MMRI

McMaster Manufacturing Research Institute

The McMaster Manufacturing Research Institute – one of the country's most advanced and best equipped research laboratories – combines research excellence with state-of-the-art equipment to meet the sophisticated research and development needs of leading manufacturers. Created in 2000 with more than $10 million in funding from its founding sponsors – the Canadian Foundation for Innovation (CFI), the Ontario Innovation Trust (OIT) and the Ontario Research and Development Challenge Fund (ORDCF) and industry partners – the MMRI provides a focus for high-profile research and serves as a vehicle for university-industry-government interaction. In addition, the institute promotes, encourages, and performs fundamental and applied research in cooperation with its industrial partners and provides systematic mechanisms for technology transfer and infusion of knowledge and research results.

For more information

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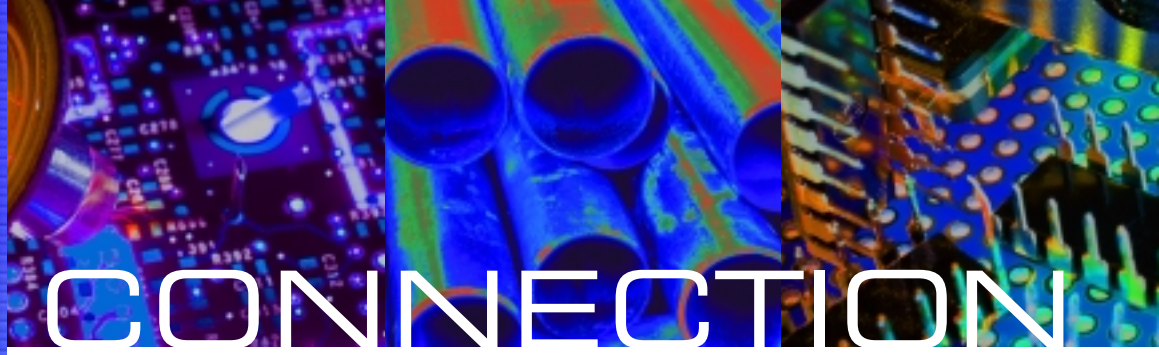
McMaster University



MMRI CONNECTION

Connecting University, Industry, and Government May 2002

Recent Events in MMRI

The spring of 2002 has been a busy one, with the MMRI playing host to many visitors, seminars and events. The following are some of the highlights.

MMRI and Materials and Manufacturing Ontario (MMO) sponsor – MMRI Distinguished Lecturer Series.

Wednesday, March 20, 2002
Dr. Ralph Hollis, Principal Research Scientist, Robotics Institute, Carnegie Mellon University
Presentation: *Beyond Flexible Assembly: An Architecture for Agile Assembly*

Thursday, March 28, 2002
Dr. Robert J. Hocken, Norvin Kennedy Dickerson Jr. Distinguished Professor of Precision Engineering; Director, Centre for Precision Metrology; The University of North Carolina at Charlotte
Presentation: *Engineering Nanotechnology at UNC Charlotte*

Tuesday, April 23, 2002
Dr. Stephen Malkin, Distinguished Professor and Head, Department of Mechanical and Industrial Engineering, University of Massachusetts, Amherst, MA
Presentation: *Simulation, Optimization and Control of Grinding Processes*

Canadian Tooling & Machining Association, Western Ontario Chapter, held their February Monthly Dinner Meeting at MMRI. Highlights of the evening program were a tour of MMRI Machining Systems Laboratory, dinner, followed by presentations: *COMO – Centre for On-Line Manufacturing Optimization* by Pam Renton, Research Engineer, MMRI *Coating Applications in Manufacturing Processes* by Eugene Ng, Post-Doctoral Fellow, MMRI.

Pam Renton, Eugene Ng, Dr. Tahany El-Wardany, Research Manager, and Jamie Bowman, Director of CTMA

Dwayne Barnett-Ritcey, Research Engineer, (right) explains Matsuura FX-5 to CTMA members during tour of Machining Systems Lab. Dwayne Houde, Research Technologist, (left) assists.

Society of Plastics Engineers (SPE) Ontario Section held their 4th Annual Industry/University Night, along with their March Monthly Dinner Meeting. SPE attendees toured the MMRI Polymer Processing Laboratory and Machining Systems Lab. Current research projects were presented by students in the Poster Competition sponsored by SPE Ontario Section.

