WIMS WORLD

University of Michigan • Michigan State University • Michigan Technological University

DIRECTOR'S MESSAGE

As I sit down to write this, we have just ended another semester or classes. It caused me to reflect on the great opportunities ahead of us and some of the things that helped us get where we are. We all need heroes in our lives, and as I think back, many of mine were teachers. I guess what set them apart was that they cared not just about what they were teaching but about who they were teaching. One that comes to mind was a high school English teacher I had. George Irgang would have done credit to any university faculty. He read us Chaucer in old English, forced us to memorize poetry (which I can still quote), and gave us a real appreciation for literature — Shakespeare, Dickens, Eliot, and so many others. I remember he once took a few of us to visit his alma mater, the University of Chicago, and, after graduation, on another trip up the north coast of Lake Superior. He was an expert on history and the Pennsylvania Dutch, and he shared those interests with me as well. And later when as an undergraduate I debated which of two then-hot fields to go into, microelectronics or ion rockets, a physics teacher named Sergio Rodriguez influenced me greatly. It was his first term teaching, and I recall he didn't understand the concept of partial credit very well; on one 100-point exam I scored a "1," earned for signing my name! But he was excited about solid-state physics and made us feel he really cared about us. I selected microelectronics as a career at least partly because of him. Those teachers, and many others along the way, made me want to be like them. They were role models. But then that's what really good teachers are, and that is why they are so very important. And that is why we have such great opportunities in the Educational thrust of this Center — opportunities, and responsibilities, to change lives. Sometimes we succeed and sometimes we don't. But good teaching is the most important thing we can do. Nothing else comes close.

Societal Impact of Microsystems seminar students with their teacher at UM, Fall 2002

In the Center, we are making real progress toward some wonderful goals in education. At the K-6 level, we are using sensor-driven wireless robots to excite students and spark an interest in exploring how things work. At the middle school level, we are working to show students the possibilities of more sophisticated devices and are using our testbeds (neural prostheses and environmental monitors) to get them excited about creating things that really benefit humankind. At the high school level, led by Michigan State, we have pioneered short courses in WIMS, WIMS for Teens, and WIMS for Women that have caused many young people to choose careers in engineering. I just hope they have as exciting a time as I have had.

At the college level, our new WIMS courses are also making a real difference. While creating them is a bit of a challenge (to say the least), our Introduction to MEMS course has drawn over 70 students at the University of Michigan alone, with more joining over the web from MSU and MTU. The enrollment in our Integrated Microsystems Laboratory course more than doubled between 2001 and 2002, and in 2003 it will come close to doubling again! And last year we offered our Societal Impact of Microsystems seminar for the first time. I am grateful to the many outstanding people who came and shared their expertise with us. We talked about coming challenges that can be addressed using microsystems — population growth, urbanization, air and water pollution, global warming, food shortages, homeland security — and about some of the opportunities that microsystems will help make possible: advances in medical implants, nanotechnology, and genetics. We wove ethics into the mix along with a look at some of the people who have helped us get where we are— from Ben Franklin and Thomas Edison to Gordon Moore and other contemporary leaders. We talked about drive and sources of innovation and whether the present era can still produce heroes. I think so. Heroes are those who give us worthy goals to shoot for and stand as role models. I hope that in this Center, through the courses we develop and the research we do, we can do that for our students. If we can, then this Center will truly be a success.

Ken D. Wise
Director
Engineering Research Center for Wireless Integrated MicroSystems

INSIDE

RECENT EVENTS

THREE NEW INDUSTRIAL MEMBERS JOIN US

We are very excited and pleased to welcome three new member companies. In October 2002, Denso Corporation, Samsung Electronics, and Discera signed on as Industrial Advisory Board Members, bringing our current number of member companies to 23.

~Luke Ling

STUDENTS TAKE FIRST PLACE IN CADATHLON COMPETITION

Congratulations to Matt Guthaus and DoRon Motter for taking a top prize at the International Conference on Computer-Aided Design (ICCAD) last November. Matt is a WIMS Ph.D. student who specializes in standard cell methodologies, and DoRon's association is with UM's Quantum Computing Laboratory. Matt and DoRon won first place in the conference's CAD Contest for their fast and furious programming in a span of 11 hours. Within this quick turnaround window, they had to solve problems in six challenge areas: circuit design and analysis; physical design; logic and high-level synthesis; system design and analysis; functional verification; and timing, testing, and manufacturing.

