

Operations Research Center

The [Operations Research Center](#) (ORC), established in 1953 as a first-of-a-kind interdepartmental graduate degree program, completed its 60th year of operation in academic year 2012–2013. The ORC administers its own graduate programs and a varied research program of methodological and applied projects. It maintains a reading room with a small library as well as state-of-the-art computational workstations and a conference room with distance-education equipment.

This report summarizes ORC's AY2013 activities and briefly reviews its educational, research, and outreach programs.

Faculty, Students, Staff

Professors Dimitris Bertsimas and Patrick Jaillet continue to serve as co-directors of the center.

During AY2013, the ORC had 50 affiliated faculty and two staff members, with faculty drawn from the MIT Sloan School of Management and the Departments of Aeronautics and Astronautics, Civil and Environmental Engineering, Economics, Electrical Engineering and Computer Science, Mathematics, Mechanical Engineering, Nuclear Science and Engineering, and Urban Studies and Planning.

The ORC offers two interdepartmental graduate degree programs, a PhD degree and an SM degree. During the past year, these programs enrolled 66 students—53 PhD candidates, and 13 SM candidates. The ORC conferred seven master's degrees and 10 PhD. Several other PhD theses were in the final stages of completion in summer 2013.

The ORC had a record year in terms of admissions yield, with 242 applications for the PhD program. We made 20 offers of admission and 14 were accepted. For the SM program, we received 84 applications, made eight offers, and all eight were accepted. This coming academic year will be the largest-ever enrollment for the ORC, totaling 75 students. We currently have five National Science Foundation (NSF) predoctoral fellows, one Department of Energy, two National Defense Science and Engineering Graduate (NDSEG) fellows, and three Natural Sciences and Engineering Research Council of Canada (NSERC) fellows.

Academic Programs

The ORC's academic programs continue to be ranked among the very best nationally and internationally. Moreover, the programs are repeatedly cited as achieving an excellent balance between application and methodological domains.

Research Activities

Research activities spanned a wide spectrum of methodological topics and applications, ranging from small, unsponsored projects involving one faculty member supervising a student's thesis to larger sponsored programs involving several faculty, staff, and students.

Methodological research includes such topics as linear, nonlinear, and combinatorial optimization; solution methods for integer programming; interior point methods for linear and nonlinear programming; dynamic programming; cluster analysis; parallel and distributed computation and algorithms; network flow algorithms; network design; probabilistic combinatorial optimization; online optimization; deterministic and stochastic facility location; queuing theory, including queuing networks; risk analysis; stochastic processes; classical and Bayesian statistics; game theory; and decision analysis and statistical decision theory.

ORC faculty members contribute to application domains as wide-ranging as manufacturing, communications, transportation, public services, logistics, marketing, financial services, health care, and nuclear engineering. Current projects address topics such as air traffic control; epidemiology; AIDS testing; life-cycle modeling of municipal solid waste; safety, risk analysis, and network design in air transportation; telecommunication network design; supply chain management; production scheduling; and transportation logistics, diseases, and disasters.

Several organizations sponsored research projects at the ORC during AY2013, including the Air Force Office of Scientific Research, Draper Laboratory, General Motors, ISO New England, Lincoln Laboratory, the NSF, the Office of Naval Research, and the Singapore/MIT Alliance Program.

Outreach and Professional Service

During academic year 2013, the ORC held multiple faculty meetings to discuss issues of interest to the center, including the following topics:

- A proposal to take the lead role in MIT's initiative to increase the Institute's strength in the statistical sciences
- The Accenture and MIT Alliance in Business Analytics as it relates to the ORC
- A proposed enhanced and larger SM program in decision analytics

Ability to Support Graduate Students

The ORC has increased its efforts to submit research proposals in order to obtain significant, collaborative research grants. One example is the NSF grant group submission "Collaborative Research: Algorithmic Approaches to Personalized Health Care," with professors Bertsimas, Jaillet, and Konstantinos Daskalakis being the principal investigators.

Seminar Series

The ORC Weekly Seminar Series was privileged to have many distinguished speakers from industry and academia this year. The operations research professionals who made presentations included Ronald de Wolf (Dutch Centre for Mathematics and Computer Science); Yossi Aviv (Washington University); Sham Kakade (Microsoft Research); James Orlin (MIT); Jim Smith (Duke University); Marshall Fisher (University of Pennsylvania); Baruch Schieber (IBM); Sigrun Andradottir (Georgia Institute of Technology); Gerard

Cornuejols (Carnegie Mellon University); Cynthia Rudin (MIT); Jeff Eisen (IBM); Juan Pablo Vielma (MIT); Tauhid Zaman (MIT); Edward H. Kaplan (Yale University); Özalp Özer (University of Texas); Eleni Pratsini (IBM); Ariel Pakes (Harvard University); John Birge (University of Chicago); Egon Balas (Carnegie Mellon); Guillermo Gallego (Columbia University); Erol Peköz (Boston University); Richard Berk (University of Pennsylvania); and Daniel Kuhn (Imperial College London).

