



WIMS WORLD

University of Michigan • Michigan State University • Michigan Technological University

DIRECTOR'S MESSAGE



Summer has now drawn to a close and we are beginning the third year of our WIMS ERC. The past two years have gone by very fast, setting the stage for many things to come. The third year should see the first prototypes of our neural prosthesis and environmental monitoring microsystems, a great many research results, and the culmination of many efforts in education. It will be an exciting and very busy time. This past summer was filled with many activities, but one I want to comment on here was a Center-wide Retreat held in July. One hundred and forty-four faculty, staff, students, and family members from the WIMS ERC gathered at the Shanty Creek Lodge, near Bellaire, Michigan, for two days of planning sessions, getting acquainted, games, and just plain fun. It was a chance to bring together all three universities under the theme "Three Universities, One Center." The Retreat led off with a plenary session that summarized accomplishments for the first two years, discussed future opportunities and challenges, and identified topics for breakout sessions, four of which were held in parallel during the late morning and again in the early afternoon of the first day. Among the topics considered at these sessions were long-term WIMS strategic planning, three-year ERC goals and challenges, Center visibility, educational activities, the Masters in Engineering program, intellectual property issues, closer inter-university cooperation, and industrial interactions.

Midway through the first afternoon, everyone gathered for the WIMS Olympics at Schuss Mountain, a friendly competition aimed at helping everyone know each other better. Challenges included a Quiz Course and three unusual contests: Egg Drop, Twinkie Tower, and Frisbee Bridge. The Overall Championship was awarded to the Brown Team before a great outdoor barbecue was served for dinner. The evening ended with a stage show by the Schussycats, featuring

musical numbers from colonial times to the present and was highlighted by a memorable performance by our Deputy Director. Fortunately, the Director was spared for lack of talent.

The second morning saw additional breakout session presentations followed by summaries of each session. Recommendations included monthly Center-wide staff meetings, expanded research on bio-WIMS, and specific faculty members assigned as contacts for each of our member companies. I think everyone agreed that this Retreat was very worthwhile in bringing all of us together as "One Center." It was also felt that the Retreats should become an annual event, continuing to situate them in locations equidistant from the various universities.

(One attendee suggested that Maui would fulfill that requirement nicely.)

Making an ERC really work, driving toward common goals, and overcoming the individual-



Faculty, staff, students, and family gather for a group shot at the base of Schuss Mountain.

ty that is so deeply engrained in our academic culture are not easy tasks but are very important. Still more difficult is forming a united organization bridging several universities, but the Retreat and many other efforts within the ERC have been effective in doing just that. And Shanty Creek was just as pretty as Maui anyway, at least in July.

Ken D. Wise

Director

Engineering Research Center for Wireless Integrated MicroSystems

INSIDE

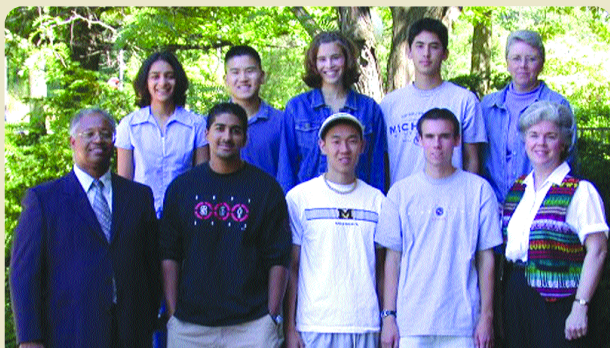
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Overall WIMS Olympic Champions, Brown Team.



RECENT EVENTS



Students and administrators of the first REU. **Back:** Pracheeti Nagarkar, Sukhyung Shin, Maureen Loy, Mark Richardson, and Billie Bahr. **Front:** Prof. Leo McAfee, Vivek Sankaran, Takamasa Masuda, David Galus, and Ms. Peggy Henderson. **Absent:** Christine Eun.

INAUGURAL SUMMER PROGRAM SUCCESSFUL!

