# 6 Research Centers

## Center for Integrated Circuits and Systems

Professor Hae-Seung Lee, Director

The Center for Integrated Circuits and Systems (CICS) at MIT, established in early 1998, is an industrial consortium created to promote new research initiatives in circuits and systems design, as well as to promote a tighter technical relationship between MIT's research and relevant industry. Six faculty members participate in the CICS: Hae-Seung Lee (director), Anantha Chandrakasan, Joel Dawson, David Perreault, Charles Sodini, and Vladimir Stojanovic. CICS investigates a wide range of circuits and systems, including wireless and wireline communication, high-speed and RF circuits, microsensor/actuator systems, imagers, digital and analog signal processing circuits, and DC-DC converters, among others.

We strongly believe in the synergistic relationship between industry and academia, especially in practical research areas of integrated circuits and systems. We are convinced that CICS is the conduit for such synergy. At present, participating companies include Agilent, Analog Devices, Bosch, Intel, IBM, Linear Technology, Marvell Technology Group, Maxim Integrated Products, Media Tek, National Semiconductor, NXP, Qualcomm, and Texas Instruments.

CICS's research portfolio includes all research projects that the seven participating faculty members conduct, regardless of source(s) of funding, with a few exceptions. (A very small number of projects have restrictions on information dissemination placed on them due to the nature of funding.)

Technical interaction between industry and MIT researchers occurs on both a broad and individual level. Since its inception, CICS recognized the importance of holding technical meetings to facilitate communication between MIT faculty and students and industry. We hold two informal technical meetings per year open to participating companies. Throughout each full-day meeting, faculty and students present their research, often presenting early concepts, designs, and results that have not been published yet, giving early access to meeting attendees. Participating companies then offer valuable technical feedback, as well as suggestions for future research. We have held bi-annual meetings each year, and the response from industry has been overwhelmingly positive.

More intimate interaction between MIT researchers and industry takes place during work on projects of particular interest to participating companies. Companies may invite students to give on-site presentations, or they may offer students summer employment. Additionally, companies may send visiting scholars to MIT. The result is truly synergistic, and we strongly believe that it will have a lasting impact on the field of integrated circuits and systems.

# 6 Research Centers

## Intelligent Transporation Research Center

Dr. Ichiro Masaki, Director

Transportation is an important infrastructure for our society. It is time to propose a new transportation scheme for resolving the increasing transportation problems. In responding to social needs, MIT's Microsystems Technology Laboratories established the Intelligent Transportation Research Center (ITRC) in September 1998 as a contact point of industry, government, and academia for ITS research and development.

ITRC focuses on the key Intelligent Transportation Systems (ITS) technologies, including an integrated network of transportation information, automatic crash and incident detection, notification and response, advanced crash avoidance technology, advanced transportation monitoring and management, etc., in order to improve safety, security, efficiency, mobile access, and environment. There are two emphases for research conduced in the center:

- The integration of component technology research and system design research.
- The integration of technical possibilities and social needs.

ITRC proposes the incremental conversion and development process from current to near- and far-future systems and develops enabling key components in collaboration with the government, industries, and other institutions. Other necessary steps are the integration of technical, social, economical, and political aspects. The integration of the Intelligent Transportation Systems in different countries is also essential. The integration of vehicles, roads, and other modes of transportation, such as railways and public buses, is all imperative.

These integrations are fulfilled with the cooperation of researchers in various fields, including the Microsystems Technology Laboratory (MTL), the Research Laboratory of Electronics (RLE), the Artificial Intelligence Laboratory (AI), the Center for Transportation Studies (CTS), the Age Laboratory, the Department of Electrical Engineering and Computer Science, the Department of Civil and Environmental Engineering, the Department of Aeronautics and Astronautics, and the Sloan School of Management. The research center has 8 MIT faculty and several visiting professors and scientists. The director of the center is Dr. Ichiro Masaki.

