results with relevant known schemes. The numerical results show that the proposed scheme is more accurate and reliable than existing schemes.

14. On the well-posedness of inviscid quasi-geostrophic equations of large-scale geophysical flows
Qingshan Chen
Clemson University
qsc@clemson.edu

When the length scale of the flow is on the same order as the Rossby deformation radius, which is often the case in the interior of the flow, the classical rigid-lid assumption is no longer valid, the impact of the free surface/interface deformations on the vorticity field is no longer negligible, and therefore it has to be accounted for in the model. In this talk, we present some new results concerning the well-posedness of the barotropic quasi-geostrophic equation and the multi-layer QG equations, where the top surface, and the layer interfaces for the multilayer QG, are left free to evolve. It is shown that, when the free surface/interfaces are included as components of the potential vorticity, the models remain globally well-posed, under certain generic assumptions on the initial state and the boundary of the domain.

15. PDE based nonpolar multiscale solvation modeling, analysis and computation.
Zhan Chen
Georgia Southern University
zchen@ georgiasouthern.edu

Solvation analysis is one of the most important tasks in chemical and biological modeling. Implicit solvent models are some of the most popular approaches. In this work, based on differential geometry theory, we defines the solvent-solute boundary via the variation of the nonpolar solvation free energy. The solvation free energy functional of the system is constructed based on a continuum description of the solvent and the discrete description of the solute. The first variation of the energy functional gives rise to the governing Laplace-Beltrami equation. The present model predictions of the nonpolar solvation energies are in an excellent agreement with experimental data. Moreover, the existence of a global minimizer for the nonpolar solvation model has been proved.

16. Spectra of boundary integral operators defined on the unit sphere for the modified Laplace equation
Vani Cheruvu
Department of Mathematics and Statistics, The University of Toledo
van i. cheruvu@utoledo.edu
Coauthors: Shravan Veerapaneni, Ryan Kohl and Eduardo Corona, Department of Mathematics, University of Michigan

We consider a modified Laplace equation on a unit sphere. Spherical harmonics are used for the expansion of the unknown function. We show that on the unit sphere, both modified Laplace single and double layer operators diagonalize in spherical harmonic basis. The analytic expressions for evaluating the operators away from the boundary are also derived. Currently, we are working on the numerical aspects. In this talk, we present both the analytical and numerical results of our work.

17. Some bifurcation results for fractional Laplacian problems
Maya Chhetri
The University of North Carolina at Greensboro
maya@ uncg. edu
Coauthors: Petr Girg

We consider an asymptotically linear problem involving fractional Laplacian operator. Using bifurcation theory, we establish the existence of unbounded connected component of solution set bifurcating from infinity at the simple
18. Application of Residue Inversion Formula for Solving System of Initial Value Problems of Linear Ordinary Differential Equations with Constant Coefficients
Sambo Dachollom
Department of Mathematics/Statistics, School Of Science, Akanu Igbia Federal Polytechnic, Unwana, Afikpo, Ebonyi State
dachollomsambo@gmail.com
Coauthors: Oko N'lia

The Laplace Transformation is one of the most widely and frequently used transformation in sciences and Engineering. Its application in solving initial value Problems (IVP) of ordinary differential equations (ODE’s) is well known to scholars. In this paper we reviewed the traditional algebraic method (i.e. the Laplace Transformation Method) of solving system of linear Ordinary Differential Equations with constant coefficients and now show how the newly established Residue Inversion Formula can best be applied directly in obtaining the Inverse Laplace Transform when solving system of linear ode’s with constant coefficients hence, simplify the traditional method. This new Residue approached eliminates computational stress and resultant time wastage by circumventing the rigor of resolving into partial fractions and the use of Table of Laplace that is not always readily available. Numerical results experimented by applying the Residue Inversion approach in solving system of initial value problems of linear ordinary differential equations with constant coefficients are proven to be elegant, efficient, valid and reliable.

19. Monotonicity Results for the Operators on Discrete Fractional Calculus
Raj Dahal
Coastal Carolina University
rdahal@coastal.edu
Coauthors: Chris Goodrich

A brief history of monotonicity and convexity of discrete fractional delta and nabla operators will be provided including some recent results on mixed order monotonicity results for sequential fractional differences.

20. Optimal Fishery Management for the Black Sea Anchovy Ecosystem Model
Mahir Demir
University of Tennessee, Knoxville
mdemir@vols.utk.edu
Coauthors: Suzanne Lenhart

In contrast to the traditional fishery management focusing on one species, ecosystem based fishery management focusing on the whole ecosystem of the species by using the dynamics of food chain models is an useful trend in the commercial fishery to not only conserve and manage renewable food resources, but also to have optimal and healthy ecosystems. A food chain model coupled with optimal control theory can be used to investigate harvesting strategies for maximizing the discounted net value of a fish population. Since fish do not exist in a habitat by themselves, the presence of predators and/or competing species is an important feature in harvest and conservation in a food web. Therefore, we present a food chain model for harvesting of Black Sea anchovy on the southern part of the Black Sea. The anchovy stock coupled with a prey and a predator species is modeled using a system of nonlinear differential equations. The objective for the problem is to find the optimal harvesting strategy that maximizes the discounted net value of the anchovy population with seasonal harvesting. Necessary conditions for the optimal harvesting policy are established. In the study, we not only got more profitable harvesting strategies for the southern part of the Black Sea, we also obtained the maximum harvesting effort for a healthy ecosystem, and obtained the optimal annual landing of the anchovy population that can be considered as a quotation for the fishery, which is a natural result of the application of optimal control theory (OCT) for an optimal and healthy fishery management.

Zachary Denton
North Carolina A&T State University
zdenton@ncat.edu

Quasilinearization method is developed for finite systems of Riemann-Liouville fractional differential equations of order $q$, $0 < q < 1$. This method is an iterative technique to approximate nonlinear systems using weighted sequences of linear systems that converge uniformly, monotonically, and quadratically to the unique solution. Sequences are constructed from lower and upper solutions from the original nonlinear system.
22. Travelling waves in the Fisher-KPP equation with nonlinear diffusion and a non-Lipschitzian reaction term  
   Pavel Drabek  
   *University of West Bohemia in Pilsen, Univerzitni 8, Pilsen, Czech Republic*  
   pdrabek@kma.zcu.cz  
   Coauthors: Peter Takac, University of Rostock, Germany  
   We consider a one-dimensional reaction-diffusion equation of Fisher-Kolmogoroff-Petrovsky-Piscouoff type. We investigate the effect of the interaction between the nonlinear diffusion coefficient and the reaction term on the existence and nonexistence of travelling waves. Our diffusion coefficient is allowed to be degenerate or singular at both equilibrium points, 0 and 1, while the reaction term need not be differentiable, even non-Lipschitz. We show that these facts influence the existence and qualitative properties of travelling waves in a substantial way.

23. Inverse scattering with energy-dependent potentials and a related Marchenko integral equation  
   Ramazan Ercan  
   *The University of Texas at Arlington*  
   ramazan.ercan@mavs.uta.edu  
   Coauthors: Tuncay Aktosun  
   The inverse problem on the line is considered for a first-order system of ordinary linear differential equations with energy-dependent potentials. The goal in the inverse problem is to determine the two potentials appearing in the linear system from the corresponding scattering data. This is accomplished by recovering the potentials from the solution to a system of linear integral equations, called the alternate Marchenko system, using the scattering data as input. A systematic derivation of the alternate Marchenko system is provided, and a contrast is made with a related Marchenko system and its derivation by Tsuchida.

24. Dynamics of bubbles in a quark-hadron system  
   Ricardo Francisco Fariello  
   *Universidade Estadual De Montes Claros*  
   ricardo.fariello@unimontes.br  
   We study the evolution of bubbles during the quark-hadron phase transition. In the literature, we have found only one derivation of the form of the bubble equation we use here. This is a relativistic version of the Rayleigh-Plesset equation for bubble dynamics. In the non-relativistic approach, this equation becomes a Briot-Bouquet equation. Interestingly, Cauchy’s problem for the non-relativistic equation of motion can be a case of the problem of spherical cavities that can always be rearranged in a standard canonical form by means of a transformation of scale known as Sundman transformation. The equation that gives the dynamics of the relativistic bubble, which is integrodifferential, and which must be numerically integrated, has a pressure difference term that controls the collapse or expansion. Our calculations show that the time-scale of the transition is rather large, lasting several Fermis.

