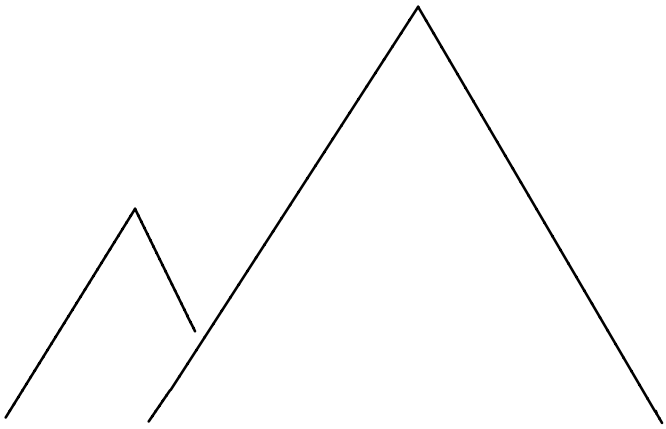

The Big Tent: Talks for Mathematical Scientists

In honor of Professor Myron Allen's retirement

September 14–18, University of Wyoming

Organizer: Zhuang Niu (zniu@uwyo.edu)

Schedule

- `https://uwyo.zoom.us/j/98815823687` Passcode: BT2020

Monday, September 14		
11:00 – 11:10	Jason Williford	*Opening Remarks*
11:10 – 12:00	Bryan Shader	*Finding needles in haystacks—a simple use of the Implicit Function Theorem in Combinatorial Matrix Theory*
12:10–13:00	Rongsong Liu	*Mathematical models for migratory birds*
Tuesday September 15		
11:00–11:50	Man-Chuang Yeung	*Solution of large and sparse linear systems*
12:10–13:00	Michelle Chamberlin	*The Research of a Mathematics Teacher Educator: Examining Factors that Influence Prospective Teachers' Mathematics Learning*
Wednesday September 16		
11:00–11:50	Hakima Bessaih	*Stochastic homogenization for some porous media models*
12:10–13:00	Saman Aryana	*Transport and Phase Behavior in Hierarchical Complex Permeable Media*
Thursday September 17		
11:00–11:50	Dan Stanescu	*Quantum Teleportation and Super-dense Coding: A look behind the scenes*
12:10–13:00	Christina Knox	*Determining both the source of a wave and its speed in a medium from boundary measurements*
13:00–13:30	Myron Allen	*Closing Remarks*
Friday September 18		
16:30–18:30: *Virtual reception at Gather Town*[1], organized by Bryan Shader		

[1]See last page for instructions.

Title and Abstract

Saman Aryana, University of Wyoming

Transport and Phase Behavior in Hierarchical Complex Permeable Media

Abstract: I was introduced to flow in permeable media by Barenblatt's papers on his non-equilibrium model. I spent several years collecting experimental data using X-ray tomography and thinking about ways to generalize and ground Barenblatt's model more firmly in the physics and the observations. That effort culminated in an alternate formulation for constitutive relations for flow in permeable media. Similar to Barenblatt's model, this formulation results in nonlinear PDEs and the corresponding numerical solutions are difficult to obtain. Several years ago, I found inspiration in a statement Myron made in a Math Colloquium at UW; he said: "time and space are related by the transport equation." It occurred to me that the time-averaged saturation in the constitutive relations may be replaced by their spatial averages and the resulting equations would be quasi-linear. This realization led to the development of a physics-based, macroscale formulation of multiphase porous-media flows that both honors the validity of Darcy's law in steady or near-steady flows and accommodates the effects of heterogeneities and non-linearities in unsteady flows. Since then, my focus has shifted slightly to microscopic and mesoscopic flow pathways and the emergent transport behavior that may result from having a wide variety of scales in a medium without a clear separation of scales. Currently, I am finding inspiration in the study of consciousness—is transport in hierarchical complex permeable media an emergent phenomenon? If yes, then it is crucial that we study transport at the correct level of complexity and scale. I continue to frequent the Math Dept. in anticipation of another illuminating quote by Myron—no pressure!

Hakima Bessaih, University of Wyoming

Stochastic homogenization for some porous media models

Abstract: We are investigating some models arising from heterogenous porous media when some parameters like permeability or porosity are defined in terms of a stochastic process which is solution of an Stochastic differential equation (SDE).

Various scales are involved both in time and space that will depend on a parameter. We investigate the well-posedness of the coupled system and its limiting behavior when this parameter goes to zero. The limiting equation will involve the invariant measure associated to the stochastic process and some averaged quantities.

Our focus will be on advection-diffusion and convection-diffusion models.