# 6 Research Centers

## MEMS@MIT

Professor Martin A. Schmidt, Director

The MEMS@MIT Center serves to unite the wide-ranging campus activities in micro/nano systems and MEMS with forward-looking industrial organizations. Currently, MEMS@MIT is composed of more than 150 faculty, students, and staff working on a broad research agenda and supported by more than $15 million/year in research sponsorship. The MEMS research efforts on campus focus on four overarching themes:

1) Materials, Processes, and Devices for MEMS - including work on piezoelectrics, magnetics, materials/package reliability, DRIE, wafer bonding, plastic fabrication, and printed MEMS

2) Biological and Chemical MEMS - includes cell manipulation, DNA and protein processing, biomolecule detection, medical sensors, microreactors, micro gas analyzers, and microfluidics

3) Actuators and Power MEMS - includeing switches, mirrors, pumps, turbines, fuel cells, thermophotovoltaics, chemical lasers, and energy harvesting

4) Sensors, Systems, and Modeling - includes wireless sensors, pressure sensing systems, and CAD for MEMS

Membership benefits include:

- Insight into newest ideas in MEMS
- Early access to research results
- Early awareness of IP generated for licensing
- Access to high-quality continuing education materials
- Partnering for federal or other funding opportunities
- Recruitment of leading MIT graduates

# 6 Research Centers

## MIT Center for Integrated Photonic Systems

Professor Rajeev J. Ram, Director

The goals of the Center for Integrated Photonic Systems are:

***1. To provide leadership and direction for research and development in photonics.***

The core activity of CIPS is the development of a long-range vision for research and the development of integrated photonic devices and systems. CIPS will host forums and facilitate working groups with industrial consortium members to identify and discuss technology and road-mapping issues:

- technology directions
- potential disruptive technologies
- technical barriers (gaps)
- actions needed to enable future-generation systems, and
- manufacturing and market issues that drive timing of technology deployment.

As an academic institution we can work openly with a variety of different organizations in developing and gathering input for our models. Whether it is performance data for new devices "in the lab," yield data for existing manufacturing processes, planning documents, or first-hand observations of the corporate decision making process, CIPS researchers benefit greatly from the unique relationship between MIT and industry. The level of detail and intellectual rigor of the models being developed here is complemented by the high quality of data available to us. CIPS researchers are developing models of optical and electronic devices, the packages they are wrapped inside, the manufacturing processes that assemble them, the standards that define them, the market that buys them, and the policy processes that influence their deployment.

***2. To foster an Institute wide community of researchers in the field of integrated photonics & systems.***

The Departments of Electrical Engineering and Computer Science, Materials Science and Engineering, Mechanical Engineering and Economics are consistently ranked as the top graduate programs in the country. Likewise, the Sloan School of Management has consistently ranked first in the nation in the areas of information technology, operations research, and supply chain management. CIPS leverages MIT's strengths, by unifying the photonics researchers in these departments and laboratories to focus on technological developments in photonics. The combined volume of research funds in the photonics area at MIT exceeds $20 million dollars annually. The faculty and staff at MIT in photonics-related areas have included Claude Shannon (founder of information theory), Charles Townes (inventor of the laser), Robert Rediker (inventor of the semiconductor lasers), and Hermann Haus (inventor of the single-frequency semiconductor laser & ultrafast optical switch). CIPS-affiliated faculty and staff continue this tradition of excellence in areas ranging from optical network architectures, to novel optical devices, to novel photonic materials.

***3. To integrate member companies into the MIT photonics community.***

CIPS will host annual meetings and seminars in photonics. For CIPS member companies, focused visits to the Institute for individual companies will be organized with faculty and graduate students. In addition, CIPS will hold forums geared towards the creation of campus-industry teams to pursue large-scale research programs. CIPS will host poster sessions at the annual meeting so as to introduce graduate students and their research to industry. CIPS publications will include a resume book of recent graduate students in the area of photonics. Graduates of the Massachusetts Institute of Technology have founded 4,000 firms which, in 1994 alone, employed at least 1.1 million people and generated $232 billion of world sales. Photonics related companies founded by alumni include Sycamore Networks, Analog Devices, Texas Instruments, Hewlett-Packard, and 3Com as well as recent start-ups such as OmniGuide.

Member companies have the opportunity to guide the research of CIPS faculty and students through the Working Groups (WGs) and individual graduate student awards.