CAARMS22

Speaker Abstracts

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Birational Geometry of Elliptic Fibrations and Combinatorics of the Intrigilator-Morrison-Seiberg Potential

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Elliptic fibrations over a normal base endowed with a rational section are birational to Weierstrass models. A given singular Weierstrass model can have numerous resolutions connected to each other by flop transitions. The structure of these flops are the subjects of several conjectures relying on ideas from supersymmetric gauge theories and string theory. These conjectures are often formulated in the language of representation theory and might hint to properties of elliptic fibrations much larger than their typical applications in string theory. I will explain these ideas and review some of the recent developments, some of which, are the results of discussions and collaborations that started in a previous CAARMS conference.

Biography

Jonathan Mboyo Esole was born in Kinshada (Democratic Republic of Congo). He is a Benjamin Peirce Fellow in the Department of Mathematics at Harvard University and a member of the Harvard University Center for the Fundamental Law of Nature. He is interested in the interface of mathematics and physcis, espcially in the study of the geometric and arithmetic aspects of string theory.

Online Overbooking Strategies in Outpatient Specialty Clinics with No-Shows and Advance Cancellations

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Timely patient access to healthcare is an ongoing problem. Patient behavior, such as no-shows and cancellations, can lead to additional issues that heighten the problem. We develop strategies that a clinic can utilize to determine if and when to overbook patients, over a finite horizon, in an online scheduling environment. We incorporate clinic parameters, including indirect waiting, no-shows, and cancellations to inform the overbooking decisions. We find that the optimal overbooking strategies are a function of both no-shows and cancellations, and that a clinic can, under certain conditions, achieve a greater service reward by overbooking patients than it can by not utilizing overbooking. Our work is motivated, in part, by our observations of scheduling decision-making at a Veterans Health Administration (VHA) specialty clinic.

Biography

Shannon L. Harris was born in Hialeah, FL and raised in Northern Virginia. She received her BS in Systems Engineering (2007) from George Mason University and her PhD (2016) in Business Analytics and Operations from the University of Pittsburgh, Katz Graduate School of Business. Her PhD thesis is entitled "Essays in Appointment Management". In Fall 2016, she will start as an Assistant Professor in Management Science at The Ohio State University, Fisher College of Business. Her research interests include predictive analytics and scheduling in healthcare and sports analytics.

Goal-directed Robot Manipulation via Axiomatic Scene Estimation

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Performing robust goal-directed manipulation tasks remains a crucial challenge for autonomous robots. In an ideal case, shared autonomous control of manipulators would allow human users to specify their intent as a goal state and have the robot reason over the actions and motions to achieve this goal. However, realizing this goal remains elusive due to the problem of perceiving the robot's environment. This talk will describe the problem of Axiomatic Scene Estimation (AxScEs, pronounced "access") for robot manipulation in cluttered scenes. This problem of AxScES is the estimation of a tree-structured scene graph describing the configuration of objects observed from robot sensing. Towards this problem, our work has developed generative approaches to problems of AxScEs through our Axiomatic Particle Filter state estimator suited to scene grasps. The result from AxScEs estimation are axioms amenable to goal-directed manipulation through symbolic inference for task planning, grasp planning, and collision-free motion planning and execution. We demonstrate results for goal-directed manipulation of multi-object scenes using the PR2 and Fetch mobile manipulation platforms.

Given the enormous push to automate much of society, this talk will additionally address the critical need to revise the incentive structure for academia in robotics and computing. The current structure of academia disincentives faculty from an earnest effort in diversity, both intellectually and demographically. I will posit how a "Title IX-like" standard for federal funding would change academic incentives such that a diverse, competent, and equitable computing ecosystem would result.

Biography

Odest Chadwicke Jenkins is an Associate Professor of Computer Science and Engineering at the University of Michigan. He earned his B.S. in Computer Science and Mathematics at Alma College (1996), M.S. in Computer Science at Georgia Tech (1998), and Ph.D. in Computer Science at the University of Southern California (2003). His research addresses problems in interactive robotics and human-robot interaction, primarily focused on mobile manipulation, robot perception, and robot learning from demonstration. His research often intersects topics in computer vision, machine learning, and computer animation. Prof. Jenkins has been recognized as a Sloan Research Fellow in 2009. He is a recipient of the Presidential Early Career Award for Scientists and Engineers (PECASE) for his work in physics-based human tracking from video. His work has also been supported by Young Investigator awards from the Office of Naval Research (ONR) for his research in learning dynamical primitives from human motion, the Air Force Office of Scientific Research (AFOSR) for his work in manifold learning and multi-robot coordination and the National Science Foundation (NSF) for robot learning from multivalued human demonstrations.