25. On a 2D avascular model of glioma with weak Allee effect  
   Peng Feng  
   *Florida Gulf Coast University*  
   pfeng@fgcu.edu  
   Coauthors: Zhewei Dai, Dorothy Wallace  
   We revisit a partial differential equation model of avascular tumor growth. The model considers the densities of tumor cells in three stages: proliferating cells, quiescent cells and necrotic cell. We investigate the effect of apoptosis of proliferating cells and necrosis of quiescent cells. We also study the effect the Allee effect on the growth of avascular tumor. The system is numerically solved in 2D using different sets of parameters to explore the effects of these parameters on growth of tumor and the formation of necrotic core.

26. Classes of reaction diffusion equations where a parameter influences the equation as well as the boundary condition  
   Nalin Fonseka  
   *University of North Carolina at Greensboro*  
   g_fonsek@uncg.edu  
   We study positive solutions to steady state reaction diffusion equations of the form:  
   \[
   \begin{align*}
   -\Delta u &= \lambda f(u); \quad \Omega, \\
   \frac{\partial u}{\partial \eta} + \mu(\lambda) u &= 0; \quad \partial \Omega,
   \end{align*}
   \]
where \( \lambda > 0, \Omega \) is a bounded domain in \( \mathbb{R}^N; N \geq 1 \) with smooth boundary, \( \frac{\partial u}{\partial \eta} \) is the outward normal derivative of \( u \), \( \mu \in C([0, \infty)) \) is strictly increasing such that \( \mu(0) \geq 0 \) and \( f \in C^2([0, r_0]) \) with \( 0 < r_0 \leq \infty \). If \( r_0 < \infty \) we assume \( f \in C^2([0, r_0]) \) with \( f(r_0) = 0 \) and \( f(s) \leq 0 \) for \( s \in (r_0, \infty) \), and if \( r_0 = \infty \) we assume \( \lim_{s \to \infty} f(s) > 0 \) and \( \lim_{s \to \infty} \frac{f(s)}{s} = 0 \) (sublinear at \( \infty \)). Note here that the parameter \( \lambda \) influences both the equation and the boundary condition. We discuss existence, nonexistence, multiplicity and uniqueness results for the cases when (A) \( f(0) = 0 \), (B) \( f(0) < 0 \), and (C) \( f(0) > 0 \). We obtain existence and multiplicity results by the method of sub-super solutions and uniqueness results by comparison principles and a priori estimates.

Joint work with R. Shivaji, Byungjae Son, K. Spetzer.

27. On the numerical estimation of parameters for a multi-part decision process
John Ford
MTSU
jrf2m@mtmail.mtsu.edu
Coauthors: Dr. Rachel Leander

The intermitotic time of mammalian cells has been modeled as a multi-stage process consisting of independent drift-diffusion threshold processes. These stochastic differential equation models are represented by the Inverse Gaussian distribution and are then convolved together to represent the total multi-stage process. However, as there is no known closed form expression for this convolution, the densities must be approximated numerically at great expense. This talk gives an overview of the scientific and mathematical background of this subject and a detailed treatment of the numerical challenges and computational techniques needed to approximate these densities. Finally, a brief discussion is given to the use of these approximate densities in the maximum likelihood estimation of model parameters for specific mammalian cell line data.

28. A unifying condition for well-posed approximations of ill-posed Cauchy problems in Banach space
Matthew A. Fury
Penn State Abington
maf44@psu.edu

In this talk, we study the abstract Cauchy problem \( \frac{du}{dt} = Au, 0 < t < T, u(0) = x \) in Banach space where \( -A \) generates a holomorphic semigroup of angle \( \theta \). While several quasi-reversibility methods have been applied in order to regularize the problem, modifications may be required depending on the value of \( \theta \in (0, \pi/2] \). Here, we consider a unifying approximation condition and class of initial data such that regularization is independent of the value of \( \theta \). Results may be drawn for the backward diffusion equation in \( L^p(\mathbb{R}^n), 1 < p < \infty \) by letting \( A = -\Delta \). Additionally, we may consider applications to strongly elliptic differential operators of even order.

29. Most Probable Tipping Events in Noisy Piecewise Linear System with Periodic Forcing
John Gemmer
Wake Forest University
gemmerj@wfu.edu
Coauthors: Jessica Zanetell

We consider a periodically forced 1-D Langevin system with piecewise smooth drift that possesses two stable periodic orbits. We ask the question: is there a most likely transition path between these periodic orbits that allows us to identify a preferred phase of the forcing when tipping occurs? For autonomous systems with smooth drift the the Freidlin-Wentzell theory of large deviations provides a framework for understanding such rare events in the singular limit of vanishing noise strength. However, for non-autonomous and non smooth systems such a universal result is lacking. One difficulty is that in contrast with autonomous systems there are three relevant time scales: the period of the forcing, relaxation time to metastable states, and Kramer’s time of escape in the absence of forcing. A second complication is that the Freidlin-Wentzell theory implicitly assumes differentiability of the drift. By using least action techniques applied to a regularized version of Onsager-Machlup functional we systematically study how these time scales as well as the existence of the discontinuity influence the tipping events.
30. The closed form particular solutions for the Laplace operators using Oscillatory radial basis functions in 2D
Balaram Ghimire
Alabama State University
baghimire@alasu.edu
Coauthors: A.R. Lamichhane, Y. Wakayama, A. Sube.

The closed-form particular solutions of the radial basis functions (RBFs) are essential for the implementation of several numerical methods to solve various partial differential equations (PDEs). Recently, a new class of oscillatory RBFs has been introduced. In this talk, we derive the closed-form particular solutions of the oscillatory RBFs for the Laplace operator in 2D so that it can be applied to particular solutions based numerical methods. We have successfully implemented the newly derived particular solutions in the method of particular solutions (MPS) for solving Poisson's equation as well as elliptic PDEs with variable coefficients.

31. Volume scavenging of networked droplets
Thomas Hagen
The University of Memphis
thagen@memphis.edu
Coauthors: Paul Steen, Cornell University

A system of $N$ spherical-cap fluid droplets protruding from circular openings on a plane is connected through channels. This system is governed by surface tension acting on the droplets and viscous stresses inside the fluid channels. The fluid rheology is given by the Ostwald-de Waele power law, thus permitting shear thinning. The pressure acting on each droplet obeys the Young-Laplace law. Liquid is exchanged along the network of fluid conduits due to an imbalance of the Laplace pressures between the droplets. This mechanism, christened “volume scavenging,” leads to interesting dynamics.

Our analytical study of this surface-tension driven flow sheds light on the occurrence of equilibria and their stability for the corresponding large gradient system of ODEs on a simple, connected graph. We will report about previously unknown equilibrium solutions (most relevant to explain the grab-and-release mechanism in palmetto beetles and biomimicry applications), a (surprisingly) complete, rigorous classification of their stability in dependence on the relevant bifurcation parameters as well as related results on forward invariant sets and hierarchies of equilibria. The long-term dynamics will be demonstrated with some animations.

32. Gradient Method in Hilbert-Besov Spaces for the Optimal Control of Parabolic Free Boundary Problems
Ali Hagverdiyev
Florida Institute Of Technology
ahaqverdiyev2011@my.fit.edu
Coauthors: Dr. Ugur G. Abdulla, Dr. Vladislav BukshTyov

In this presentation I will talk about computational analysis of the inverse Stefan type free boundary problem, where information on the boundary heat flux is missing and must be found along with the temperature and the free boundary. We pursue optimal control framework introduced in U.G. Abdulla, Inverse Problems and Imaging, 7, 2(2013), 307-340; 10, 4(2016), 869-898, where boundary heat flux and free boundary are components of the control vector, and optimality criteria consist of the minimization of the quadratic declinations from the available measurements of the temperature distribution at the final moment, phase transition temperature on the free boundary, and the final position of the free boundary. We develop gradient descent algorithm based on Frechet differentiability in Hilbert-Besov spaces complemented with preconditioning or increase of regularity of the Frechet gradient through implementation of the Riesz representation theorem. Five model examples with various levels of complexity are considered. Extensive comparative analysis through implementation of preconditioning and Tikhonov regularization, calibration of preconditioning and regularization parameters, effect of noisy data, comparison of simultaneous identification of control parameters vs. nested optimization is pursued.