During the January independent activities period, the ORC offered a full-day Analytics in Healthcare session in which several talks focused on academic medical centers, the use of electronic health records to improve care, risk-based breast cancer screening policies, and the benefits of a cloud-based electronic medical records system. The speakers included professor Retsef Levi (MIT), John D'Amore (Clinformetrics, Inc.), Turgay Ayer (Georgia Tech), and Michael Howell and Daniel Talmor (Beth Israel Deaconess Medical Center).

Future Plans

The ORC program is stable and not facing any unusual challenges. Depending on the success of the two newly introduced PhD tracks, additional specializations may be added to the doctoral program in the future. The program also plans to continue its involvement in and collaboration with the newly formed Accenture and MIT Alliance in Business Analytics, as well as exploring possible further synergies and collaborations with other units at MIT. The center will work toward the establishment of the proposed enhanced and larger SM program in decision analytics, and intends to play a larger role in decision analytics and statistics within the Institute. Finally, the center is considering a major redesign of its physical space, which would become essential as plans for a larger SM program move forward.

Diversity

The ORC has always attempted to provide an environment that is responsive to the varied professional and personal needs of MIT's operations research community and that builds diversity. Of the center's two staff members (a support staff person and an academic program administrator), one is a woman. Eleven of the ORC's current graduate students are women. Over the past several years, we have made diligent efforts to attract qualified women and underrepresented minorities to our graduate programs by targeting information to math departments in liberal arts colleges and by sending information to historically black colleges.

Professional Activities

Faculty

Itai Ashlagi has received a CAREER Award from the National Science Foundation for his project, "Novel designs for kidney exchange and other markets, in the intersection of OR, Econ and CS." CAREER Awards are NSF's most prestigious awards in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the context of the mission of their organizations.

Hamsa Balakrishnan, along with Ioannis Simaiakis, Melanie Sandberg, and R. John Hansman, received the Center for Naval Analyses 2012 Operational Analysis Award, which recognizes work that is judged as having provided the most creative, empirically based support to a real-world decision, or solution to a real-world problem.

Michel Goemans was awarded the 2012 Farkas Prize of the Institute for Operations Research and the Management Sciences (INFORMS) Optimization Society, which was established in 2006 and is awarded annually to a mid-career researcher for outstanding contributions to the field of optimization over the course of their career. Goemans also became a fellow of the American Mathematical Society, which recognizes members who have made outstanding contributions to the creation, exposition, advancement, communication, and utilization of mathematics. In addition, Goemans was elected a fellow of the Society of Industrial and Applied Mathematics for contributions to combinatorial optimization, and in particular to the design and analysis of approximation algorithms.

Stephen Graves was awarded the 2012 Manufacturing and Service Operations Management Society (MSOM) Distinguished Service Award, created to recognize individuals whose distinguished service to MSOM has helped to advance significantly the goals and objectives of the section.

Richard C. Larson and Anna Teytelman were awarded the 2013 International Society for Pharmacoeconomics and Outcomes Research Value in Health Paper-of-the-Year Award for their paper “Modeling the Effects of H1N1 Influenza Vaccine Distribution in the United States” (*Value in Health* 2012; 15:15866). The award promotes quality research, originality, and utility in health care decisions for articles published in *Value in Health*.

Andrew Lo was awarded the Chinese Engineers and Scientists of Southern California 2013 Achievement Award. Lo also was elected a fellow of the American Academy of Arts and Sciences.

James Orlin was awarded the 2013 Harold Larnder Prize, given by the Canadian Operational Research Society (CORS). The prize is awarded annually to an individual who has achieved international distinction in operational research. The prizewinner delivers the Harold Larnder Memorial Lecture on a topic of general interest to operational researchers at the CORS national conference.

Carolina Osorio was awarded the 2012 Association of European Operational Research Societies (EURO) Doctoral Dissertation Award for her thesis: “Mitigating Network Congestion: Analytical Models, Optimization Methods and their Applications.” This award distinguishes an outstanding PhD thesis in operational research defended in one of the 30 countries having an operations research society that is a member of EURO.

Asu Ozdaglar received the inaugural Steven and Renee Finn Innovation Fellowship from the MIT Electrical Engineering and Computer Science department. The fellowship provides tenured, mid-career faculty in the Department of Electrical Engineer and Computer Science with resources for up to three years to pursue new research and development paths.