Engineers of the Future

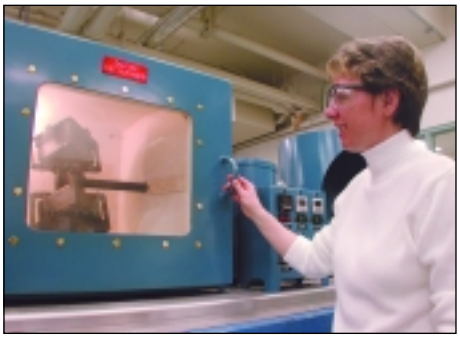
The Parkside High School Robotics Team dropped by for some technical advice regarding their entry into the Canada FIRST Robotics Competition. Craig Wilkinson recently wrote: "We were very fortunate to have such prompt support from Miky Dumitrescu and Warren Reynolds (MMRI Research Engineers), Dave Schick (Tech Service Coordinator) and Lucian Balan (Ph.D student) in solving many of the technical problems that we encountered, including some crucial work done in the machine shop for our drive system.

McMaster leading the way in polymer processing and design

Human culture and civilization has long depended on a remarkable class of naturally-occurring, long-chain molecules, known as polymers. These natural organic polymers include proteins, cellulose, starch and other substances that are found in materials like wood, paper, leather and wool, that we use for clothing, shelter and other essential needs.

Fascinated by the useful properties of these materials, scientists in the early part of the 20th Century struggled and finally succeeded in unlocking their chemical secrets and began to create their own man-made polymers. Within a few short decades, these discoveries gave rise to whole new industries, including the one that we've come to know as plastics.

Today, there are more than 30,000 commercially available polymer grades. Some are suitable for the fabrication of plastic products by extrusion and others for injection molding, blow molding, thermoforming and other processes. It's a $30-billion industry in Canada, employing more than 100,000 people.



Lab Manager Elizabeth Takács demonstrates the rotomolding process. A weighed charge of plastic powder is placed in a mold, which is heated and rotated to distribute the powder evenly across the mold surfaces. As the powder melts, a homogeneous plastic layer forms on the surface of the mold. The mold is then cooled and the finished piece removed.

At McMaster University's Centre for Advanced Polymer Processing and Design (CAPPA-D), researchers are investigating a wide range of issues relating to the formulation of polymer compounds and their use in various manufacturing processes. One of the exciting projects underway at the Centre focuses on rotational molding, a technique employed for the production of hollow plastic articles. Under the direction of Dr. John Vlachopoulos, a talented team of graduate students and staff is working to identify the properties that make polymer grades suitable for rotational molding, and to develop new compounds that will expand the range of products that can be made using this technique.

Rotational Molding

While other methods for fabricating plastic are more widely used – blow molding, for example, which produces the ubiquitous PET bottles that line our supermarket shelves – the rotomolding process is employed to create many common articles, including plastic toys, store mannequins and signs, as well as industrial products like large plastic vessels (up to 100,000 liters) and containers for the storage of hazardous chemicals.

The rotomolding technique offers some interesting advantages, as compared with other manufacturing methods. Since it is a low pressure process, the molds are generally simple and relatively inexpensive. Also, the molded articles have a relatively uniform thickness, are free from frozen-in stresses, and their surface can be textured. Additionally, rotomolding can produce very large, thick-walled articles that could not be made economically by any other technique.

Materials Research

The rotomolding process was first developed in the 1940s, but was not widely employed until the early sixties when polyethylene powders were first successfully rotomolded. Today, a wider range of materials can be employed, including nylon and polystyrene. Thanks to the research of CAPPA-D, the variety of plastic compounds that can be used with this technique is expanding.

The development of new compounds is a challenging task. While there are tens of thousands of different kinds of plastics, only about 100 of these have suitable properties for rotomolding. The investigation of new materials is a key part of the research activities at the Centre. By blending different polymers, new compounds can be created with desirable physical properties, such as scratch resistance, rigidity, resistance to impact, and material strength.

Finding new materials that can be rotomolded is of great interest to firms that manufacture polymer resins. A number of these, including The Dow Chemical Company and ExxonMobil, have commissioned CAPPA-D to conduct research to develop and test new polymer grades for possible commercial use.