33. Multiple Positive Radial Solutions to Elliptic Equations in an Annulus
Jaffar Ali Shahul Hameed
Florida Gulf Coast University
jashahulhameed@fgcu.edu
Coauthors: S. Padhi

We will investigate the existence of multiple positive radial solutions of the elliptic equation

$$\Delta u + \lambda g(|x|)f(u) = 0, \quad R_1 < |x| < R_2,$$

(1)
where $x \in \mathbb{R}^N$, $N \geq 2$, along with the following linear boundary conditions at $R_1$ and $R_2$:

$$u = 0 \text{ on } |x| = R_1 \text{ and } |x| = R_2,$$

$$u = 0 \text{ on } |x| = R_1 \text{ and } \frac{\partial u}{\partial r} = 0 \text{ on } |x| = R_2,$$

$$\frac{\partial u}{\partial r} = 0 \text{ on } |x| = R_1 \text{ and } u = 0 \text{ on } |x| = R_2,$$

where $x \in \mathbb{R}^N$, $N \geq 2$, $r = |x|$ and $\frac{\partial}{\partial r}$ denotes the differentiation in the radial direction, and $0 < R_1 < R_2 < \infty$.

We use Leggett-Williams multiple fixed point theorems to obtain sufficient conditions for the existence of at least one and in some cases multiplicity of positive radial solutions.

34. **Persistence of spatial analyticity for nonlinear evolution equations**  
   Alex Himonas  
   *University of Notre Dame*  
   himonas@nd.edu  

In this talk we will discuss the persistence of spatial analyticity for solutions of the Cauchy problem of two important integrable evolutions equations, namely, the Korteweg-de Vries and the Camassa-Holm equations. For a class of analytic initial data with a given uniform radius of analyticity, we shall present lower bounds on the uniform radius of analyticity at any time.

35. **Positive weak solutions of fractional Laplacian boundary value problems**  
   Elliott Hollifield  
   *University of North Carolina at Greensboro*  
   ezholli@uncc.edu  

Coauthors: Maya Chhetri, Petr Girg  

We present a sub- and supersolution method for fractional Laplacian boundary value problems. Using this method, we establish existence of positive weak solutions with nonlinearities satisfying a sublinear condition at infinity. We present numerical experiments that verify our theoretical results.

36. **Recent progress on a Camassa-Holm type equation.**  
   John Holmes  
   *The Ohio State University*  
   holmes.782@osu.edu  

Camassa-Holm type equations are of the form $u_t + uu_x = F(D, u)$, where $F(u)$ is an order zero or less operator applied to $u$. These equations can be thought of as perturbations of Burgers equation. Indeed, Camassa-Holm type equations share many of the same properties which Burgers equation exhibits. We will explore some of these properties for a Camassa-Holm type equation.

37. **A Discrete Age Structured Model of Hantavirus Among Rodents in Paraguay**  
   Morganne Igoe  
   *University of Tennessee-Knoxville*  
   migoe@utk.edu  

Coauthors: E. Joe Moran, Unity College; Theresa Sheets, University of Maryland, Baltimore County; Jeff DeSalu, The Ohio State University; Colleen B. Jonsson, University of Tennessee-Knoxville and National Institute for Mathematical and Biological Synthesis; Suzanne Lenhart, National Institute for Mathematical and Biological Synthesis; Robert D. Owen, Texas Tech University; Megan A. Rúa, National Institute for Mathematical and Biological Synthesis and Wright State University.

Rodent-borne hantaviruses are zoonotic pathogens that can cause disease in humans through inhalation of rodent excreta. To evaluate the prevalence of the Jaborá virus over time within its rodent reservoir, we formulated a mathematical model with multiple age classes of the rodent reservoir and unique infection class progression feature. We then param-eterized the model with data collected from a survey of rodents in the the Mbaracayú Reserve in Paraguay where the virus is endemic. Our model incorporates three types of infection over the lifetime of the rodent as well as a recovered class. A new feature of the model allows transition from the latent to the persistently infected class. With a more complete age and disease structure, we are better able to identify the driving forces of epidemiology of hantaviruses in rodent populations.
38. Evolution of interfaces for the non-linear parabolic p-Laplacian type diffusion equation of non-Newtonian elastic filtration with strong absorption
Roqia Jeli
506 Golden dove ave ne
rjeli2011@my.fit.edu
Coauthors: Dr. Ugur Abdulla
We present a full classification of the short-time behaviour of the interfaces and local solutions to the nonlinear parabolic p-Laplacian type reaction-diffusion equation of non-Newtonian elastic filtration
\[ u_t - \left( |u_x|^p u_x \right)_x + bu^\beta = 0, \quad 1 < p < 2, \beta > 0 \]
If interface is finite, it may expand, shrink, or remain stationary as a result of the competition of the diffusion and reaction terms near the interface, expressed in terms of the parameters \( p, \beta, \text{sign } b \), and asymptotics of the initial function near its support. In some range of parameters strong domination of the diffusion causes infinite speed of propagation and interfaces are absent. In all cases with finite interfaces we prove the explicit formula for the interface and the local solution with accuracy up to constant coefficients. We prove explicit asymptotics of the local solution at infinity in all cases with infinite speed of propagation. The methods of the proof are based on nonlinear scaling laws, and a barrier technique using special comparison theorems in irregular domains with characteristic boundary curves. A full description of small-time behaviour of the interfaces and local solutions near the interfaces for slow diffusion case when \( p > 2 \) is presented in a recent paper.

39. Topological Degrees on Unbounded Domains
Ishwari J. Kunwar
Fort Valley State University
kunwari@fvsu.edu
Coauthors: Dhruba R. Adhikari
Let \( D \) be an open subset of \( \mathbb{R}^N \) and let \( f : D \to \mathbb{R}^N \) be continuous. The classical topological degree for \( f \) demands that \( D \) be bounded. The boundedness of domains is also assumed for the topological degrees for compact displacements of the identity and for operators of monotone type in Banach spaces. In this talk, we present, following the methodology introduced by Nagumo, a construction of topological degrees for functions on unbounded domains in finite dimensions, and define the degrees for Leray-Schauder operators and \((S+)\)-operators on unbounded domains.

40. Solving Differential Equations in terms of Special Functions
Vijay Jung Kunwar
Albany State University
vijay.kunwar@asurams.edu
Coauthors: Mark van Hoeij
Special functions play a key role on solving ordinary differential equations. Special functions like Airy, Bessel, Kummer, Whittaker, Liouvillian, and Hypergeometric functions are used to find closed form solutions which are exact solutions expressed using finite amount of data. A differential equation is called Fuchsian if all of its singularities are regular. Algebraic solutions of Fuchsian equations can be found using Kovacic’s algorithm, while non-algebraic solutions can be obtained as closed form in terms of Hypergeometric functions. In this presentation, we will discuss about our algorithms to find closed form solutions of second order ordinary differential equations using Hypergeometric functions.

41. Beam Equation from ODE to PDE
Tuwaner Lamar
Morehouse College
tuwaner.lamar@morehouse.edu
A study of a beam equation is conducted starting with the one-dimensional ordinary differential equation (ODE) model and progressing to the time dependent partial differential equation (PDE) model. Analysis of exact solution along with theory of existence and uniqueness of solutions are presented.
42. Assessing the Economic Tradeoffs Between Prevention and Suppression of Forest Fires
Suzanne Lenhart
University of Tennessee
slenhart@utk.edu

Optimal control theory is applied to a model of managing fire events incorporating the economic impacts. The number of large-scale, high-severity forest fires occurring is increasing, as is the cost to suppress these fires. We incorporate the stochasticity of the time of a forest fire into our model and explore the trade-offs between prevention management spending and suppression spending. The problem is converted to an optimal control problem for ordinary differential equations by taking the expectation of the objective functional with respect to the random variable for a fire event.