Pablo Parrilo and John Tsitsiklis, along with Amir Ali Ahmadi and Alex Olshevsky, have been awarded the 2012 INFORMS Computer Society Award, an annual award for the best English language paper or group of related papers dealing with the operations research/computer science interface. The award recognized the significant contributions of three papers:

- Ahmadi, Olshevsky, Parrilo, and Tsitsiklis, “NP-Hardness of Deciding Convexity of Quartic Polynomials and Related Problems,” *Mathematical Programming*, 2011.
- Ahmadi and Parrilo, “A Convex Polynomial that is not Sos-convex,” *Mathematical Programming*, 2011.
- Ahmadi and Parrilo, “A Complete Characterization of the Gap Between Convexity and Sos-convexity,” *SIAM Journal on Optimization*, 2012.

Georgia Perakis and Joline Uichanco, along with Siddharth Balwani, Mallik Angalakudati, Jorge Calzada, Bikram Chatterjee, and Nicolas Raad, were awarded First Prize in the 2012 INFORMS Services Science Section Best Paper Award for “Stochastic Optimization for Resource Allocation with Random Emergencies.” The award recognizes excellence among section members. The INFORMS Section on Service Science promotes and disseminates research and applications among professionals interested in theory, methodologies, and applications in service science, engineering, and practice.

Cynthia Rudin (and the team she led) won the 2013 INFORMS Innovative Applications in Analytics Award for her work on “Analytics for Power Grid Distribution Reliability in New York City.” This award recognizes innovative application and integration of a variety of analytical techniques that provide unique insights and business value to organizations.

David Simchi-Levi was selected as an MSOM fellow for 2013. MSOM fellowships recognize outstanding research and scholarship in operations management. He was also honored in the *Production and Operations Management* January-February 2013 issue for contributions to the theoretical and practical aspects of supply-chain management. In addition, Simchi-Levi received the 2012 Thinkers & Movers Award given by DSC Logistics to recognize individuals whose innovative leadership has resulted in groundbreaking supply chain understanding and practices.

Students

Chaithanya Bandi and Nataly Youssef were finalists in the 2012 George Nicholson Student Paper Competition for “Robust Queueing Theory.” The George Nicholson Student Paper Competition is held each year to identify and honor outstanding papers in the field of operations research and the management sciences written by a student. Chaithanya Bandi and Nataly Youssef also won the inaugural ORC Best Student Paper award for the same paper.

Maxime Cohen, current ORC student, received the Martin fellowship from MIT. Martin Fellows investigate emerging issues in sustainability, exchange information, and participate in occasional seminars and an annual retreat. These activities support

fellows' development of the collaborative capacity that is critical to the successful implementation and application of sustainability scholarship.

Martin Copenhaver, incoming student to the ORC for fall 2013, received a NDSEG fellowship for graduate studies.

Joseph Huchette, incoming ORC student for fall 2013, received an NSF fellowship for graduate studies.

Zachary Leung, Jeremie Gallien, and Prashant Yadav were awarded first place in the INFORMS Section on Public Programs, Services, and Needs (SPPSN) Best Paper Competition for "Rationality and Transparency in the Distribution of Essential Drugs in Sub-Saharan Africa: Analysis and Design of an Inventory Control System for Zambia." The INFORMS SPPSN Best Paper Competition is intended to encourage journal-quality research in all of the disciplines and application areas represented within SPPSN, and to build a tradition of scholarly exchange of knowledge at research meetings that goes beyond attendance at sessions.

Will Ma, current ORC student, received a NSERC fellowship for graduate studies.

Velibor Misic received honorable mention in the Canadian Operational Research Society Student Paper Competition, Open Category for the paper he wrote along with Timothy Chan, "Adaptive and Robust Radiation Therapy Optimization for Lung Cancer." The annual competition recognizes the contributions of papers either directly to the field of operational research through the development of methodology or to another field through the application of operational research.

Alexander Remorov, current ORC student, received an NSERC fellowship for graduate studies.

Alumni

Timothy Chan (University of Toronto) and Douglas Fearing (Harvard Business School) were awarded first prize in the 2013 MIT Sloan Sports Analytics Conference research paper competition for "The Value of Flexibility in Baseball Roster Construction." Chan was also awarded second place in the INFORMS SPPSN Best Paper Competition for "Optimizing the Deployment of Public Access Defibrillators."

Ioana Popescu was awarded the 2012 MSOM Best Paper Award for "Media Revenue Management with Audience Uncertainty: Balancing Upfront and Spot Market Sales." The annual award recognizes the paper most deserving for its contribution to the theory and practice of operations management among articles published in one of the prior three volumes of *Manufacturing & Service Operations Management*.

Nikolaos Trichakis received third place in the 2012 George B. Dantzig Dissertation Award for the paper "Fairness in Operations: From Theory to Practice." The award is given for the best dissertation in any area of operations research and management sciences that is innovative and relevant to practice.

Yuan Zhong was a finalist in the 2012 George Nicholson Student Paper Competition for “Optimal Queue-size Scaling in Switched Networks”. The competition is held each year to identify and honor outstanding papers in the field of operations research and the management sciences written by a student.

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