June 16-August 10. As part of the WIMS Education Thrust, we launched the Research Experience for Undergraduates (REU) program this past summer. The first of many to come, this annual summer opportunity combines research work and classroom learning into a dynamic introduction to WIMS and MEMS. Nine undergraduates, four students from around the country and five UM engineering students, were paired up with graduate research assistants and faculty. The undergraduates gained exposure to graduate level research in design, manufacturing, programming, laboratory management, and educational outreach.

They took classes together and shared in many organized social activities, enabling them to experience the Ann Arbor area and enrich their undergraduate experience. The REU program is funded by NSF.

~Peggy Henderson

STUDENTS SWEEP DESIGN AUTOMATION CONFERENCE

June 10-14. Congratulations to WIMS Ph.D. students—Steven Martin, Troy Olsson III, and Haluk Kulah—for their outstanding success in the Student Design Contest held in conjunction with the Design Automation Conference (DAC) in New Orleans. Having won the last three years, UM graduate students managed to come out on top again, facing students representing 22 universities from around the world.

Steven and Troy took first place in the conceptual category and best paper for their entry, “A Microsystem for Near-Patient Accelerated Clotting Time Blood Tests.”

Haluk took third place in the operational category with his paper, “Low Noise Switched-Capacitor Interface Electronics for Sub-micro Gravity Resolution Micromachined Accelerometers.”

For more details, read page 95 of the June 24 issue of EE Times (available at www.eetimes.com) or see www.dac.com/39th/pstudcon.html.

~Richard Brown



Students receive high praise from Conference Leaders. **Left to Right:** Robert Walker and Giovanni De Micheli, DAC Board Representatives; Prof. Richard Brown, Steven Martin, and Troy Olsson of the WIMS ERC; and Steven P. Levitan, Design Contest Coordinator for DAC.



MSU graduate students discuss current research with students and teachers.

SCIENCE TEACHER WORKSHOP DRAWS ATTENTION

June 25. Dean Aslam, Professor of Electrical Engineering and Computer Science and WIMS Associate Director, graciously hosted this year's Science Teacher Workshop at Okemos High School, Okemos, Michigan. Middle and high school teachers were invited for a day of exploration and introduction to programs and initiatives implemented by the WIMS Education Thrust, including Lego Mindstorms and the summer DAPCEP workshops.

Graduate students from MSU also were present to demonstrate projects, answer questions, and discuss their research.

Teachers were given hands-on learning time to experience WIMS and MEMS projects that have been implemented in the classroom. The intent of such programs is to bolster interest amongst youth in the math and engineering sciences.

~Peggy Henderson

EDUCATION HIGHLIGHTS

"One of my greatest learning experiences was that I learned how to program a robot and use strategies to build the robot and make it go through the obstacles."

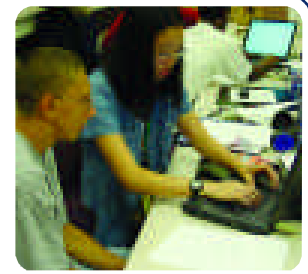
"I had a great time getting to know people different from myself, and learning that different people can still have fun."

"Building the robot showed me how critical planning was. The program also allowed me the opportunity to see if I really could or would like to be an engineer."

Above are only a few of the accolades from students regarding their WIMS for Teens experience at the University of Michigan. The students, hailing from the Detroit, Ann Arbor, and Lansing areas, were selected for the program based on their interest in math, science, and engineering. During the weeklong program, they took courses in technical writing, integrated math and physics, and WIMS. Their days were jam-packed, starting at 8 a.m. with classes and ending around 9 p.m. with the WIMS lab where they built and programmed a robot to compete in an obstacle course. Their experience culminated in a presentation of their final projects to families, friends, and faculty, in addition to competing in the LegoRobotics Arctic Challenge.

In evaluating the program, students stated that it gave them the

Below: WIMS staff Al Tessmer helps a group of students during one of their intensive robot building and programming sessions in a UM Media Union computer lab.