43. The long time behaviour of Energy norm of the Fractional Klein Gordon Equation
Satbir Malhi
The University of Kansas
smalhi@ku.edu
Coauthors: Milena Stanislavova

In this talk, we consider the fractional Klein-Gordon equation in one spatial dimension, subjected to a damping coefficient, which is non-trivial and periodic, or more generally strictly positive on a periodic set. We showed that the energy of the solution decays at the polynomial rate $O(t^{-1/2})$ for $0 < s < 2$ and at some exponential rate when $s \geq 2$.

Our approach is based on the asymptotic theory of $C_0$ semigroups in which one can relate the decay rate of the energy in terms of the resolvent growth of the semigroup generator. The main technical result is a new observability estimate for the fractional Laplacian, which may be of independent interest.

44. Blood Flow with Nanoparticles through Stenosed Arteries under the effect of Magnetic field
Rajbala Malik
Asst. Prof. A.I.J.H.M. College, Rohtak(Haryana)-India
anjalisidharath@gmail.com
Coauthors: Sushila Kumari, Jagdish Singh; Department of Mathematics, Pt. N.R.S Govt. College, Rohtak-India; Department of Mathematics, M.D.U., Rohtak-India.

The present investigation is devoted to suppositional study of blood flow with nano particles through a stenosed artery with permeable walls. The initiation of nanoparticles in blood will produce unharmonious consequences for stenosed tube. This study is carried out to reveal the effects of magnetic field on the harsh consequences of nanoparticles in case of stenosed artery. The governing equations of visualized model of blood flow are solved using the blend of laplace and Hankel transform method. The closed forms of expressions are accomplished for velocity and temperature distributions. The flow rate and shear stress are also compassed in the constricted region of tube. The results are manifested by using MATLAB and are demonstrated as plots for the distinctive parameters. It is depicted that the combined effect of time and magnetic field, is advantageous for the flow of blood in the stenosis region and with the rise in volume fraction of nanoparticles, the velocity of blood takes the edge off.

45. Nonlinear scalar multipoint boundary value problems at resonance
Dan Maroncelli
College of Charleston
maroncellidm@cofc.edu

In this work we provide conditions for the existence of solutions to nonlinear boundary value problems of the form

$$y(t + n) + a_{n-1}(t)y(t + n - 1) + \cdots + a_0(t)y(t) = g(t, y(t + m - 1))$$

subject to

$$\sum_{j=1}^{n} b_{ij}(0)y(j - 1) + \sum_{j=1}^{n} b_{ij}(1)y(j) + \cdots + \sum_{j=1}^{n} b_{ij}(N)y(j + N - 1) = 0$$

for $i = 1, \cdots, n$. The existence of solutions will be proved under a mild growth condition on the nonlinearity, $g$, which must hold only on a bounded subset of $\{0, \cdots, N\} \times \mathbb{R}$. 
46. The first-order master equation of mean-field games
Sergio Mayorga
Georgia Institute of Technology
smayorga3@gatech.edu

We will introduce a 1st-order mean-field game system (mfg) of equations and explain its relationship to an $N$-player differential game in Nash equilibrium. We will show how the mfg system can be solved and how it can be used to construct a solution to one of the so-called master equations of mean field game theory. An intuitive understanding of the master equation can be gained by looking back to the $N$-player differential game.

47. Mathematics of an epidemiology-genetics model for assessing the role of insecticides resistance on malaria transmission dynamics
Jemal Mohammed-Awel
Department of Mathematics, Valdosta State University, Valdosta, Ga 31698, USA
jmohammedawel@valdosta.edu
Coauthors: Abba Gumel; School of Mathematical and Statistical Sciences, Arizona State University, Tempe, AZ, 85287, USA

Although the widespread use of indoors residual spraying (IRS) and insecticides treated bednets (ITNs) has led to a drastic reduction of malaria cases and burden in endemic areas, such usage has also resulted in the major challenge of the evolution of insecticide resistance in the mosquito population in those areas. Thus, efforts to combat malaria also include the urgent problem of effectively managing insecticide resistance. This study is based on the design and analysis of a new mathematical model for assessing the impact of insecticides resistance in the mosquito population (due to widespread use of IRS and ITNs) on the transmission dynamics and control of malaria in a population. The model, which couples disease epidemiology with vector population genetics, incorporates several fitness costs associated with insecticide resistance for malaria model. Detailed rigorous analysis of the model is presented. Using data and parameter values relevant to malaria dynamics in moderate and high malaria transmission settings in some parts of Ethiopia, simulations of the model show that, while the ITNs-IRS strategy can lead to the effective control of the disease in both the moderate and high malaria transmission setting if the ITNs coverage is high enough (e.g., > 72 % in moderate and > 95 % in high transmission setting), it fails to effectively manage insecticide resistance in the community. It is further shown that the effective size of the coverage level of the ITNs and IRS required to effectively control the disease, while effectively managing insecticide resistance in the mosquito population, depends on the magnitude of the level of resistant allele dominance (in mosquitoes with heterozygous genotype) and several fitness costs associated with the insecticide resistance in the vector population. For instance, in a moderate transmission setting, malaria burden can be reduced to low levels of endemicity (even with low coverage of ITNs and IRS), and insecticide resistance effectively managed, if the fitness costs of resistance are at their assumed baseline values. However, such reduction is not achievable if the fitness costs of resistance are further lowered.

48. Application of the Henstock integral to path integrals: new formulation and numerical experiments
Ekaterina Nathanson
Georgia Gwinnett College
enathanson@ggc.edu
Coauthors: Palle E. T. Jørgensen, Wayne N. Polyzou

We address the issue of finding a rigorous interpretation to what in the literature is called “the Feynman integral”, solution to the Schrödinger equation. Our approach utilizes the Henstock integration technique and nonabsolute integrability of the Fresnel integrals. It is known that a solution to Feynman's original problem in the form of a sigma-finite positive path-space measure is not possible. In our analysis, we change the perspective and allow instead complex “probability densities,” computed as Fresnel integrals. We define the path integral as the expectation value of the potential functional, with respect to a complex probability distribution on a space of paths. This formulation was used in numerical experiments on computing real-time path integrals for potential scattering in one dimension.

49. Spectral dimension of fractal Laplacians and application to heat kernel estimates
Sze-Man Ngai
Georgia Southern University and Hunan Normal University
smngai@georgiasouthern.edu
Coauthors: Qingsong Gu, Jiaxin Hu, Wei Tang, Yuanyuan Xie

We report some results on the spectral dimension of fractal Laplacians defined by one-dimensional self-similar measures with overlaps. As an application, we show that spectral dimension plays an important role in obtaining heat kernel estimates for the associated Laplacians. Some of this work is joint with Qingsong Gu, Jiaxin Hu, Wei Tang and Yuanyuan Xie.
50. Modeling the macrophage-anthrax spore interaction: implications for early host-pathogen interactions
Buddhi Pantha
*Abraham Baldwin Agricultural College*
bpantha@abac.edu
Coauthors: Judy Day, Alan Cross, Suzanne Lenhart

Inhalational anthrax, caused by the gram positive bacteria Bacillus anthracis, is a potentially fatal form of anthrax infection. It is initiated after inhaled spores are deposited in the lung, phagocytosed by immune cells, and subsequently transported to nearby lymph nodes. Intracellular spores that successfully germinate and become vegetative bacteria can lyse their host cell and contribute to bacterial outgrowth and toxin production. To better understand the early disease dynamics of the host-pathogen interaction, we develop a mathematical model of ordinary differential Equations and estimate parameters using available data. The model which consists of two subsystems is designed in accordance with an in vitro experimental protocol in which macrophages were challenged with varying doses of spores at spore-to-macrophage ratios of 1:1, 1:2, 1:10, 1:20. Initial modeling results suggested the need to consider two distinct subpopulations of anthrax bacteria: newly germinated bacteria which cannot replicate immediately and fully vegetative bacteria which can. Additional modeling results provide insights into possible reasons why macrophage-induced killing is more effective at the 1:20 ratio.

