Computation for Design and Optimization

The Computation for Design and Optimization (CDO) SM program has been in operation since 2005. During academic year 2009, CDO continued to expand in its number of students, affiliated faculty, and program-related activities. The program sponsored the fourth Distinguished Speaker seminar series. The fourth admissions cycle was conducted. The roster of CDO-affiliated faculty members, representing nine departments, increased to 37. Fifteen students graduated in September 2008, two in February 2009, and four in June 2009. Nineteen students are on the September 2009 degree list, and 23 new students will join CDO in the 2010 academic year.

The CDO Program

Substantial improvements in numerical methods and dramatic advances in computer hardware have generated vast opportunities for computational science and engineering. Consequently, intensive computation for design and optimization is now an essential activity in the design and operation of a wide variety of complex engineered systems, such as micromachined devices, guidance/control systems, imaging systems, distribution networks, telecommunications, and transportation systems. The critical role that computation plays across engineering disciplines in both academia and industry has created a need to educate tomorrow's engineers in computational science for design and optimization. The CDO master's degree program addresses this need by educating students in the formulation, analysis, and critical application of computational approaches to designing, predicting, controlling, and optimizing engineered systems. CDO graduates are equipped with the knowledge required to create and harness computational tools that will drive the engineered systems of the future.

Current Goals

The CDO program's goals for the upcoming year include:

- Integrating the CDO SM program into the new Center for Computational Engineering (CCE)
- Redesigning the CDO website within the framework of the new CCE website
- Continuing to foster community among CDO-affiliated faculty and students
- Expanding the outreach of CDO throughout MIT and elsewhere

Accomplishments

Faculty Awards

CDO-affiliated faculty members received the following awards and recognition during AY2009:

Paul I. Barton (with N. Selvakumar of Thermax Ltd., India) received the 2008 Indo-American Frontiers of Engineering Award from the Indo-US Science and Technology Forum, in partnership with the National Academy of Engineering, for "Studies on

Transport Gasifier for High-Ash Coal with Use of Oxygen Carriers for Economic CO_2 Separation and Reduced Overall Plant Cost."

Luca Daniel was awarded the RLE-MIT Junior Faculty Award for "RLE's most promising untenured faculty" in June 2008. In addition, he was bestowed the Emanuel E. Landsman Chair for Career Development, Department of Electrical Engineering, 2008–2010. Also, with Bradley Bond, he received the 2008 Best Paper Award at the Institute of Electrical and Electronics Engineers (IEEE)/Association for Computing Machinery (ACM) William J. McCalla International Conference on Computer-Aided Design, in November 2008.

Olivier de Weck received the *Systems Engineering Journal* Outstanding Paper Award (INCOSE), in June 2008, as well as the 2008 Technical Working Group Collaboration Award (INCOSE), in January 2009.

Steven G. Johnson received the Edmund F. Kelly Research Award, given by the MIT Department of Mathematics every three years to "recognize outstanding work" by a junior faculty member, in April 2009.

In April, 2009, Gilbert Strang was elected to the US National Academy of Sciences, in recognition of his distinguished and continuing achievements in original mathematics research.

Joel Voldman was presented with the Young Innovators Award for exceptional technical advancement and innovation in his early career at the 12th International Conference on Miniaturized Systems for Chemistry and Life Sciences, in October 2008.

Admissions

This year, CDO received the largest number of applications to date: 126 students applied for AY2010 admission. Of these, 33 were admitted, 23 plan to enroll, and two have deferred to 2010. Fifteen of the new students will be in the dual-degree CDO-SMA program (described below). CDO will have six continuing students, one of whom is also a PhD student in the Department of Mechanical Engineering. We expect to have a total of 28 CDO students in September 2009, and one will join the program in January 2010. In addition, it is typical for several current MIT graduate students in other programs to apply to CDO on a "rolling admissions" basis and join the program at various times throughout the academic year.

Research Support and SMA-2

In 2005, CDO was awarded a five-year collaborative research and education program grant through the Singapore–MIT Alliance (SMA-2). As CDO enters its fifth and final year of this grant period, the program and CDO-affiliated faculty will receive $1.8 million in SMA-2 research funds for AY2010.

The educational adjunct to this SMA-sponsored research support is a two-year dual-degree program in computational engineering (CE), in which students are awarded two master's degrees: one in CDO from MIT and the other in CE from the National

University of Singapore. Up to 16 SMA fellowships per year are available through the SMA-CE program. Of the 17 students enrolled in CDO during AY2009, 12 were SMA fellowship recipients and are expected to complete their CDO degrees in September 2009. Of the incoming fall 2009 students, 15 will be SMA fellowship recipients.

Initiatives

CDO Student and Faculty Environment

CDO program activities are intended to establish a productive, collegial environment for students and faculty. For CDO students, this year we conducted a fall program orientation, held lunches for students to meet with the CDO director, and hosted winter and June social events for the CDO community. A CDO Steering Committee meeting was held in October to review the status of the program and consider its future as it becomes an education program of the Center for Computational Engineering.

CDO organized the ongoing the Distinguished Speaker Series, in which six prominent researchers presented their current research on topics relevant to computation for design, control, simulation, and optimization. The seminars are free and open to the public, and streaming videos of the lectures are provided on the CDO website. The series will continue next year.

CDO and the Center for Computational Engineering

MIT's new Center for Computational Engineering will subsume the CDO program as of AY2010. CCE supports computational engineering research and education at MIT and emphasizes the development of new computational methods relevant to engineering disciplines, and the innovative application of computational methods to important problems in engineering and science. CCE will have faculty and research partners from across the School of Engineering, as well as other departments and units involved in computational engineering around the Institute. Most of CDO's affiliated faculty have elected to join the CCE-affiliated faculty group.

Personnel

The outgoing CDO program director is professor Jaime Peraire (Aeronautics and Astronautics). The codirectors of the Center for Computational Engineering, professor Anthony T. Patera (Mechanical Engineering) and associate professor Karen Willcox (Aeronautics and Astronautics), will serve as the CDO codirectors starting in AY2010. Laura Koller is the CDO academic administrator and will continue to be responsible for administration of the SM program, graduate student support, admissions, and communications about the program.

Jaime Peraire
Director
Professor of Aeronautics and Astronautics

More information about the Computation for Design and Optimization program can be found at http://web.mit.edu/cdo-program/.