SAMSI Announces the 2016 - 2017 Scientific Research Programs

SAMSI has two compelling programs planned for 2016-2017. The programs will be the Program on Optimization (OPT) and the Program on Statistical, Mathematical and Computational Methods for Astronomy (ASTRO).

Statistical, Mathematical and Computational Methods for Astronomy

The ASTRO program will include

themes such as cosmology, exoplanets, gravitational waves and synoptic surveys. While astronomers typically specialize in one of these areas, the organizers have identified several common mathematical and statistical tools and challenges. For example, each of the astronomical sub-fields could benefit from improved non-standard time series analysis based on unequally spaced observations, multilevel hierarchical modeling, uncertainty quantification, reduced order modeling and inference with inexact models.

By bringing together experts in each of these areas, the SAMSI program will accelerate the adoption of modern statistical and applied mathematical tools into modern astronomy. Astronomers will bring scientifically important problems and real datasets, statisticians and applied mathematicians will bring methodological expertise and will help translate the newly developed methodologies into computationally feasible algorithms. Thus, the program aims to address several long-standing questions hanging over modern astronomy, such as:

How can we improve detection of planets or gravitational waves through improved modeling of non-stationary, non-Gaussian noise in time-series data?

How can we perform robust inference and quantify uncertainty when working with mis-specified models

(e.g., stellar activity in Doppler surveys, fast but approximate models to gravitational wave signatures, parametric or non-parametric models for the population of planets, supernovae, or variable stars)?

Given high-dimensional data and computationally intensive physical models, how can we harness emulators and modern samplers (e.g., MCMC, Hamiltonian sampling, sequential samplers) to rigorously quantify confidence in detections for planets, gravitational wave sources, and higher-order cosmological parameters?

How can we combine domain-knowledge with upcoming large, synoptic surveys (with irregular, heteroscedastic time-series, and auxiliary information) to develop robust classifiers and identify rare objects in a computationally feasible manner?

The program will provide multiple avenues for cross-disciplinary interactions, including the opening workshop (August 22-26, 2016), long-term visitors, and regular WebEx based working groups, so participants can continue collaborations, even if they can only spend limited time in residence at SAMSI.

The organizing committee includes: G. Jogesh Babu (Penn State), Jessi Cisewski (Yale), Eric Ford (Penn State), Matthew Graham (CalTech), Tom Loredo (Cornell), Ashish Mahabal (California Institute of Technology), Ilya Mandel U. Birmingham), Chad Schafer Carnegie Mellon). The local scientific coordinators include: Joseph Guinness
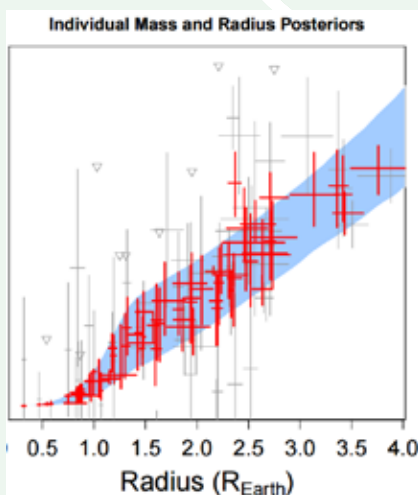
From the director...

This year, the main SAMSI programs are on the applications of statistics and applied mathematics to neuroscience and to forensic science. Both got off to a rousing start in their opening workshops and have several active working groups. The neuroscience program has evolved around the twin themes of spike train analysis and neuroimaging; a particular highlight of the opening workshop was Emery Brown's talk highlighting the role of mathematical modeling and statistics in understanding the neuroscience behind general anesthesia. The forensic science opening workshop also featured a very wide range of speakers representing statistics, crime labs, the Innocence Project and a special lunchtime presentation by Gerald LaPorte, the Director of the Office of Investigative & Forensic Sciences at the National Institute of Justice. We would also like to thank the Center for Forensic Sciences at RTI International for providing video coverage of this workshop.

Next year's programs, on Optimization and on Statistical, Mathematical and Computational Methods for Astronomy, are also well advanced in planning. Please do get in touch with us if you would like to attend! Also, we are recruiting for six new postdocs to work with these programs – details are on the SAMSI website.

Earlier in the year, we had our third-year site visit from the National Science Foundation, and were gratified to receive an extremely positive report, highlighting SAMSI as "a unique joint statistics and applied mathematics institute … of exceptional value to the Nation" and especially praising our postdoctoral program and working groups. As a result of this report, we have been invited to apply for a new grant from NSF that, if successful, will extend our funding from 2017 to 2020. Nevertheless, in the current climate of tightened NSF budgets and closer scrutiny of the role of institutes, we cannot afford to be complacent, and we are examining how we can utilize our resources to best advantage while continuing to offer a broad mixture of research programs and other activities as we have in the past.

If you would like to propose a program to SAMSI or if you have suggestions that you would like to discuss with us, please let us know! Our website at http://www.samsi.info/programs/proposing-new-samsi-program has been recently updated to give more details about the program planning process.

Postdoc Profile - Benjamin Risk

As Ben Risk was growing up in Northbrook, Illinois, (a suburb of Chicago) he always liked to look out in the yard and see the birds soaring above. "As a kid, I was really interested in biology and ecology and birds," said Ben.

He went to Dartmouth for his undergraduate work where he decided to major in environmental and evolutionary biology. He collected data on the breeding demography of a songbird called the black-throated blue warbler, which got him interested in statistics.