Above: Hectic days in the life of a WIMS for Teens student. **Below:** WIMS for Teens teacher Assata Moore leading the integrated math and physics class.



opportunity to explore their personal interest in engineering. Over fifty percent of the students answered that they either would or probably would be an engineer. Other students want to pursue careers in law, medicine, or economics. Some are undecided. The strongest element of the program for the students was meeting boys and girls their age from different ethnicities and regions. They also agreed that the program helped them learn about science and math, experience academic life, and develop professional and academic skills. Eighty-eight percent of the students expressed a desire to participate in a program like WIMS for Teens again.

A pre-college, summer, middle school program, WIMS for Teens is a collaboration between MSU and UM, with special direction from the MSU College of Engineering Diversity Programs Office.

~Patti Farrel and Drew Kim

STUDENT LEADERSHIP

This past quarter the WIMS Student Leadership Council has been involved in many activities. At the Center-wide Retreat students from the three universities discussed directions and activities, and we shared thoughts about our Center. Time to relax and have some fun getting to know each other on a social level was more than a perk: the opportunity has led to a more comfortable relationship among students across campuses.

WIMS students also participated in the REU summer program as mentors to the nine undergraduate participants, which provided a mutual learning experience.

For the first time IAB members were invited to present their research to the students and field any questions they had. Judging by the turnout, it was an overwhelming success. Plans to repeat the event next year have already been made.

~Andrew DeHennis
President
Student Leadership Council

RESEARCH HIGHLIGHTS

SOLID STATE ELECTRONICS LAB UPGRADES

August 20. In addition to purchasing new equipment, the Solid State Electronics Laboratory is undergoing major improvements including new safety systems, staff, tools, and added utilities. All of which will enhance the capabilities that have made the SSEL one of the primary centers for micro device research and fabrication in the nation.

~Jorge Jimenez



Raith 150, an electron beam lithography tool. Setup comprises a LEO SEM Gemini column, 6-inch wafer capability, direct write applications for III/V and II/VI semiconductors, beam energy spectrum from 200V to 30kV, and pattern generation at speeds of up to 10 MHz.

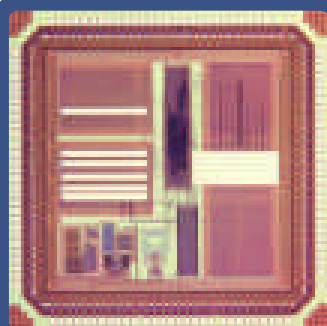


EV620, deep ultraviolet mask aligner. This offers a 500W broadband lamp, split field top side and bottom side optics with joy stick control, optics for 248nm or 365nm exposure, 4-inch wafer capability (6-inch optional), alignment accuracy better than 1 μ m, and wafer bond alignment capabilities.

SOI MICROCONTROLLER ON THE HORIZON

Our microcontroller has always been at the leading edge of technology. And now it is about to get better, as we switch from CMOS to SOI. It is a general purpose microcontroller that will employ various architectural and circuit techniques to reduce power while maintaining an acceptable level of computational throughput. Once the architecture is fully tested and verified, the microcontroller design will be migrated from a 0.18 μ m complementary metal oxide semiconductor process to partially depleted silicon-on-insulator. In moving to SOI, the digital circuitry will take advantage of the reduced source-drain and interconnect capacitance that is characteristic of an SOI process. Furthermore, the leakage current of SOI is lower than that of CMOS. A predicted power savings of approximately 30% is expected for the SOI microcontroller when compared to the original CMOS implementation. However, to improve power efficiency various SOI related design issues still need to be addressed such as floating body effects, body contacts, and dynamic threshold control or forced bipolar operation.

~Robert Senger



WIMS Microcontroller taped-out in TSMC 0.18 μ m CMOS.



ACS 200, automatic spinner developer cluster tool. This encompasses a 4-module cluster tool, material handling robotic arm, automatic wafer size detection (up to 8-inch wafers), automatic photoresist dispense, HMDS vapor prime oven, two hot plates, one cool plate, wafer back side cleaning, edge bead removal, auto bowl cleaning, and developer module capable of dispensing two different developers plus DI water and nitrogen.