51. An Isospectral Flow on Banded Matrices
Krishna P Pokharel
*Young Harris College*
kppokharel@yhc.edu

In this talk, we discuss an isospectral flow (Lax flow) in the space of matrices, which deforms any given real banded matrix with simple real spectrum to a symmetric matrix. The Lax flow is given by

\[
\frac{dA}{dt} = \left[ A^T, A \right]_{du},
\]

where brackets indicate the usual matrix commutator, \([A, B] = AB - BA\), \(A^T\) is the transpose of \(A\) and the matrix \([A^T, A]_{du}\) is the matrix equal to \([A^T, A]\) along diagonal and upper triangular entries and zero below diagonal. We prove that if the initial condition \(A_0\) is banded matrix with lower bandwidth \(p = 2\) and upper bandwidth \(q = 0\) with simple real spectrum and second subdiagonal elements different from zero, then \(\lim_{t \to \infty} A(t)\) exists, it is a pentadiagonal symmetric matrix isospectral to \(A_0\) and it has the same sign pattern in the second subdiagonal elements as the initial condition \(A_0\). Some simulations results are provided to highlight some aspects of this nonlinear system.

52. Identification of Parameters in Systems Biology
Roby Poteau
*Florida Institute of Technology*
rpoteau2010@my.fit.edu
Coauthors: Dr. Ugur Abdulla

We consider the inverse problem for the identification of the finite dimensional set of parameters for systems of nonlinear ordinary differential equations (ODEs) arising in systems biology. A numerical method which combines Bellman’s quasilinearization with sensitivity analysis and Tikhonov’s regularization is implemented. We apply the method to various biological models such as the classical Lotka-Volterra system, bistable switch model in genetic regulatory networks, gene regulation and repressilator models from synthetic biology. The numerical results and application to real data demonstrate the quadratic convergence.

53. Special-Functions Solutions of Burger’s Equation
Emma Previato
*Boston University*
ep@bu.edu

The inviscid Burgers equation is part of an ”integrable hierarchy” of PDEs, also known as dispersionless KP. Work by A.V. Zabrodin (2001) gave a geometric solution that uses moments of an analytic curve, but no explicit formulas; A. Boyarsky, A. Marshakov, O. Ruchayskiy, P. Wiegmann and A. Zabrodin (2001) identified one case in which the curve is algebraic and the solution can be made explicit. In joint work with Shigeki Matsutani (2008), explicit solutions were found, that use Klein’s sigma function on any curve that is a cyclic cover of the Riemann sphere; these were extended by J. Komeda and Matsutani (2018) to any smooth curve in Weierstrass canonical form. The independent variables are integrals on the Jacobian of the curve. The talk will present the definition of the sigma function and the explicit solutions, and review the Zabrodin construction to pose the question of the relationship between the two.
Qualitative Analysis of Non convolution Volterra Summation Equations
Youssef Raffoul
University of Dayton
yraffoul1@udayton.edu

In the past hundred and fifty years, Lyapunov functions/functionals have been exclusively and successfully used in the study of stability, existence of periodic and bounded solutions. This author has extensively used Lyapunov functions/functionals for the purpose of analyzing solutions of functional equations and each time the suitable Lyapunov functional presented us with unique difficulties that could only overcome by the imposition of severe conditions on the given coefficients. In practice, Lyapunov direct method requires pointwise conditions, while as so many real-life problems call for averages. Moreover, it is rare that we encounter a problem for which a suitable Lyapunov functional can be easily constructed. It is common knowledge among researchers that stability and boundedness results go hand in hand with the type of the Lyapunov functional that is being applied. We use fixed point theory and other mathematical tools, to qualitatively analyze solutions of Volterra summation equations. Volterra summation equations play major role in the qualitative analysis of neutral difference equations. To see this we consider the neutral difference equation

\[ \Delta (D(n,x_n)) = f(n,x_n), \quad n \in \mathbb{Z}^+. \]  

If

\[ D(n,0) = f(n,0) = 0, \]

then one would have to ask that the zero solution of \( D(n,0) = 0 \) be stable in order for the zero solution of (2) to be stable. On the other hand, if we are interested in studying boundedness of solutions of (2), one would have to require that the solutions of

\[ D(n,x_n) = h(n), \]

be bounded for a suitable function \( h(n) \) with a suitable conditions. Equation (2) is typified by neutral equations of the form

\[ \Delta \left( x(n) + \sum_{s=n-h}^{n-1} b(s+h)x(s) \right) = f(n,x_n). \]

In particular, we consider the vector Volterra summation equation

\[ x(t) = a(t) - \sum_{s=0}^{t-1} C(t,s)x(s), \quad t \in \mathbb{Z}^+. \]

where \( x \) and \( a \) are \( k \)-vectors, \( k \geq 1 \), while \( C \) is an \( k \times k \) matrix. To clear any confusion, we note that the summation term in (4) could have been started at any initial time \( t_0 \geq 0 \). We will establish the Resolvent equation associated with (4) combined with Lyapunov functionals and fixed point theory to obtain boundedness on solutions and their asymptotic behaviors. One of the major difficulties when using a suitable Lyapunov functional on Volterra summation equation is relating the solution back to that Lyapunov functional. For \( x \in \mathbb{R}, \|x\| \) denotes the Euclidean norm of \( x \). For any \( k \times k \) matrix \( A \), define the norm of \( A \) by \|A\| = \text{sup}\{|Ax| : \|x\| \leq 1\}. \] Let \( X \) denote the set of functions \( \phi : [0,n] \rightarrow \mathbb{R} \) and \( \|\phi\| = \max\{|\phi(s)| : 0 \leq s \leq n\}. \) We will prove general theorems concerning the qualitative analysis of (4).
56. Monotone iterative techniques for Caputo differential equations with bounded delay
Diego Ramirez
Savannah State University
ramirez@ savannahstate .edu

In this talk we begin by stating the definitions of different sets of coupled lower and upper solutions of a Caputo
differential equation of order \( q, \ 0 < q < 1 \), with bounded delay. Then we construct two sequences which converge
uniformly and monotonically to minimal and maximal solutions of the problem. Finally, we state a condition that
guarantees the uniqueness of the solution.

57. Dual-Wind Discontinuous Galerkin Methods for Elliptic Obstacle Problem
Aaron Rapp
University of North Carolina at Greensboro
af rapp@ uncg .edu
Coauthors: Dr. Tom Lewis Dr. Yi Zhang

A discontinuous Galerkin (DG) finite-element interior calculus has been developed as a common framework to describe
various DG approximation methods for second-order elliptic problems. In this presentation, we will discuss the dual-
wind DG method and its application to the obstacle problem with Dirichlet boundary conditions. In particular, we will
consider applying the method to the problem \(-\Delta u \geq f\) on \(\Omega\) with \(u = g\) on \(\partial\Omega\) and \(u \geq \psi\) on \(\Omega\), where \(\psi\) is the given
obstacle. We will also present the results for several numerical tests that validate the performance of the method.

58. The 2D Anisotropic Magnetic Benard Equations
Dipendra Regmi
University of North Georgia
dipendra . regmi@ un g .edu
Coauthors: Ramjee Sharma

We study the global regularity of two dimensional magnetic Benard equations. We establish some conditional global
regularity results for partial dissipation and diffusion cases. We further investigate the slightly regularized system and
prove global existence and uniqueness.

59. Isometric Immersions, Energy Minimization, Periodic Patterns, and the Geometry of Leaves
Maximilian Rezek
Wake Forest University
rezemk17@ wfu .edu
Coauthors: John Gemmer

In the non-Euclidean model of elasticity, growth is modeled by a Riemannian metric that encodes local changes in
distance. In response to the growth, the sheet deforms to minimize an elastic energy. The elastic energy consists of the
sum of the stretching and bending energy. Minimizers of the stretching energy consist of isometric immersions of the
metric, while minimizers of the bending energy remain flat. The competition between bending and stretching selects a
pattern in the sheet. In this talk, we will show that periodic patterns have the lowest energy for a large class of metrics.
Qualitatively, our results agree with patterns observed in leaves and torn elastic sheets.