The competition, held in San Jose, California, tested CAD knowledge, as well as problem-solving, programming, and teamwork skills. The "CADathlon," as the contest is dubbed, is sponsored by the Association for Computing Machinery (ACM) Special Interest Group on Design Automation (SIGDA) and is in the style of ACM's long-running Programming Contest. Each team of two Ph.D. students was given a linux box, a C compiler, and some standard libraries to use in solving the six CAD-related challenges. Matt and DoRon beat 14 teams from other prestigious universities, including Massachusetts Institute of Technology, University of California at Berkeley, University of Wisconson at Madison, Carnegie Melon University, and National Tsing Hua University. According to the grapevine, Matt and DoRon were "far and away the best team." They each received $1,000.

More information can be found at
http://www.eecs.tufts.edu/~soha/cadathlon02/

~Richard Brown

SOLID STATE ELECTRONICS LAB CONTINUES TO UPGRADE

Since the release of our last newsletter, many of the new machines we told you about have been put into operation, and more are to come. EV Group's EV620 has come online and already has 40 registered users. Similarly, users are being trained on Suss Microtec's ACS 200. Their SB6 6-inch substrate bonder and MABA6 6-inch mask aligner are both online too. The Raith 150 electron beam lithography system (see Fall Newsletter) has undergone characterization and users are being trained on it. Through the hard work of Tim Brock and Ken Wise of UM and Motorola's Ray Roup and Bishnu Gogoi, a decommissioned GCA AS200 was donated to the lab and is currently being rebuilt with delivery in April. We want to thank three member companies, EV Group, Suss Microtec, and Motorola, for their assistance in the acquisition of this equipment. Without their generous help, the Solid State Electronics Lab would not be the state-of-the-art facility that it is today.

~Luke Ling

SANDIA FELLOWSHIP AWARDED TO WIMS GRADUATE STUDENT

Brian H. Stark, a fourth-year WIMS graduate student at the University of Michigan, has been named the first Sandia Research Graduate Fellow. A graduate from Cornell University in Ithaca, New York, Brian received his B.S. in Electrical Engineering, cum laude, in 1999. During his undergraduate career, he interned at the Jet Propulsion Laboratory, where he worked on processes related to MEMS reliability. His work there culminated with his authorship of a MEMS reliability guide, which remains the only published document on this subject. From 1997 to the present, he has served as the CEO of Stark Software, a small company that creates software packages for the medical community. He has published six conference papers and two journal papers since 1997. He entered the University of Michigan in June 1999 to pursue his Ph.D. in Electrical Engineering with a major in Circuits and Microsystems and a minor in Solid State Electronics.

The Sandia Research Graduate Fellowship at the University of Michigan is part of a wider sponsorship program at major universities across the U.S. The goal of the fellowship is to encourage innovation in science-based, multi-disciplinary research through support for an outstanding doctoral candidate in science and engineering. In establishing the fellowship, Sandia National Laboratories hopes to strengthen its partnership with the University of Michigan to encourage a new generation of scientists and engineers who can contribute to areas of national interest and critical need.

Sandia National Laboratories is one of the largest federal laboratories in the United States. With major laboratory locations in New Mexico and northern California, Sandia employs over 8,000 regular employees, post-docs, long-term visitors, and contractors. Sandia projects to hire 500 new technical employees per year over the next four years. Major programs at Sandia involve basic and applied research in physical sciences, biology, and information science, as well as engineering programs in defense, energy, and environment. For the past decade Sandia has built a significant portfolio of activities in homeland defense, including intelligence technologies, building security, public asset protection, cybersecurity, and multispectrum sensor technologies.

~Cathy Morgan

Brian H. Stark (second from left) receives congratulations from Professors Khalil Najafi and Ken Wise, Industrial Liaison Joseph Giachino (far right), and WIMS System Integrator from Sandia National Laboratories Cathy Morgan.

EDUCATION HIGHLIGHTS

The Techno Spartans, a lego robotics team based in Lansing, Michigan, placed second among seventeen teams in the Saginaw Regionals of the FIRST Lego League Competition. For Inspiration and Recognition of Science and Technology (FIRST) sponsored the event at Saginaw Valley State University. The team, which is coached by Drew Kim, director of the Diversity Programs Office at Michigan State University, received 290 out of 310 possible points, the second highest score. In addition, the team was also awarded the prize for "Most Robust Robot."

