

Operations Research Center

The Operations Research Center (ORC), established in 1953 as a first-of-a-kind interdepartmental graduate degree program, completed its 52nd year of operation in 2004–2005. The center 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.

This report summarizes the center's AY2005 activities and briefly reviews its educational, research, and outreach programs.

Faculty, Students, and Staff

Professor James B. Orlin, Edward Pennell Brooks professor of operations research, and John N. Tsitsiklis, professor of electrical engineering and computer science, served as codirectors during AY2005.

This year, ORC had 48 affiliated faculty and senior staff, with faculty drawn from the Sloan School of Management and the departments of Electrical Engineering and Computer Science, Civil and Environmental Engineering, Mathematics, Aeronautics and Astronautics, Mechanical Engineering, Nuclear Science and Engineering, and Urban Studies and Planning. Two faculty members who joined ORC this year are Devavrat Shah (EECS and ESD), and Pablo Parrilo (EECS).

ORC offers two interdepartmental graduate degree programs—a PhD and a master's degree. During AY2005, these programs enrolled 44 students: 34 PhD candidates and 10 SM candidates. The center conferred eight master's degrees and five PhDs. Several other PhD theses were in the final stages of completion in the summer of 2005.

Academic Programs

ORC's academic programs continue to be recognized as ranking among the very best nationally and internationally. The programs, moreover, 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 a single faculty supervising a student's thesis, to much 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; deterministic and stochastic facility location; queueing theory, including queueing networks; risk analysis; stochastic processes;

classical and Bayesian statistics; game theory; and decision analysis and statistical decision theory.

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

Several organizations sponsored research projects at ORC during AY2005, such as Amazon Corporation; National Science Foundation; C.S. Draper Laboratory (several projects and Draper fellowships); General Motors; Logistics Management Institute; Office of Naval Research; and Singapore-MIT Alliance.

Outreach and Professional Service

In an effort to enhance the quality of life for ORC graduate students while at MIT, ORC staff submitted a proposal for a Graduate Student Life Grant. The center was awarded two years of funding that will be put towards a number of student-related initiatives throughout the academic year.

ORC has continued with the Tuesday seminar series for its students. This series is a mixture of internal research presentations as well as professional development seminars.

The ORC Seminar Series was privileged to have many distinguished speakers from industry and academia this year. Among the many operations research professionals who made presentations were: Stefanos Zenios (Stanford); Alan Frieze (Carnegie-Mellon); Garud Iyengar (Columbia); Uriel Rothblum (Technion, Israel); Michael Pinedo (New York University); Robert Shumsky (University of Rochester); Erica Plambeck (Stanford); Gilbert Laporte (HEC Montreal, Canada); Robert Smith (University of Michigan); William DuMouchel (Lincoln Technologies, Inc.); Linda Green (Columbia Business School); Franz Rendl (University of Klagenfurt, Austria); Lawrence Wein (Stanford); Adrian Vetta (McGill University, Canada); George Nemhauser (Georgia Institute of Technology); Robin Roundy (Cornell University).

The center also offered a program of activities during the January independent activities period, including a series of presentations on the practice of operations research and management science presented by Michael Ricard (Draper Laboratory); John Bossert (Optiant); Andrew Lo (MIT); Chuck Joyce (GMO).

Operational Issues

During 2004–2005, ORC did not experience any significant operational or organizational challenges. Professor Tsitsiklis will be stepping down as codirector at the end of 2005, and a replacement will need to be identified at that time.

This past year, ORC completely made over its website, <http://web.mit.edu/orc/www/>. In addition to updating the website's look and feel, ORC has also attempted to reach out further to the MIT community and elsewhere. In particular, we want to make MIT undergraduates better aware of opportunities in operations research.

We have created a new Undergraduate Research Opportunities Program (UROP) page with UROP listings for most of the ORC faculty. We have also created an OpenCourseWare page which lists those operations research subjects at MIT that are available on the OpenCourseWare site. These may be accessed via <http://web.mit.edu/orc/www/academics/>.

Professor Orlin has made an effort to enhance the operations research concentration at the Sloan School of Management (he is the faculty coordinator for the concentration.). Under his leadership, the number of operations research concentrators has increased from around 5 to more than 25, and he expects further increases over the next few years. The increase in operations research concentrators may translate to an increase in applications to ORC from MIT undergraduates.