60. A 2D-PDE Model of Tailing Under High Pressure
Hashim Saber
University of North Georgia
Hashim . saber@ un g .edu
Coauthors: Amer Awad

Tailings are the materials left over after the process of separating the valuable fraction from the uneconomic fraction
of an ore. The most common method of disposal of tailings material is storing them in Tailing Dams and failing of
these Dams can cause serious damage to the surrounding environment. This paper focuses on the study the mechanical
characteristics of the tailings material under high pressures with the objective of gaining knowledge about the tail
behavior under consolidation. The problem is treated into two stages, the first stage is determining the sliding mass. The
second stage is when failing occurs. We propose a model for the first stage with an adaptive constitutive equation and
then analyze the second stage by considering flow properties under consolidation. We developed a two-dimensional (2D)
partial differential equation model for the analysis of the propagation of landslides involving a fluidized material such
as debris and mud flows. Preliminary numerical results of the proposed algorithm will be presented. The performance
of the algorithm and the analysis of the results suggest the use of the method to solve real problems of tailings under
high pressure.
61. Approximate Solution of Fredholm Integral Equation of the Second Kind Using a Combine Method
Nermin Abdelsatar Saber
Faculty of Engineering, Badr University in Cairo
engnermeinn@hotmail
Coauthors: Shoukralla, E. S., EL-Serafi, S. A.

A combine method is given for the approximate solution of Fredholm integral equations of the second kind. The proposed method based on the iteration techniques, while the kernel and the given known functions of the integral equation are approximated by Maclaurin polynomials of degree with error estimations. The convergence of the solution is studied and the conditions for the convergent solution is given. An algorithm of the obtained solution is established via matrices. Thus reducing the required solution so that only one coefficient matrix is required to be computed. Therefore, computational complexity can be considerably reduced and much computational time can be saved. The new proposed approach needs a small number of iterations to provide an exact result that proofs the power of the presented combine method.

---

62. On the almost axisymmetric flows.
Marc Sedjro
AIMS-Tanzania
sedjro@aims.ac.tz

Coauthors: Michael Cullen, Wilfrid Gangbo

Almost axisymmetric flows approximate the inviscid rotating hydrostatic Boussinesq equations and model tropical cyclones. In 1988, Shutt et al proposed a discrete procedure to construct a solution to the forced axisymmetric flow within a rigid boundary. In this talk, I will discuss how we have extended their results to the continuous case within an appropriate free boundary domain. In addition, I will explain how overcoming a regularity issue could be an important step toward extending our procedure to handle almost axisymmetric flows.

---

63. Breast Cancer Detection through Electrical Impedance Tomography and Optimal Control Theory: Theoretical and Computational Analysis
Saleheh Seif
Florida Institute of technology
sseif2014@my.fit.edu

Coauthors: Ugur G. Abdulla, Vladislav Bukshtynov, Saleheh Seif

The Inverse Electrical Impedance Tomography (EIT) problem on recovering electrical conductivity tensor and potential in the body based on the measurement of the boundary voltages on the electrodes for a given electrode current is analyzed. A PDE constrained optimal control framework in Besov space is pursued, where the electrical conductivity tensor and boundary voltages are control parameters, and the cost functional is the norm declinations of the boundary electrode current from the given current pattern and boundary electrode voltages from the measurements. The state vector is a solution of the second order elliptic PDE in divergence form with bounded measurable coefficients under mixed Neumann/Robin type boundary condition. Existence of the optimal control and Fréchet differentiability in the Besov space setting is proved. The formula for the Fréchet gradient and optimality condition is derived. Extensive numerical analysis is pursued in the 2D case by implementing the projective gradient method, re-parameterization via principal component analysis (PCA) and Tikhonov regularization.

---

64. Numerical solutions of generalized Korteweg-de Vries (KdV) equations
Scott Sims
University of North Georgia
scott.sims@ung.edu

Coauthors: Ramjee Sharma

We consider the following generalized version of the Korteweg-de Vries-Burgers (KdV) equation

\[ u_t + au_x + 2buu_x + cu_{xxx} - du_{xx} = 0. \]

Here, \( u = u(x, t) \) is a scalar function of \( x \in R \) and \( t \geq 0 \). This KdV equation models the shallow water waves. The scalar \( u \) represents the amplitude of the wave. Using periodic boundary conditions, the numerical solutions are computed by the pseudo-spectral method. In this presentation, we investigate the various limits of solutions as one or more of the parameters \( a, b, c \) and \( d \) tend to zero.
An existence result for superlinear semipositone $p$-Laplacian systems on the exterior of a ball

Byungjae Son

Wayne State University
byungjaeson@wayne.edu

Coauthors: Maya Chhetri, Lakshmi Sankar, Ratnasingham Shivaji

We study the existence of positive radial solutions to the problem

\[
\begin{align*}
-\Delta_p u &= \lambda K_1(|x|) f(v); \quad \Omega_e, \\
-\Delta_p v &= \lambda K_2(|x|) g(u); \quad \Omega_e, \\
u(x) &= v(x) = 0; \quad |x| = r_0, \\
u(x) &\to 0, v(x) \to 0 \text{ as } |x| \to \infty,
\end{align*}
\]

where $\Delta_p w := \text{div}(|\nabla w|^{p-2} \nabla w), 1 < p < n, \lambda$ is a positive parameter, $r_0 > 0$ and $\Omega_e := \{ x \in \mathbb{R}^n \mid |x| > r_0 \}$. Here $K_i : [r_0, \infty) \to (0, \infty), i = 1, 2$ are continuous functions such that $\lim_{r \to \infty} K_i(r) = 0$, and $f, g : [0, \infty) \to \mathbb{R}$ are continuous functions which are negative at the origin and have a superlinear growth at infinity. We establish the existence of a positive radial solution for small values of $\lambda$ via degree theory and rescaling arguments.

Spread of Zika Virus Diseases on Complex Network with Non-monotone Incidence Rate

Akhil Kumar Srivastav

Vellore Institute of technology
akhilkumar.srivastav2016@vitstudent.ac.in

Coauthors: Mini Ghosh

Vector-borne diseases are diseases caused by viruses, bacteria, parasites that are transmitted by vectors such as mosquitoes, ticks, sand-flies, mites etc.. As per WHO fact sheet, vector-borne diseases contribute more than 17\% are causing more suffering and mortality every year. In recent years, zika virus disease is also affecting people worldwide. Due to its large outbreaks in America during 2015-2016, This disease still is in America. It has become a major public health concern. Zika virus disease is primarily a mosquitoes-borne disease but there are evidences of sexual transmission of this disease too. In this paper, a nonlinear mathematical model on complex network for zika virus disease by considering non-monotonic incidence rate for human to human transmission is formulated and analyzed. The basic reproduction number (R0) of the model is computed. The key parameters of the model are computed using curve fitting to the real data by least-square method. Sensitivity analysis and numerical simulation are also performed for our proposed model. In addition to control the disease, different types of immunization strategies are discussed. Further this model is extended to optimal control model and is analyzed by using Pontryagins Maximum Principle. It has been observed that optimal control plays a significant role in reducing the number of zika infectives. Finally, numerical simulation is performed to illustrate the analytical findings.

Acoustic wave propagation in piezoelectric materials

Eric Stachura

Kennesaw State University
estachur@kennesaw.edu

We will discuss well-posedness of a Cauchy problem for acoustic wave propagation in piezoelectric materials. We then will provide a stability analysis of these solutions not assuming positive definiteness of the stress-strain tensor or the piezoelectric stress tensor. Finally we discuss continuous dependence on initial data, allowing the piezoelectric tensor to be time dependent, provided solutions belong to an appropriate function space.