During the competition, students had to design and construct a lego robot that would complete at least eight feats of dexterity and durability based loosely on the theme of City Sights, an exploration into issues that urban planners face every day. The robots had to traverse an obstacle course that involved collecting food loops from plants, removing rocks from a soccer field, activating a drawbridge, spinning a windmill, returning four toxic barrels to a base, stacking modular houses in a development, interacting with a neighboring team by providing food, and supplying material to a building site.

Moreover, the team was required to use their robot to solve a specific and self-directed problem. The Techno Spartans chose to tackle the issue of water pollution. They faced, in addition to the problem, an interview by judges who evaluated their performance and design solution.

Working with lego robots is one of the ongoing educational outreach activities for the Center and is a foundation for our WIMS for Teens summer program (recall the Fall Newsletter).

More information on year-long activities is available on the FIRST Lego League site (http://www.firstlegoleague.org/site-mod/design/layouts/default/).

~Susan Masten and Drew Kim

Techno Spartans pose with well-deserved awards.

Techno Spartans anxiously await their start at the FIRST Lego League competition.

STUDENT LEADERSHIP

In striving to meet the important goals of the WIMS ERC, we not only wish to make significant advancements in microsystems, but also to develop highly trained professionals in this field. To this end, many students in our Center consistently serve as examples to us all. These are the students who take the lead in training others, who selflessly assist newer students in doing their research, and who volunteer to help fix problems and improve their laboratories. The efforts of these student leaders are often overlooked, yet without them various labs would cease to function. For a second year, the WIMS Student Leadership Council presented the WIMS Outstanding Leadership Award to two recipients. John R. Clark and Timothy J. Harpster were selected by popular vote of the entire WIMS Students' Association. Congratulations John and Timothy!

SLC's President and Vice-President, Andrew DeHennis and Timothy J. Harpster, respectively, attended the annual national ERC student retreat in Washington D.C. in November. Student representatives from all the ERCs around the country gathered for a 2-day session to share their SLC experiences, including unique programs; difficult challenges; social activities; and interaction between SLCs and students, faculty, staff, and NSF.

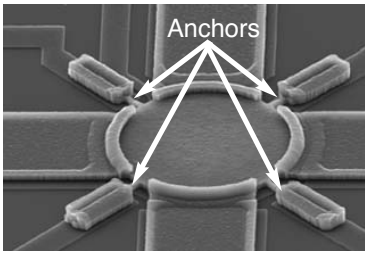
The transition of a new year also brings a transition of SLC officers. In December 2002, new officers were nominated and elected at our annual elections meeting. Please welcome your new officers:

Timothy J. Harpster **President**	Helena Chan and Neil Welch **Social Outreach co-Chairs**
Joseph Potkay **Vice President**	
Jeffrey Driscol **Education Outreach Chair**	Nelson Supelveda-Alancastro **MSU Chair**
Steven Martin **Industrial Outreach Chair**	Tom Wallner **MTU Chair**