One of the more interesting areas currently being investigated is the use of rotomolding to manufacture automotive parts. Working closely with AUTO21, a federally-sponsored national centre of excellence, CAPPA-D is investigating the use of plastic foam in rotomolding applications – an endeavour that holds the promise of new, ultra-light parts for the fuel-efficient car-of-the-future.

Marieke Rijkse, a visiting student from Delft University, observes the "sintering" process – a critical step in rotomolding, where polymer particles are heated and coalesce in a homogenous melt.

Another project involves recycling. The use of recycled plastics in rotational molding has been almost impossible until now, because post-consumer resins are usually found as commingled waste, containing particles with varying physical properties that do not meet the specifications for rotomolding. But, thanks to research at the Centre, a method has been discovered to blend recycled polyethylene waste with various viscosity and impact modifiers to obtain compounds with properties suitable for rotational molding.

Because the rotomolding process accounts for a relatively small part of the overall plastics industry (about $4 billion CDN annually in North America), much of the research in the private sector has focused on other manufacturing techniques. CAPPA-D is one of the few research centres in the world that has expertise in this area, making it an obvious partner for manufacturers looking for help to find new materials that have suitable properties for rotomolding. ■

For more information contact Dr. John Vlachopoulos, Professor, Department of Chemical Engineering, McMaster University at vlachopj@mcmaster.ca

The COMO centre provides computer-aided engineering online

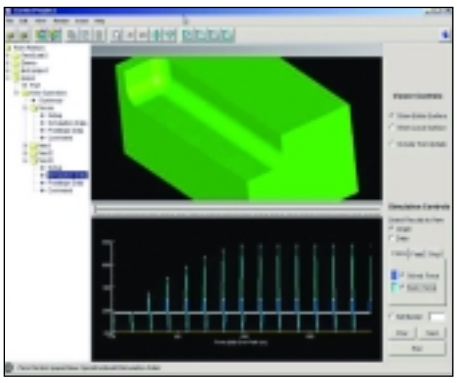
To succeed in a 21st Century competitive global marketplace, manufacturing companies not only have to design products that consumers want, but they must bring them to market quickly in order to stay ahead of the competition.

To achieve this, businesses have been turning to computers to speed the design, engineering and manufacturing process. Today, virtually all manufacturing firms employ CAD/CAM systems to design new products and to program automated production equipment. Many firms are now seeking to optimize the design and manufacturing process itself, using powerful new software tools for computer-aided engineering (CAE).

At the MMRI, researchers have taken the strategy one step further, combining the techniques of CAD/CAM and CAE with the power of the Internet. Under the direction of the Centre for Online Manufacturing Optimization (COMO), these software tools are being made available to Canadian businesses online. Although still in its early stages, COMO has already attracted the participation and support of firms in the aerospace, automotive and die-molding sectors.

Concept

The concept underlying COMO is disarmingly simple – a manufacturing engineer at a remote location, say in Montreal, uploads the design specifications for a new product from his desktop PC to the server at COMO's research centre at McMaster University. Using a graphical interface, the engineer can carry out simulated manufacturing processes to create the product, using the set of machining process simulations stored in COMO's database. These simulations cover a broad range of machining operations, including milling, drilling, tapping and turning.



A simulated machining process can be viewed on screen by the manufacturing engineer at a remote location.

Research Engineer Dwayne Barnett-Ritcey prepares one of the machining lab's state-of-the-art CNC machines for a prototyping run.

The engineer can view the simulated process on his own computer screen, together with data showing the speed of the machining process, the load forces on the tool and the stock, and other relevant physical data. By making adjustments to the initial machining strategy and re-running the simulation, an optimal manufacturing process can be determined.

At this stage, the engineer can choose to test the optimized process by creating a physical prototype. The MMRI's Machining Systems Laboratory (MSL) has several state-of-the-art CNC machines that are linked to the COMO system. By uploading the optimized process information to the lab, an actual physical part can be machined to the client's specifications. The engineer can remotely view the machining process via streaming video over the Internet, together with sensor information gathered by data acquisition devices monitoring the process.

The benefits to COMO's clients are several:

- By simulating the manufacturing process, the client avoids the traditional trial-and-error approach, where engineers try to figure out the best way to make the part by putting it through a machining process in a real production environment. This can take weeks or even months, and involve a considerable investment of staff time and equipment that could be better used elsewhere.
- By simulating the manufacturing process on the computer, it is possible not only to figure out how the desired piece can be produced, but to optimize the process itself for maximum production speed and minimum waste of raw materials, energy, and damage to machining tools.
- All of this is achieved using COMO's software, expertise and machining facilities, freeing up the client's resources for other work.