Modeling the Immune Response of Celiac Disease

Cara Sulyok

University of Tennessee, Knoxville
csulyok@vols.utk.edu

Coauthors: Judy Day, Suzanne Lenhart

Celiac disease is a hereditary autoimmune disease that affects approximately 1 in 133 Americans. It is caused by a reaction to the protein gluten found in wheat, rye, and barley. After ingesting gluten, a patient with celiac disease may experience a range of unpleasant symptoms while small intestinal villi, essential to nutrient absorption, are destroyed in an immune process mediated by T cells. The only known treatment for this disease is a lifelong gluten-free diet and there is currently no drug treatment. A gluten-free diet will not address the damage in all cases; this is referred to as refractory celiac disease.
This preliminary work provides a mathematical framework to better understand the biological and immunological mechanisms in celiac disease. The model will be able to analyze various theories behind the progression of this disease by capturing the dynamics of a healthy subject, a patient with celiac disease, and a patient with refractory celiac disease. By doing so, we can evaluate and suggest potential therapies to mitigate the effects of celiac disease.

69. The Diffusion Phenomenon for Damped Wave Equations with Space-Time Dependent Coefficients
Montgomery Taylor
University of Tennessee, Knoxville
mtaylo35@vols.utk.edu

We present a method to study the long-time behavior of solutions to damped wave equations, where the coefficients of the equations are space-time dependent. These solutions exhibit the diffusion phenomenon, meaning their asymptotic behaviors align with the asymptotic behaviors of solutions to corresponding parabolic equations. Sharp decay estimates for solutions to damped wave equations are given, and decay estimates for derivatives of solutions are also discussed.

70. On the Numerical Solution of Source Identification Problem for an Elliptic-Hyperbolic Equation
Fatma Songul Ozesenli Tetikoglu
NUIST Reading Academy, Nanjing, Jiangsu, China
fstetikoglu@hotmail.com
Coauthors: Allaberen Ashyralyev

In this work, a boundary value problem for the differential equation with parameter in a Hilbert space with self-adjoint definite operator is investigated. The well-posedness of this problem is presented. The stability inequalities for the solution of source identification problem for elliptic-hyperbolic equations are given.

71. The Invisible Primes: Study on Prime Pairs and Prime Quadruplets
Shashwat Adrishya Tiwari
F-14, Swastik Green City, Shahdol, (M.P), India
nimishbashwataeapj@gmail.com

In the year 2013 Yitang Zhang proved that \( \lim_{n \to \infty} \inf (P_{n+1} - P_n) < 7 \times 10^7 \). This equation states that, there are infinitely many pairs of prime numbers, which differ by 70 million or less. In this talk, we will discuss some results on prime 2-tuple and some unique prime 4-tuple; also, we will discuss some prime 6-tuple. I took a new approach to find infinitely many pairs of prime numbers, which differ by 70 million or less. In this talk, we will discuss some results on infinitely many pairs of the form \((P, P+2n)\), \(n \in \mathbb{N}\). This talk includes these two proposed conjectures:-

Conjecture 1- All those consecutive primes which exists in the form of \((P, P+2n)\) for \(P>5\), are separated at a distance of \(6k\) from the next prime pair or next prime 2-tuple, i.e. \((P+2n)-(P+2n+2)=6k\) except for those prime pairs which are of the form \((P, P+6n)\), here \(n, k \in \mathbb{N}\).

Conjecture 2-There exists many such prime quadruplets of the form \(A = \{P, P + 2, P + 8, P + 12\}\) and \(B = \{7k - 6, 7k - 4, 7k + 2, 7k + 6\}\) such that \(B \subset A\), here \(P \in \mathbb{P}\), \(k \in \mathbb{N}\).

72. Parabolic generalized equations and the generalized truncation method
Livinus Uko
Georgia Gwinnett College
luko@ggc.edu

In this paper we are interested in the theoretical and iterative solution of the parabolic generalized equation \(u'(t) + Au(t) + g(u(t)) \geq f(t)\) on \([0, T]\), where \(u(0) = u_0\), \(f\) is continuous, \(A\) is continuous, coercive and linear, and \(g\) is maximal monotone.

One is the simplest methods for the theoretical and iterative solution of this problem is the method of Rothe which, for \(k = T/N\), generates the nodal values of a step function \(v_N\) through the iterations, \(v_N^0 = u_0\) and \((v_N^n - v_N^{n-1})/k + Av_N^n + g(v_N^n) \geq f_N^n\) for \(n = 1, 2, \ldots, N\), where \(f_N^n \approx f(nk)\). The discretized subproblems to be solved at each time step are elliptic generalized equations which can be shown to be solvable under relatively mild conditions, and it can be shown that the step function \(v_N\) converges in an appropriate space to a solution \(u\) of the parabolic generalized equation. However, the solution of these multivalued discretized subproblems is still a formidable task which may turn out to be as difficult as the original problem.

An alternative approach is the generalized truncation method which generates the nodal values of an approximating step function \(u_N\) through the iterations, \(u_N^0 = u_0\); \((u_N^n - P_N u_N^{n-1})/k + Au_N^n = f_N^n\) for \(n = 1, 2, \ldots, N\), where the
\[ P_N = (1 + (T/N)g)^{-1} \]
the (single-valued and non-expansive) Yoshida resolvent maps of \(g\). The main attraction of the method – which generalizes the truncation method developed by A. Berger for obstacle problems – is the fact that the
problems to be solved at each time step are elliptic equations which are much easier to solve than the elliptic inclusion problems that occur in Rothe’s scheme.

Our main aim in the present paper is to present the convergence analysis and error bounds of the generalized truncation scheme in a direct and simpler manner that eliminates one of the key assumptions used to analyze it in our previous paper. We also give an illustrative example.

73. A comparative stochastic and deterministic study of the permanence of malaria in a class of infectious disease models
Divine Wanduku
Georgia Southern University, 65 Georgia Ave. Room 3008, Statesboro, GA, 30460,
dwanduku@georgiasouthern.edu

Two families of malaria models are presented. The first family represents the dynamics of malaria in a nonrandom environment. In the second family, malaria spreads in a highly random environment with variability from the disease and transmission rates. The families of epidemic models are systems of ordinary and Ito-stochastic differential equations with random delays representing the delay times of disease incubation and acquired immunity. The permanence of malaria in both types of systems is established and compared to determine the effects of white noise on the permanence of disease. A numerical example is presented to compare the two situations.

74. A fractional differential equation model for bike share systems
Min Wang
Kennesaw State University
min.wang@kennesaw.edu

In this talk, a fractional differential equation model is developed to describe the bike share station status based on the historical bike share data. The analytic solution of the model is investigated as well.

75. Numerical Simulation of Solid Phase Adsorption Models Using Time-Integrated, Upwinded Finite Element Strategies
Anastasia Wilson
Augusta University
anawilson@augusta.edu

Coauthors: Eleanor Jenkins, Clemson University; Juan Wang, Bristol-Myers Squibb; Scott Husson, Clemson University

The emergence of biopharmaceuticals as a way to manage chronic disease has created a need for technologies that deliver purified products efficiently and quickly. This has led to increased research on the development of high-capacity ion-exchange membranes to improve adsorption-based bioseparations processes. In this work, a numerical scheme for approximating solutions to mathematical models associated with advection-dominated solid phase adsorption processes is developed and analyzed. The scheme utilizes continuous Galerkin finite elements for discretization of the transport equation, stabilized via streamline upwinding. The work is motivated by previous research which uses temporal integration and mixed finite element methods to discretize similar model equations. The analysis verifies solvability of the upwinded discrete scheme, and numerical convergence rates that follow the expected estimates are also provided. The results of the algorithm are compared with experimental data and the effects of various velocity profiles on the model results are examined.

76. Two variants of the 2D Euler vorticity equation
Jiahong Wu
Oklahoma State University
jiahong.wu@okstate.edu

Coauthors: Peter Constantin, Ramjee Sharma, Bei Xiao

This talk presents analytic and numerical results on the global existence and regularity problem concerning two models that resemble the 2D Euler vorticity equation. Each of the models contains the Euler vorticity transportation part and also an extra term represented by a singular integral operator acting on the vorticity. The vorticity is no longer bounded in these models. We have performed simulations on these models and obtained some analytic results. In addition, we will also explain how some of the open problems on the Boussinesq equations and the MHD equations can be reduced to the models discussed here.
77. An elementary proof of the Eigenvalue preservation for the co-rotational Beris-Edwards system
Xiang Xu
Old Dominion University
x2xu@odu.edu

We study the co-rotational Beris-Edwards system modeling nematic liquid crystals and revisit the eigenvalue preservation property discussed before. We give an alternative but direct proof to the eigenvalue preservation of the initial data for the Q-tensor.