Michelle Chamberlin, University of Wyoming

The Research of a Mathematics Teacher Educator: Examining Factors that Influence Prospective Teachers' Mathematics Learning

Abstract: In this session, I present a *lesson experiment* used to evaluate and enhance prospective elementary teachers' (PSTs) mathematical understandings in an undergraduate mathematics class. For a lesson experiment, a teacher-researcher addresses the question, what did students learn during the lesson, and how and why did instruction impact such learning? It is a systematic effort to improve instructional practice by studying one's teaching and merges research and practice. In this study, I used the lesson experiment process to investigate the PSTs' understandings of area measurement. An important construct for area measurement is understanding how area units are constituted by linear units (e.g., a square-centimeter is constituted by linear dimensions of 1-centimeter each) and being able to work back and forth between such measures. Presentation attendees will hear about the PSTs' understandings of area units and how such understandings were impacted by the lesson as well as learn about the lesson experiment process.

Christina Knox, University of Wyoming

Determining both the source of a wave and its speed in a medium from boundary measurements

Abstract: In this talk we will discuss the inverse problem of determining both the source of a wave and its speed inside a medium from measurements of the solution of the wave equation on the boundary. This problem arises in photoacoustic and thermoacoustic tomography. We will present a brief overview of previous uniqueness results and then present our two original uniqueness results. If the reciprocal of the wave speed squared is harmonic in a simply connected region and identically one elsewhere then a non-trapping wave speed can be uniquely determined from the solution of the wave equation on the boundary of domain without knowledge of the source. If the wave speed is known and only assumed to be bounded, then, under a natural admissibility assumption, the source of the wave can be uniquely determined from boundary measurements. The talk is based on a joined work with Amir Mordifam (University of California, Riverside).

Rongsong Liu, University of Wyoming

Mathematical models for migratory birds

Abstract: We derive and analyze mathematical models for the spatiotemporal distribution of a migratory bird species. The first one is a patch model with delay. The birds have specific sites for breeding and winter feeding, and usually several stopover sites along the migration route, and therefore a patch model is the natural choice. However, we also model the journeys of the birds along the flyways, and this is achieved using a continuous space model of reaction-advection type. The second model is that the flyway is a curve parametrised by arc-length. Flight speed depends on position along the flyway, to take account of factors such as wind and the pausing of birds at various locations for wintering

or stopovers. Per-capita mortality along the flyway is both position and age-dependent, allowing for increased risks at stopover locations due to predation, and increased risks to immature birds. A reaction-advection age-structured equation models population dynamics along the flyway and, using a Laplace transform technique, the model is reduced to a scalar delay differential equation for the number of adult birds at the breeding location.

Bryan Shader, University of Wyoming

Finding needles in haystacks—a simple use of the Implicit Function Theorem in Combinatorial Matrix Theory

Abstract: Many inverse problems reduce to is there a matrix with a given structure and given multi-set of eigenvalues. One way to model the structure of an n by n symmetric matrix A is via its graph G(A), which has vertices 1, 2, ..., n and an edge joining distinct vertices i and j whenever the ij-entry of A is nonzero. The inverse eigenvalue problem for graphs (IEP-G) is to determine the possible eigenvalue multi-sets among the matrices with a given graph.

In this talk we will describe a recently developed method, based on the implicit function theorem, that enables one to solve the IEP-G for many graphs from a nice solution for one graph.

The talk will (hopefully) illustrate nice connections between analysis, matrix theory, and graph theory.

Dan Stanescu, University of Wyoming

Quantum Teleportation and Super-dense Coding: A look behind the scenes

Abstract: Quantum computing promises interesting avenues for the development of fast algorithms and secure communication protocols. This talk will start with an overview of the field, turning afterwards to the challenges that a couple of quantum algorithms which can be thought of as basic building blocks in quantum communication face on current architectures.

Man-Chung Yeung, University of Wyoming

Solution of large and sparse linear systems

Abstract: Computational simulation of scientific phenomena and engineering problems often depend on solving large and sparse linear systems. This talk gives a brief introduction of some of the existing methods for the solution of such systems with an emphasis on ML(n)BiCGStab, a Krylov subspace method developed by the speaker. It is a method that lies between the well-known BiCGStab and GMRES, and is computationally more stable and converges faster than them.

Virtual reception at Gather Town

When: Friday, September 18 from 4:30 p.m. – 6:30 p.m.
Where: `https://gather.town/aZ087gtvfZjRG101/Myron_Allen_Bash`
Logistics: The link above takes you to a website for GatherTown. GatherTown is an application that allows one to have virtual get-togethers.

(1) On your laptop or desktop computer open up the **Chrome** or **Firefox** browser.
(2) Go to `https://gather.town/aZ087gtvfZjRG101/Myron_Allen_Bash`.
(3) Enter your first name, agree to let it use your camera and audio, and indicate that are of age (some of you may need to lie!).
(4) You will be assigned a "SuperMario"-type character and placed in the virtual room. The virtual room is set up as a large bar. Unfortunately, they haven't yet figured out how to distribute refreshment and drink virtually. You'll need to supply those on your own.
(5) Use the arrows on your keyboard to move about the bar. When you are near a group of people then you can see and talk with them. When you are not near a group, then you can't see or hear them. You can adjust your "hearing distance" by clicking on the "bulls-eye" in the menu bar at the bottom of your screen.