PERSONNEL FOCUS



Mary E. McCune was recently hired to assist with the Center's financial activities. Mary will help Barb Rice and Pam Bogdanski with the massive volume of ordering and paperwork they handle on a daily basis.

No stranger to the UM, Mary has worn many hats in her career here since 1994. Most recently she wrapped up a seven-year stint with M-Stores, the University's internal supply store. Mary's experience with University policies, procedures, and practices will lend itself to a smooth transition into the WIMS ERC and will help increase office efficiency. We are happy to welcome her to our team.



Al Tessmer has joined the Center as Program Associate primarily responsible for activities in the Education Thrust but will work with the Industrial Liaison as well. Al is a 30-year-plus teaching veteran who served the Lincoln Park, Livonia, and Ann Arbor School Systems as a science and technology teacher. During that time he was a junior high and high school wrestling, football, and softball coach. During his teaching career, Al researched and developed learning, performance, and change initiatives, which he shared with both schools and industry. He regularly lectures on his two learning specialties, accountability and differentiated learning.

Al has great regards for the Teacher in Space programs, having been a candidate for the 1986 Challenger mission, and he visited the former Soviet Union in 1990 and 1992 as part of a joint Russian/American Teacher in Space program.

Combining his academic background with his teaching and learning research, Al will be responsible for developing and implementing the standards-based curriculum project to be used in secondary school classrooms. He will also continue to develop our graduate student and secondary school education partnerships. Finally he will help build relations between WIMS faculty and other universities to promote future collaboration.



Ted Zellers, Sensors and MicroInstruments Co-Thrust Leader, with oversight of the μ GC effort as well as specific responsibility for several μ GC components, was recently promoted by the University of Michigan to Full Professor in the Departments of Environmental Health Sciences and Chemistry. He also just completed a 1-year appointment on a National Research Council expert panel charged with drafting a report that identified research priorities for the development of electronic and photonic materials impacting future national security interests.

INDUSTRIAL LIAISON'S REPORT



With the end of summer so too comes the end of many internships, yet as we say our farewells, plans for internship possibilities in the coming year may already be brewing. By now, our graduate students should be the first thought that comes to mind when searching for reliable resources. You've had the opportunity to meet with many of them at our last four IAB meetings, and if not, or if you are a new member to the Center, you will have the chance to do so in May. If travel to the University of Michigan this May is not an option, you can always find out more about our students by browsing through their biographies on our Web site in the Members Only section (www.wimserc.org).

Your participation in the IAB meeting however does offer an excellent opportunity to meet one-on-one with the students and discuss mutual interests. You might even find yourself an intern for next summer!

In response to student and member comments in the past we allotted more time for poster sessions during the October meeting to facilitate these discussions.

Joseph M. Giachino

Associate Director
Industry



Graduate student Timothy Harpster explains packaging.

The Commercialization of Micro and NanoSystems Conference (COMS), recently held at the Marriott Eagle Crest Resort, was co-chaired by our own Joseph Giachino and featured a keynote address by Center Director, Ken Wise. Dean Aslam (MSU) presented a paper, while Leo McAfee (UM) sat on the Education Panel. Over 320 members of the business and educational community attended the conference, which was opened by an address from Governor John Engler.

The Student Leadership Council arranged and led afternoon tours and demonstrations for COMS attendees on September 8. Interest was so high arrangements have been made to accommodate larger tours next year.