78. Local discontinuous Galerkin methods for the Khokhlov-Zabolotskaya-Kuznetsov equation
He Yang
Augusta University
HYANG1@augusta.edu

Khokhlov-Zabolotskaya-Kuznetsov (KZK) equation is a model that describes the propagation of the ultrasound beams in the thermoviscous fluid. It contains a non-local diffraction term, an absorption term and a nonlinear term. Accurate numerical methods to simulate the KZK equation are important to its broad applications in medical ultrasound simulations. In this paper, we propose a local discontinuous Galerkin method to solve the KZK equation. We prove the L2 stability of our scheme and conduct a series of numerical experiments including the focused circular short tone burst excitation and the propagation of unfocused sound beams, which show that our scheme leads to accurate solutions and performs better than the benchmark solutions in the literature.

79. A mathematical model for studying and forecasting the impact of vertical transmission in mosquito Aedes vexans on the dynamics of Rift valley fever
Paul Python ndekou tandong
Cheikh Anta Diop university, Dakar, Senegal
pppython@yahoo.fr
Coauthors: Alassane Bah Papa Ibrahima Ndiaye Iacques Andre Ndione

Rift Valley fever is a viral illness caused by two species of mosquitoes known as Aedes vexans and Culex poicilipes. In vertical transmission process, female mosquitoes transmit viruses when laying eggs. In this paper, we developed a mathematical model for Rift valley fever with vertical transmission in female Aedes vexans mosquitoes based on ODE(ordinary differential equation). We used an effective contact rate from animals to mosquitoes, an effective contact rate from mosquitoes to animals, an incubation period of mosquitoes and an incubation period of animals. We computed the basic reproduction number of the model defined as the effective number of secondary infections caused by the typical infected individual during his entire period of infectiousness. Results on sensitivity analysis indicate a direct relationship between basic reproduction number and vertical transmission rate. We analyzed the model for founding the stability of the disease-free equilibrium. We tested which model parameters have a positive impact on the Rift valley fever transmission. Reducing or eradicating Rift valley fever will be done by reducing the Aedes vexans mosquito populations and their eggs. Numerical simulations show that, due to the number of eggs laid by female Aedes vexans and the high number of infected eggs, the spread of Rift valley fever is very fast thus public health workers should take care during the period of epemics

80. Interface Development for the Nonlinear Degenerate Multidimensional Parabolic Equations Modeling Reaction-Diffusion Processes
Amna Abu weden
Florida Institute of Technology
aabuweden2014@my.fit.edu
Coauthors: Ugur Abdulla

We present a full classification of the short-time behavior of the interface in the Cauchy problem for the nonlinear second order degenerate parabolic PDE

$$u_t - \Delta u^m + bu^\beta = 0, \quad x \in \mathbb{R}, \quad t > 0$$

with nonnegative and radially symmetric initial function $u_0$ such that

$$\text{supp } u_0 \subset \{|x| < R\}, \quad u_0 \sim C(R - |x|)^\alpha, \quad \text{as } |x| \to R - 0,$$

where $m > 1, C, \alpha, \beta > 0, b \in \mathbb{R}$. Interface surface $t = \eta(x)$ may shrink, expand or remain stationary depending on the relative strength of the diffusion and reaction terms near the boundary of support, expressed in terms of the parameters $m, \beta, \alpha, \text{sign } b$ and $C$. In all cases we prove explicit formula for the interface asymptotics, and local solution near the interface.
## Summary of the SEARCDE 2018 Program

**Saturday, October 6**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00am – 6:00pm</td>
<td>Registration (Lobby)</td>
<td>MTN 3110</td>
</tr>
<tr>
<td>12:45pm – 1:00pm</td>
<td>Opening Remarks (MTN 3110)</td>
<td>MTN 3110</td>
</tr>
<tr>
<td>1:00pm – 2:00pm</td>
<td><strong>Plenary 1</strong></td>
<td>MTN 3110</td>
</tr>
<tr>
<td>2:00pm – 2:20pm</td>
<td>Coffee Break (Lobby)</td>
<td>MTN 3110</td>
</tr>
<tr>
<td>1:00pm – 2:00pm</td>
<td><strong>Plenary 1</strong></td>
<td>MTN 3110</td>
</tr>
</tbody>
</table>

### Plenary 1
- **Moderator:** Ryan Thompson (MTN 3110)

#### Session 1A – 1B – 1C – 1D – 1E – 1F
- A. Balueva
- P. Drabek
- D. Wanduku
- V. Cheruvu
- Z. Denton
- D. Ramirez

#### Session 2A – 2B – 2C – 2D – 2E – 2F
- K. Acharya
- D. Regmi
- B. Pantha
- X. Xu
- S. Malhi
- R. Thompson

#### Session 3A – 3B – 3C – 3D – 3E – 3F
- H. Saber
- T. Lamar
- I. Aslan
- D. Adhikari
- M. Chhetri
- G. Bhatt

### Coffee Break
- (Lobby)

#### PARALLEL SESSIONS

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:20pm – 2:40pm</td>
<td>J. Ford</td>
</tr>
<tr>
<td>2:40pm – 3:00pm</td>
<td>H. Bhatt</td>
</tr>
<tr>
<td>3:00pm – 3:20pm</td>
<td>A. Balueva</td>
</tr>
<tr>
<td>3:20pm – 3:40pm</td>
<td>S. Alzahrani</td>
</tr>
<tr>
<td>3:40pm – 4:00pm</td>
<td>J. Wu</td>
</tr>
<tr>
<td>4:00pm – 4:30pm</td>
<td>J. Wu</td>
</tr>
<tr>
<td>4:30pm – 4:50pm</td>
<td>H. Yang</td>
</tr>
<tr>
<td>4:50pm – 5:10pm</td>
<td>B. Ghimire</td>
</tr>
<tr>
<td>5:10pm – 6:10pm</td>
<td>Peter Constantin: <em>Singularities in Fluids</em></td>
</tr>
<tr>
<td>6:20pm – 8:30pm</td>
<td>RECEPTION DINNER (Student Center Robinson Ballroom)</td>
</tr>
</tbody>
</table>

**Sunday, October 7**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30am – 11:00am</td>
<td>Registration (Lobby)</td>
</tr>
<tr>
<td>7:30am – 8:30am</td>
<td>Light Breakfast and Coffee (Lobby)</td>
</tr>
<tr>
<td>8:30am – 9:30am</td>
<td><strong>Plenary 3</strong></td>
</tr>
<tr>
<td>9:30am – 9:50am</td>
<td>Coffee Break</td>
</tr>
<tr>
<td>9:50am – 10:10am</td>
<td>L. Uko</td>
</tr>
<tr>
<td>10:10am – 10:30am</td>
<td>H. Saber</td>
</tr>
<tr>
<td>10:30am – 10:50am</td>
<td>E. Nathanson</td>
</tr>
<tr>
<td>10:50am – 11:10am</td>
<td>A. Asipchuk</td>
</tr>
<tr>
<td>11:10am – 11:30am</td>
<td>A. Hagverdiyev</td>
</tr>
<tr>
<td>11:30am – 11:50am</td>
<td>M. Aydogan</td>
</tr>
<tr>
<td>11:50am – 12:10pm</td>
<td>P. Tandong</td>
</tr>
</tbody>
</table>

#### PARALLEL SESSIONS

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:10am – 10:30am</td>
<td>R. Ercan</td>
</tr>
<tr>
<td>10:30am – 10:50am</td>
<td>L. Alzaki</td>
</tr>
<tr>
<td>11:10am – 11:30am</td>
<td>A. Hagverdiyev</td>
</tr>
</tbody>
</table>

**Plenary 2**
- **Moderator:** Jiahong Wu (MTN 3110)

**Plenary 3**
- **Moderator:** Maya Chhetri (MTN 3110)

If you need this document in an alternate format for accessibility purposes, please contact the conference organizers at searcde@ung.edu or 678-717-3757.