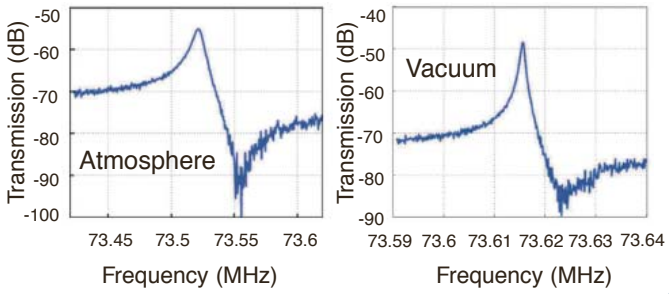
~Timothy Harpster

STEMLESS WINE GLASS MODE POLYSILICON DISK RESONATORS

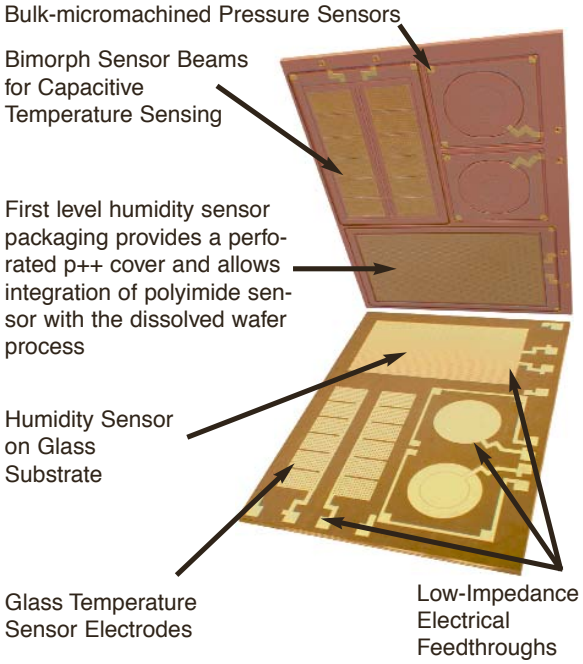
Polysilicon wine-glass-mode micromechanical disk resonators featuring a stemless non-intrusive suspension structure have been demonstrated in both vacuum and atmospheric pressure at frequencies as high as 73.4 MHz. The measured Qs are 98,000 in vacuum and 9,800 in atmosphere, the highest ever-reported Qs in this frequency range and in these environments for any on-chip micro-scale resonator. The new structure offers lower termination resistances, greatly simplified impedance matching, and lower DC-bias voltage requirements, as well as the ability to seal at ambient pressures, paving the way for a new generation of smaller and higher-performance communication devices.



~ Mohamed Abdelmoneum



INNOVATIONS IN ENVIRONMENTAL SENSING



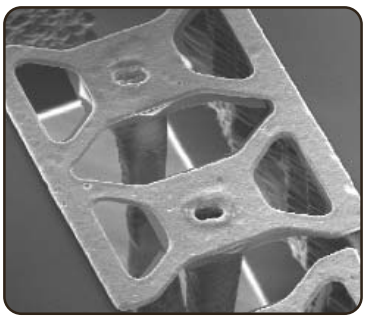
A MEMS chip measuring pressure, temperature, and relative humidity has been realized for an ultra-low-power environmental microsystem. The chip uses (1) a bimorph structure based on differential thermal expansion for sensing temperature and (2) a polymer structure based on moisture absorption for sensing relative humidity.

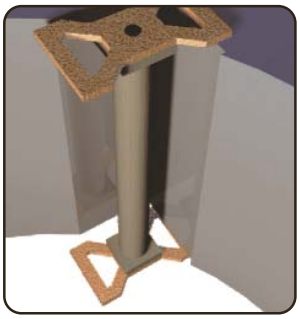
~Andrew DeHennis

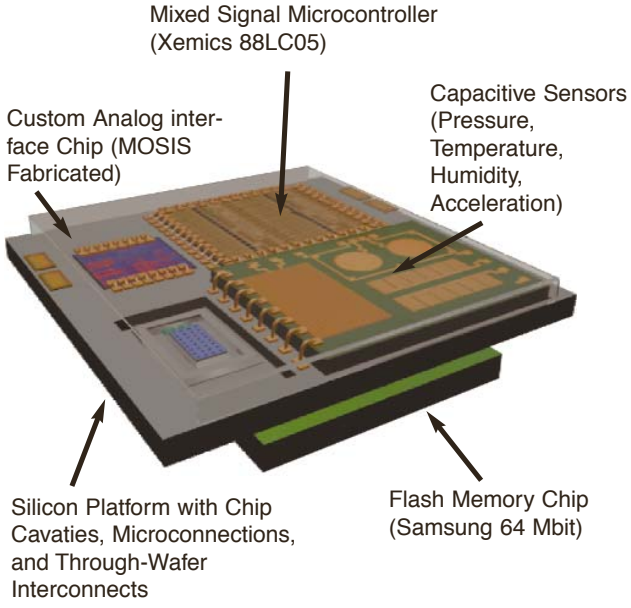
BREAKTHROUGH IN PLATFORM ETCHING

A new feedthrough technology based on deep dry etching has been developed to realize low-resistance, low-capacitance connections between components mounted on opposite sides of a silicon platform. The resulting microsystem is less than 0.5cc in size and contains a commercial microprocessor and flash memory chips along with custom sensors to allow autonomous data collection.