Inferring Parking Occupancy and Parking Search from Parking Payment Data

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The excessive search for parking, known as cruising, generates pollution and congestion. Consequently, cities are looking for policy levers to reduce the damage caused by cruising. An important piece of this problem is accurately measuring the number of cars searching for parking, which is difficult and requires expensive sensing technologies. In recent joint work with Robert Hampshire (University of Michigan), we develop an approach that eliminates the need for sensing technology. Our approach uses parking meter payment transactions to estimate parking availability and the number of cars searching for parking. The estimation scheme uses a *particle Markov chain Monte Carlo* method with a stochastic queueing model. We show that our approach generates asymptotically unbiased estimates of the parking occupancy and underlying model parameters such as arrival rates, average parking time, and the payment compliance rate. We validate the performance of this approach using parking meter data from a large scale parking experiment called SF *park*, and compare our parking occupancy estimates against the ground truth measured by parking sensors.

Biography

Daniel Jordon is a Data Scientist at SeatGeek Inc., a live event ticketing startup based in New York City. His work deals with data pipeline engineering and model development related to pricing and marketing. He received his PhD in Mathematics from Drexel University in 2013, with a focus on functional analysis and partial differential equations. He subsequently did post-doctoral fellowships at Carnegie Mellon University and the University of Michigan doing research in applied probability and transportation. He has broad research interests in mathematics and computer science.

Optimal Dispatching Policies for Donation Collection with Stochastic Demand

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This study introduces a Markov decision process (MDP) model for collecting donations and distributing them to disaster survivors. Donations that accumulate over time at collection sites are periodically transported to a relief center where they are used to satisfy the stochastic demands of beneficiaries. The MDP model minimizes expected unsatisfied demand during a finite horizon.

Biography

Emmett Lodree, Jr. was born and raised in New Orleans, Louisiana. He earned his BS (1995) and MS (1997) in Mathematics from the University of New Orleans, followed by his MS (1999) and PhD (2001) in Industrial Engineering from the University of Missouri-Columbia. Currently, he is an Associate Professor of Operations Management at the University of Alabama, where he has been since 2009. His research program primarily focuses on the application of stochastic dynamic programming methods to problems in the area of disaster response logistics. His research interests also include inventory theory, humanitarian operations, and the interface between operations management and economics.

Geometrical Aspects of the Intriligator-Morrison-Seiberg Superpotential

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Recent joint work with Steven Glenn Jackson (UMB), Mboyo Esole (Harvard), and Ravi Jagadeesan (Harvard) has produced a theory for understanding the incidence geometry of the central hyper-plane arrangement whose hyper-planes are the vanishing loci of the weights of the first and the second fundamental representations of gl(n) restricted to the dual fundamental Weyl chamber. We obtain generating functions that count flats and faces of a given dimension. This counting is interpreted in physics as the enumeration of the phases of the Coulomb and mixed Coulomb-Higgs branches of a five dimensional gauge theory with 8 supercharges in presence of hyper-multiplets transforming in the fundamental and anti-symmetric representation of a U(n) gauge group as described by the Intriligator-Morrison-Seiberg superpotential. I shall outline the theory. The SU(n) case presents a more complicated geometry; I shall elaborate on its nature if time permits.

Biography

Alfred Noël was born in the city of Cayes, Haiti. He studied pure and applied mathematics at Northeastern University in Boston Massachusetts. His PhD dissertation, in representation theory of Lie groups, was directed by Donald R. King. He spent eight years at ComputerVision as a software engineer and has been at the University of Massachusetts Boston since 1998 where he is currently a Professor of Mathematics.

Time Varying Queues

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In this talk, I will discuss the how time varying queues arise naturally in our society and how we can use differential equations, stochastic processes, and queueing theory to describe the phenomena around us. This talk will describe how to use and extend standard techniques to more complicated systems that arise in reality. Examples from Uber dynamics and healthcare dynamics will illustrate these ideas.

Biography

Jamol Pender was born and raised in the Bronx, NY. He received a B.S.E (2008) from the Unviersity of Pennsylvania in Electrical and Systems Engineering and a PhD (2013) in Operations Research and Financial Engnieering from Princeton University. His PhD thesis in applied probability was titled: "Dynamics Rate Queues: Estimation, Stabilization, and Control." Currently, he is an Assistant Professor of Operations Research and Information Engineering at Cornell University, where he has been since 2015. His research interests fall into areas of applied probability, which includes queueing theory. His research on time varying queueing systems has been applied in areas such as telelcommunications, healthcare, and more recently collaborative economies and smartphone queueing apps. He also has an interest in mathematical finance, especially limit order books and option pricing.