Professor Orlin is also leading an initiative to create an undergraduate interdisciplinary minor in operations research. Preliminary discussions have been promising. We anticipate that a proposal will be sent to the Committee on Curriculum some time during fall 2005.

Future Plans

The ORC program is currently stable and does not face any unusual challenges. Still, there are a number of issues that were identified in the course of this year's strategic planning exercise, which will be explored. These include:

- Possible realignment of offered courses
- Exploration of new, but important application domains
- Increasing diversity and representation of minorities
- Ensuring ORC's continued ability to support graduate students
- Possible changes in the master's program
- Relations with the Engineering Systems Division
- Program visibility
- External activities

ORC has established an operational partnership with the newly established Computation for Design and Optimization program by providing space and logistical support for it. A closer form of partnership is under discussion.

Diversity

ORC has always attempted to provide an environment that is responsive to the varied professional and personal needs of the operations research community at MIT, and that builds upon diversity.

The staff of the ORC is composed of two support staff members and one administrative officer. Of these three staff, two are women, and one is African American.

Four of the affiliated ORC faculty are women. Two of them are assistant professors recently hired by the departments of Mechanical Engineering and Electrical Engineering and Computer Science.

One of the ORC's affiliated faculty is from an underrepresented minority group.

As for the student population, 11 of our current graduate students are women and one doctoral student is from an underrepresented minority group.

ORC makes no faculty appointments.

Over the past years, we have made 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. We intend to continue these pursuits and look for other targets of opportunity for increasing diversity at the center.

Professional Activities

- Dimitris Bertsimas was elected to the National Academy of Engineering in February 2005. Election to the academy is among the highest professional distinctions accorded an engineer. Dimitris was recognized for his contributions to optimization theory and stochastic systems and innovative applications in financial engineering and transportation. In addition, he was awarded the Gold Medal for Operations Research by the Greek operations research society in July 2004.
- Olivier L. de Weck received the Best Paper Award INCOSE 2004 from the 14th Annual International Symposium of the International Council on Systems Engineering, Toulouse, France, June 2004.
- John Hauser, James B. Orlin, Michael Yee (PhD student), and Ely Dahan won the EXPLOR Award for excellence in online marketing research.
- Richard C. Larson was appointed a Mitsui professor in November 2004. He is also serving as the president of INFORMS, the main professional organization in operations research.
- Amedeo R. Odoni was elected a fellow of INFORMS in October 2004.
- Pablo Parrilo received the 2005 Donald P. Eckman Award "in recognition to pioneering contributions to the integration of algebraic and numerical techniques as computational tools for the optimization and robustness of control systems." The Donald P. Eckman Award recognizes an outstanding young engineer in the field of automatic control. The recipient must be younger than 35 years on January 1 of the year of award. In addition, he received the 2005 SIAG/CST Prize for his "fundamental contributions in computation for control, based on a novel approach that creatively combines concepts and techniques from algebra and convex optimization."

- Daniela Pucci de Farias received an National Science Foundation Career Award in February 2005.
- Santosh Vempala was elected as a Guggenheim fellow for the year 2005–2006 for work on algorithmic convex geometry.
- Alexandre Belloni, an ORC student, was awarded an IBM PhD fellowship (2005–2006) for graduate studies.
- Timothy Chan, an ORC student, received a Student Life Programs Leadership Award. This award is presented to an individual student who went above and beyond his or her call of duty as an organization leader, and who showed dedication to their organization and to campus life at MIT.
- Xuan Vinh Doan, an ORC student, received an IHPC-SGI Award for Best Student in High Performance in Computations for Engineered Systems Programme from the SMA-MIT Alliance master's program in July 2004.
- Pranava Goundan, an ORC student, received a Graduate Student Council Graduate Teaching Award from the Sloan School of Management in May 2005.
- Carine Simon, an ORC student, was the recipient of a Robert Guenassia Award in January 2005.
- Amy Mainville Cohn (PhD, 2002) was awarded a Sloan Foundation Industry Fellowship in 2004.
- Soulaymane Kachani (PhD, 2002) was awarded the MIT Arab Student Organization's Science and Technology Award in 2005.

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Codirector

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More information about the Operations Research Center can be found online at <http://web.mit.edu/orc/www/>.