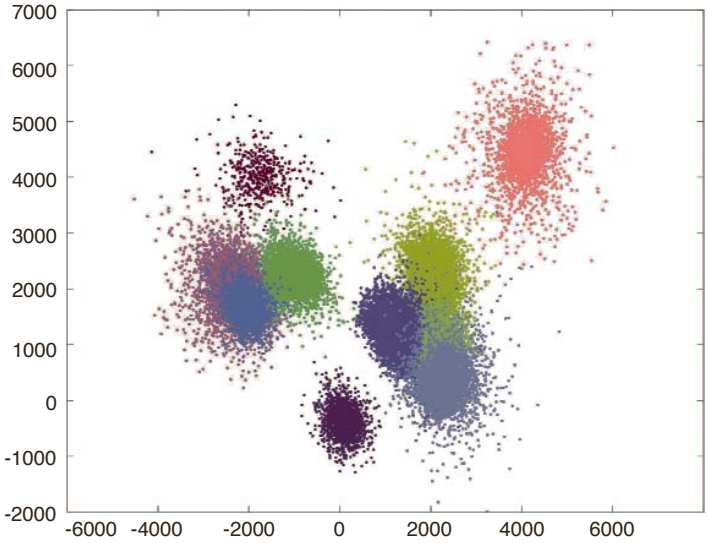
~David Lemmerhirt

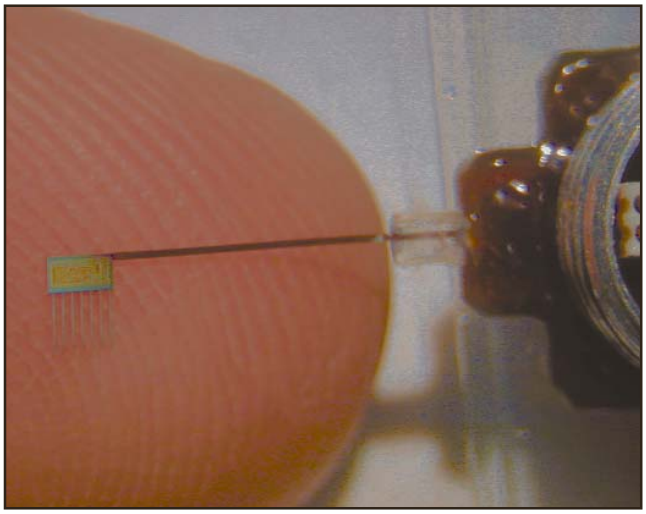






COOPERATIVE EFFORTS





Silicon neural probes containing integrated electronics were used in long-term behavioral experiments for the first time last semester in cooperation with Professor Gyorgy Buzsaki and the Center for Neuroscience at Rutgers University. Two probe types, one with 64 sites and one with 96 sites, are being used to better understand neural activity in the rat hippocampus. The figure at left shows the activity of nine separate neurons recorded from one shank. Each shank supports numerous neuron-monitoring sites. A single probe, moreover, comprises at least seven shanks.

INDUSTRIAL LIAISON'S REPORT

The May 2003 Industrial Advisory Board meeting will be here soon. A priority at this advisory board meeting is to offer ample time for students and IAB members to discuss their respective projects, both the Center's research programs and the many exciting activities at member companies. To help facilitate interaction, we plan to offer members the opportunity to give brief company overviews to the students, as well as to faculty and staff. You will be receiving details on times and locations in the near future. If you have any suggestions on how we can make the IAB meeting more beneficial to all, or if you have other requests, please bring these to my attention promptly. I will be happy to hear and discuss your thoughts.

With the coming end of the winter academic term, some of our students will be available for internships. If your company has an internship program that would be appropriate for one or more of our students, please contact me so I can answer questions, provide any needed information, and assist in arranging interviews.

To facilitate your identification of suitable student interns, student biographies and research project descriptions can be found in the Members Only section of our web site, www.wimserc.org.

Joseph M. Giachino
Associate Director
Industry

PERSONNEL FOCUS

Miguel Levy has been an Associate Professor of Physics and Materials Science at Michigan Technological University since March 2000. Before joining MTU, he was a Senior Research Scientist in the Applied Physics Department at Columbia University. His research expertise is the study and fabrication of novel material structures and devices for advanced integrated photonic and micromechanical applications. Professor Levy obtained his Ph.D. degree at City University of New York in 1988, after earninig his M.S. degree from Cornell University and a B.S. from Duke University, all in Physics.