SEMINAR SERIES

July 2, 2002

Dr. Justin Williams
University of Wisconsin Medical School & University of Michigan
Neural Engineering: Emerging Technology in Neural Prosthetics and Neurosurgery

July 16, 2002

Professor Ludwig J. Balk
University of Wuppertal--Germany
Nanocharacterization of Electronic Materials and Devices

July 23, 2002

Professor Massood Atashbar
Western Michigan University
Application of Surface Acoustic Wave Transducers as Sensors

July 30, 2002

Professor Mark Sheplak
University of Florida
MEMS Based Directional Acoustic Technology

September 10, 2002

Robert Sulouff
Analog Devices, Micromachined Products Division
Taking Inertial MEMS Products to the Market Place

September 17, 2002

Professor Mehran Mehregany
Case Western Reserve University
Silicon Carbide Material and Process Technologies for Microelectromechanical Systems

PRESENTATIONS

Paper presented at the American Industrial Hygiene Conference and Exposition, San Diego, CA, June 2-7, 2002

M. D. Hsieh and E. T. Zellers
Evaluation of a Commercial Belt-Mounted Multi-Vapor Monitoring Instrument

Invited presentation at the Commercialization of Micro and NanoSystems Conference, Ypsilanti, MI, September 8-12, 2002

K. Wise
Integrated Sensors, MEMS, and Microsystems: A Perspective on their Development and Commercialization

Papers presented at the IEEE Midwest Symposium on Circuits and Systems, Tulsa, OK, August 4-7, 2002

M. Ghovanloo and K. Najafi
A High Data Transfer Rate Frequency Shift Keying Demodulator Chip for the Wireless Biomedical Implants

J. Zhang, K. Zhang, Z. Wang, and A. Mason
A Universal Micro-Sensor Interface Chip With Network Communication Bus and Highly-Programmable Sensor Readout

PUBLICATIONS

M. D. Hsieh and E. T. Zellers
In Situ UV-Photopolymerization of Gas Phase Monomers for Micro-analytical System Applications
Sensors and Actuators B, 82(2-3), 287-296 (2002)

C. J. Lu and E. T. Zellers
Multi-adsorbent Preconcentration/Focusing Module for Portable-GC/Microsensor-Array Analysis of Complex Vapor Mixtures
Analyst, 127, 1061-1068 (2002)
(web publication date: July 17, 2002)

Q. Y. Cai and E. T. Zellers
Dual-Chemiresistor GC Detector Employing Monolayer-Encapsulated Metal Nanocluster Interfaces
Anal. Chem., 74, 3533-3539 (2002)

M. D. Hsieh and E. T. Zellers
Evaluation of a Hand-Held 'Electronic Nose' for Selective Multi-vapor Analysis
Am. Ind. Hyg. Assoc. J. (submitted, July 2002)

C. J. Lu, J. Whiting, R. D. Sacks, and E. T. Zellers
Portable GC With Tunable Retention and Microsensor Array Detection for Analyzing VOCs in Indoor Air
Anal. Chem. (submitted, August 2002)

W. C. Tian and S. W. Pang
Freestanding Microheaters in Si With High Aspect Ratio Micro-structures
J. Vac. Sci. Technol. B 20, 1008-1012 (2002)

J. Zhou and A. Mason
Communication Buses and Protocols for Sensor Networks
Sensors, (ISSN: 1424-8220), vol. 2 (7), (August 2002)
<http://www.mdpi.net/sensors/>

DOCTORAL DISSERTATION

Ponnambalam Selvaganapathy
Microfabricated Components for an Integrated Microfluidic Electroanalysis System
The University of Michigan 2002
Advisors: Prof. Carlos Mastrangelo and Prof. Ken Wise

Genetic tests and assays have broad applications in biotechnology and medicine. My main objective is to develop components and related technologies to create an integrated microfluidic system for these assays. Initial development yielded three results: an inline electrochemical detector, capable of detecting DNA for capillary electrophoresis; a novel electrokinetic pumping mechanism for bubble free electrokinetic flow; and an inline microvalve using solid state paraffin as the microactuation material. While these devices can stand alone, my goal is to incorporate them into a complete genetic analysis system.

FALL 2002 6

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

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WIMSWorld is published quarterly by the Engineering Research Center for Wireless Integrated MicroSystems.

WIMSWorld
WIMS ERC
212 Engineering Programs Bldg.
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