



Stacks of silicon wafers wait for the next step in TRL.

MTL RESEARCH CENTERS

MIT Center for Integrated Circuits and Systems (CICS)

Prof. Hae-Seung Lee, Director

The MIT Center for Integrated Circuits and Systems (CICS) is a form of an industrial consortium created to promote new research initiatives in circuits and systems design, as well as to promote tighter technical relation between MIT's research and relevant industry. Seven faculty members, Hae-Seung Lee as Director, Anantha Chandrakasan, Joel Dawson, David Perreault, Michael Perrott, Charles G. Sodini, and Vladimir Stojanovic participate in the Center for Integrated Circuits and Systems. We are investigating a wide range of circuits and systems related to wireless and wireline communication, digital systems, microsensor/actuator networks, imaging systems, digital and analog signal processing, power electronics, and many other systems.

We strongly believe in the synergistic relation between the industry and academia, especially in practical research areas of the integrated circuits and systems. We are convinced that the Center for Integrated Circuits and Systems is the conduit for such synergy. The Center currently has twelve member companies. The Center includes all research projects that the three participating faculty members conduct regardless of the sources of funding. There are two different forms of technical interaction between the member companies and the Center. The broad interaction occurs through research reviews held twice a year open to member companies. These are technical reviews where technical representatives from member companies can critique the projects. In each full day review, we present as many projects as possible. The more intimate interaction happens at a more personal level with graduate students who are working on projects of member company's particular interest. The member company may invite them to give presentations at their site.

At biannual research reviews we have received valuable technical feedback as well as suggestions for future research. There has been close interaction between member companies and the Center personnel through company visits, summer employments, and personal interactions. We believe such an interaction has given very positive results for both MIT and member companies. We are hoping to continue to expand the Center in the future.

Intelligent Transportation Research Center (ITRC)

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 & incident detection, notification and response, advanced crash avoidance technology, advanced transportation monitoring and management, etc., in order to improve the safety, security, efficiency, mobile access, and environment. There are two emphasis for research conducted 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, are 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.

MEMS@MIT

Prof. Martin A. Schmidt, Director

The MEMS @ MIT Center is a newly formed center intended to serve as a means to unite the wide-ranging campus activities in MEMS with forward-looking industrial organizations. The MEMS research efforts on campus span a wide range of activities with three overarching themes: i) Biological, Chemical and Medical MEMS, ii) Power MEMS, and iii) Enabling Technologies. In addition, we maintain an industrial consortium designed to connect member companies to the MEMS-related activities on campus. Overall, MEMS @ MIT includes approximately two dozen faculty and more than 100 students.

The research program in Biological, Chemical and Medical MEMS includes work on manipulation and processing of biologically-relevant materials of varying size scales from tissue engineering scaffolds and cell manipulation, to devices for separation and sorting of DNA and proteins. Additionally, we are working on various sensing platforms for detection of biomolecules. A wide range of microfluidic devices are explored in this research area. Microchemical systems for synthesis and characterization are an area of substantial research. This includes work in developing the core technology for fabrication and packaging of these reactors. The program in Power MEMS spans a wide range of targeted power outputs. Energy scavenging by vibration harvesting is studied for low power distributed systems. Various approaches to fuel burning power generation are studied from thermophotovoltaics to fuel cells and microturbine engines. Enabling Technologies explored in the Center include work on MEMS processes and process modeling. Materials characterization is a critical area of focus. CAD tools for modeling MEMS devices, as well as novel metrology methods form a core competency of the Center. Micro and nano-mechanical devices such as switches, actuators, and self-assembled devices round out the research portfolio.

MIT Center for Integrated Photonic Systems

Prof. 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 & systems. CIPS will host forums and facilitate working groups with industrial consortium members to identify and discuss technology and roadmapping 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 which 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 technology 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-up 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.