Natasha Kobidze recently joined the Center as Clerical Aide to assist Dean Aslam at MSU with financial and daily duties. A native of Russia, Natasha has traveled the world with her husband and two daughters. She holds a B.A. in Electrical Engineering from Bauman Moscow State Technical University, Russia. She first came to the United States eight years ago for a brief period before moving to Japan. She recently relocated to the U.S. and has been with MSU since August 2002, playing a vital role in the communication that keeps Center partnerships going. Natasha is honored to hold her first job in America. The honor is all ours, Natasha. Welcome!

SEMINAR SERIES

September 24, 2002
Professor Amit Lal
Cornell University
Applications of Ultrasound to MEMS

October 1, 2002
Professor David Beebe
University of Wisconsin-Madison
Alternative Approaches to Microfluidic Systems Design, Construction and Operation

October 15, 2002
Professor Jack Judy
University of California, Los Angeles
Ferromagnetic MEMS

October 29, 2002
Roy Olsson III
University of Michigan
Silicon Neural Recording Arrays with On-chip Electronics for In-vivo Data Aquisition

Pedram Mohseni
University of Michigan
A Multi-channel Wireless FM Transmitter for Biomedical Neural Recording Applications

November 5, 2002
Professor Andrew Mason
Michigan State University
Transducer Interface Electronics in Multi-Element Microsystems

November 12, 2002
Professor Rong Gang
University of Oklahoma
Middle Ear Implantable Hearing Systems

November 19, 2002
Professor Karl F. Bohringer
University of Washington
Micro-Self-Assembly on Programmable Surfaces

December 3, 2002
Dr. Frank Dorman
Restek Corporation
Achieving the Optimum Chromatographic Separation Through the Use of Scientifically Designed Capillary Columns and Stationary Phases

December 10, 2002
Professor Mark Meyerhoff
University of Michigan
Improving the Biocompatibility and In-vivo Analytical Performance of Intravascular Chemical Sensors via Nitric Oxide Release Polymeric Coatings

PRESENTATIONS

28th European Solid-State Circuits Conference, Florence, Italy, September 2002
K. K. Das and R. B. Brown
A Novel Sub-1 V High Speed Circuit Design Technique in Partially Depleted SOI-CMOS Technology with Ultra Low-Leakage Power

24th International Conference of the Engineering in Medicine and Biology Society, Houston, TX, October 2002
M. Ghovanloo and K. Najafi
A BiCMOS Wireless Stimulator Chip for Micromachined Stimulator Microprobes
P. Mohseni and K. Najafi
A Low-Power Fully Integrated Bandpass Operational Amplifier for Biomedical Neural Recording Applications

28th IEEE International Silicon-On-Insulator Conference, Williamsburg, VA, October 2002
K. K. Das and R. B. Brown
Novel Ultra Low-Leakage Power Circuit Techniques and Design Algorithms in PD-SOI for Sub-1 V Applications

49th AVS International Symposium, Denver, CO, November 2002
W. C. Tian and S. W. Pang
Thick and Thermally Isolated Si Microheaters for Preconcentrators

Developments in Multichannel Recording VI: Satellite Symposium of the 32nd Annual Meeting of the Society for Neuroscience, Orlando, FL, November 2002
Roy Olsson III
Development and Characterization of Multichannel Neural Recording Arrays with On-Probe Electronics

International Mechanical Engineering Conference & Exposition, New Orleans, LA, November 2002
L. W. da Silva and M. Kaviany
Miniaturized Thermoelectric Cooler

PUBLICATIONS

S. Guillaudeu, X. Zhu and D. Aslam
Fabrication of 2-μm-Wide Polycrystalline Diamond Channels Using Silicon Molds for Micro-fluidic Applications
Diamond and Related Materials
Vol. 12, 65-69 (2003)

DOCTORAL DISSERTATIONS

Haluk Kulah
Closed-Loop Electromechanical Sigma-Delta Microgravity Accelerometers
The University of Michigan 2002
Advisor: Prof. Khalil Najafi

Junseok Chae
High-Sensitivity, Low-Noise, Multi-Axis Capacitive Micro-Accelerometers
The University of Michigan 2002
Advisor: Prof. Khalil Najafi

Schedules of upcoming seminars as well as a listing of publications are available at www.wimserc.org.

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