The Camassa-Holm Equation: Analysis, Numerics, Generalizations and Applications

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In this talk, we study the dynamics of the interaction among a special class of solutions of the one-dimensional Camassa-Holm equation and its generalizations. The equation yields soliton solutions whose identity is preserved through nonlinear interactions. These solutions are characterized by a discontinuity at the peak in the wave shape and are thus called peakon solutions. We apply a variety of numerical methods to study both the analytical and physical properties of the Camassa-Holm equation and show its potential for modeling the propagation of tsunami waves. In particular, we provide global existence and uniqueness results for the Camassa-Holm Equation by establishing convergence results for the particle method applied to these equations, and then use this same method to numerically quantify the nonlinear interaction among the peakon solutions. We conclude the talk by proposing new invariant-preserving finite difference schemes for a generalization of the Camassa-Holm equation as a potential model for the propagation of tsunami waves.

Biography

Terrance Pendleton was born in New Jersey and raised in Phenix City, AL. He received his BS (2007) in mathematics education at Alabama A&M University, and his PhD (2013) in applied mathematics from North Carolina State University. His PhD thesis in partial differential equations was titled: "An Analytical and Numerical Study of a Class of Nonlinear Evolutionary PDEs." Currently, he is a postdoctoral research fellow at Iowa State University through the Alliance for Building Faculty Diversity in the Mathematical Sciences. Beginning Fall 2016, he will be an assistant professor of mathematics at Drake University. His research interests fall into areas of partial differential equations and numerical analysis.

Nanophotonics of Thermal Radiation and Optical Interactions

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Advances in nanofabrication over the past few decades have enabled and encouraged the study of material structures with features at the scale or smaller than the electromagnetic wavelength. These engineered materials can exhibit a wide range of unusual optical behaviors, allowing unprecedented control over the propagation and behavior of light, e.g. allowing us to slow and confine light at the nanometer scale. I will give an overview of recent developments in our understanding of the ways in which thermal radiation (the familiar glow of hot objects), quantum fluctuation and optical interactions (the forces and interactions of light waves induced by quantum and material effects), and more generally, our ability to localize and control photons, can be dramatically modified in nanostructured media, e.g. enabling us to design materials that radiate millions of times more energy than blackbodies or efficiently convert light from infrared to visible or ultraviolet wavelengths.

Biography

Alejandro Rodriguez is an Assistant Professor of Electrical Engineering at Princeton University, working in the areas of nanophotonics, nonlinear optics, and fluctuation electromagnetic phenomena. He received both his B.A and Ph.D in Physics from MIT in 2006 and 2010, and was a postdoctoral fellow at Harvard University until 2013, during which time he co-developed some of the first methods for computing fluctuation interactions in complex environments and made significant contributions to the understanding of ways of tailoring thermal radiation and Casimir forces in nanostructured media. Recent contributions include the first fundamental limits to radiative heat transport at the nanoscale (generalizing the famous Stefan–Boltzmann law to the near field) and inverse designs of photonic structures exhibiting complex and exotic spectral and nonlinear properties. He is a recipient of the NSF Early CAREER Award, was elected a National Academy of Sciences Kavli Fellow, and was also named a DOE Fredrick A. Howes Scholar in Computational Science. When not playing with photons, he enjoys salsa dancing, playing video games, and listening to afro-Cuban music.

Dynamic Control of a Single Server System when Jobs Change Status

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From health care to maintenance shops, many systems must contend with allocating resources to customers or jobs whose initial service requirements or costs change when they wait too long. We present a new queueing model for this scenario and use a Markov decision process formulation to analyze assignment policies that minimize holding costs. We show that the classic $c\mu$ rule is generally not optimal when service or costs requirements can change. Even for a two-class customer model where a class 1 task becomes a class 2 task upon waiting, we show that additional orderings of the service rates is needed to ensure the optimality of simple priority rules. We then show that seemingly-intuitive switching curve structures are also not optimal in general. We study these scenarios and provide conditions under which they do hold. Lastly, we show that results from the two-class model do not extend to when there are $n \geq 3$ customer classes. More broadly, we find that simple priority rules are not optimal. We provide sufficient conditions under which a simple priority rule holds. In short, allowing service and/or cost requirements to change fundamentally changes the structure of the optimal policy for resource allocation in queueing systems.

Biography

Gabriel was born (and raised) in Mayagüez, Puerto Rico and received his BS (2008) in Mathematics from the University of South Florida. Gabriel is a President's Postdoctoral Fellow in the Center for Healthcare Engineering and Patient Safety at the University of Michigan. He graduated from Cornell with a PhD from the Center for Applied Mathematics under the mentorship and guidance of Dr. Mark E. Lewis. His research focuses on developing frameworks using queueing theory, Markov decision processes, simulation, and other Operations Research techniques, that can help identify effective and practical policies for resource allocation in healthcare settings. His recent research projects include "Emergency Medical Service Allocation in response to Large Scale Events" and "Optimal Control of an Emergency Room Triage and Treatment Process." He has been awarded the 2013 Zellman Warhaft Commitment to Diversity Graduate Student Award from Cornell's Diversity Program in Engineering; Cornell/Sloan Fellowship, 2011-2014; and National Defense Science and Engineering Graduate Fellowship, 2008-2011.