Later, Ben went to graduate school and received a Master's degree in environmental science from the University of California, Berkeley. His thesis developed a Bayesian formulation of a metapopulation model. "I was realizing that by specializing in statistics I could be involved in many different fields. I also wanted to be involved in research

that would have applications to human health, so I decided I wanted to pursue biostatistics research," said Ben. It was at that point that Ben enrolled in the Ph.D. program in statistics at Cornell University.

A lot of people at Cornell have been involved with SAMSI, and Ben's advisors, David Ruppert and David Matteson, also mentioned SAMSI as a place to apply to after he finished his degree. The program on computational challenges in cognitive neuroscience was also announced at JSM 2014, which prompted him to email Haipeng Shen.

Ben is currently researching statistical methods for the analysis of MRI. He is working on one project with Hongtu Zhu, where they are developing a spatial model of the heritability of cortical attributes that are correlated with intelligence. "We are looking at cortical thickness and volume to assess the degree of nature versus nurture,"

he explained. He is also working with Daniel Rowe to examine how image processing may affect the conclusions people make regarding which parts of the brain are connected.

Ben is involved in three working groups. He is in the Functional Imaging Methods and Functional Connectivity, the Big Data Integration in Neuroimaging, and the Acquisition, Reconstruction, and Processing of MRI Data working group with Dan Rowe.

Ben is an NIH trainee, so will continue his research at SAMSI next year. He is also associated with UNC's biostatistics department, so will spend time there as well.

When Ben has time, he likes to go cycling and to play guitar. Of course, he still loves birds, so he also likes to go birding when he has time.

(NCSU), Soumen Lahiri (NCSU) and Robert Wolpert (Duke). The directorate liaison is Sujit Ghosh (SAMSI and NCSU) and the National Advisory Committee liaison is Michael Stein (U. Chicago). For further information check out the website www.samsi.info/ASTRO/ and/or contact Sujit Ghosh by email: ghosh@samsi.info

Optimization Program

The OPT program will be a great subject for applied mathematicians and statisticians to collaborate together to further this area of research. The year's program will focus on optimization for large-scale statistical analysis, such as computing high-dimensional covariance functions; statistical approaches to numerical solutions of large-scale optimization problems, such as Bayesian inference for parameter estimation and inverse problems; and applications of optimization.

Some of the topics that will be covered include:

- Optimization under uncertainty
- Convex and semi-definite optimization
- Robust and stochastic optimization
- PDE-constrained optimization with uncertainties
- Statistical inverse problems
- Computation of high-dimensional covariance functions
- Machine learning
- Signal and image processing and compressed sensing

The organizing committee includes:

Mihai Anitescu (U. Chicago and Argonne), Sven Leyffer (Argonne), *Michael Mahoney (U. California-Berkeley), *Habib Najm (Sandia), Pablo Parrilo (MIT), Ekkehard Sachs (U. of Trier). (*National Advisory Committee Members)

The directorate liaison is Ilse Ipsen (NCSU) and the local scientific coordinators include: Pierre Gremaud (NCSU), Eric Laber (NCSU), Shu Lu (UNC), Dávid Papp (NCSU), Gabor Pataki (UNC) and Brian Reich (NCSU).

SAMSI is hiring 6 postdocs for the 2016-2017 academic programs. To apply, go to mathjobs.org, SAM-SIPD2016 Job #7448

Director's letter (Continued)

(From page 2)

We congratulate our Governing Board member Robert Calderbank on two recent awards. Robert was named the 2015 recipient of the Claude Shannon award, the most prestigious prize in Information Theory, and he was also named an Honorary Member of the London Mathematical Society. Robert has agreed to become the Chair of the SAMSI Governing Board, in succession to Dan Solomon, while Dan's place on the Board has been taken over by Dr. William (Bill) Ditto, the new Dean of the College of Sciences at NCSU. We look forward to working closely with Robert, Bill and the other Board members, as we continue to develop our plans for the future.

Calendar of Events for SAMSI

February 22-23, 2016
Undergraduate Workshop Focusing on Forensics
March 21-22, 2016
Workshop on Distributed Data Analysis with Applications in Finance and Healthcare
April 6-8, 2016
Spring Opportunities for Women in Math Sciences
May 4-6, 2016
CCNS Transition Workshop
May 9-12, 2016
Forensics Transition Workshop
May 16-20, 2016
Games and Decisions in Reliability and Risk Workshop
May 22-27, 2016
Interdisciplinary Workshop for Undergraduate Students
May 29 – June 3, 2016
SAMSI-SAVI Workshop, Mumbai, India
July 17-27, 2016
Industrial Math/Stat Modeling Workshop for Graduate Students
August 22-26, 2016
Opening Workshop: Astronomy
August 29-September 2, 2016
Opening Workshop: Optimization

For more information about SAMSI programs and workshops, visit SAMSI's website at **http://www.samsi.info**

Students at the undergraduate workshop in October.

Undergraduate Workshop Focusing on Neuroscience

The halls at SAMSI were filled with enthusiastic undergraduate students who had a great introduction to the field of computational neuroscience. Students employed applied mathematics and statistical methods during some of the lab sessions.

Students heard lectures from visiting statisticians and applied mathematicians including tutorials on clinical brain imaging, diffusion tensor imaging study of multiple sclerosis, computed tomography and more. The students got to travel to Duke University to tour the Center for Neuroimaging, led by Stephan Mague.

Graduate students and postdoctoral fellows led a panel discussion about careers in mathematical sciences and answered questions from the students about what to do to get into graduate school.

Another undergraduate workshop will be held in February that will focus on the field of forensics. Interested students can apply on the SAMSI website.

Undergraduate workshop on Computational Neuroscience.

Riding on the bus to Duke University for the tour.