The manufacturing process optimization system employed by COMO has been tested for several industrial applications. For both optimization and prototyping, the reduction in engineering process time, as compared with traditional approaches, has been in the range of 25-40%. For companies wanting to bring new products to market more quickly, this smart approach can cut weeks or months from the development cycle and reduce overall manufacturing costs.

It's not only industry that benefits from the research efforts of COMO. The software also serves as a wonderful teaching tool to help students visualize and understand the processes involved in machining and manufacturing. As such, it helps to train the next generation of engineers in the techniques of computer-aided engineering and smart manufacturing. ■

For more information contact Dr. Stephen Veldhuis, Assistant Professor, Department of Mechanical Engineering, McMaster University at veldhu@mcmaster.ca

Future Events in MMRI

Rotary Club of Hamilton

Marcel Mongeon, Executive Director and Legal Counsel, Office of Research Contracts and Intellectual Property will be hosting 35 Professionals from Korea who are visiting Canada on a group study exchange.

Partnerships 2000

MMRI to participate in MMO Partnerships 2002, a one-of-a-kind innovation event to be held at the Toronto Congress Centre, Thursday, June 20, 2002. Please look us up at the MMRI booth.

Short Courses Planned for 2002

Grinding Technology
Dr. Philip Koshy
August 28, 29, 30, 2002

Fundamentals of Metal Cutting
Dr. Stephen Veldhuis and
Dr. Tahany El-Wardany
September 18, 19, 20, 2002

Rotational Molding
Elizabeth Takács
November 6 & 7, 2002

Location for courses
McMaster University
Centre for Continuing Education
Downtown Centre, 2nd floor
50 Main Street East
Hamilton, Ontario L8S 4L8
Website: *www.mcmastercce.com*

McMaster University

Visitors to MMRI

Sheridan College

Michael Sava, NRC IRAP Advisor, Elizabeth Theriault, Dean, and Don Wiles, Associate Dean of Sheridan College toured MMRI Labs and met with Dr. Andy Hrymak and MMRI staff to identify areas of mutual interest.

Acting Director Dr. Andrew Hrymak welcomes guests to MMRI.

St. Clair College

Visit by Mr. Mark Benoit, Chair, St. Clair College and members of industry to tour MMRI facility and learn how Institute developed and how relationships were built with industry and government in creating the success of the Centre. They are in the process of creating the Ford Centre for Excellence in Manufacturing in Windsor.

Siemens Westinghouse Inc.

After attending the MMRI Open House last year, a meeting with MMRI was initiated last Fall by Ms. Sandy Manners, Communications Director and Dr. Hanafy Ahmed, Manager, Technical Procurement to introduce their engineers and managers to the McMaster Manufacturing Research Institute and to explore areas for future collaboration.

Plasmatreat Presentation

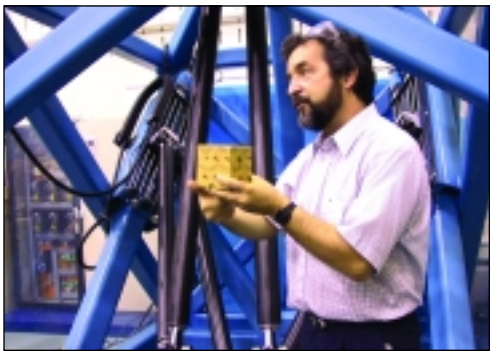
Mr. Daniel Kaute from Plasmatreat spoke to MMRI Staff and Students on "The possibilities of Process Innovation with Openair Plasma Technology, using high performance, environmentally friendly, and cost effective bonding, coating and printing solutions."

Presentation at Ford Motor Company

MSL staff visited Ford Advance Manufacturing Development Technology Centre in Detroit and made presentations on "Simulation of Metal Cutting", "Mill Grind Machine" and on "Fixturing Dynamics".

Central Canada Branch of the Institution of Mechanical Engineers (IMechE)

IMechE toured the Machining, Polymer Processing, Metal Forming Labs of MMRI Laboratories and attended presentation on key research projects.



Dan Centea, Graduate Student, explains Hexapod to ImechE visitors.

Tradesco Mold

MMRI tour of Machining Systems Lab, presentation on Hardened Steel, (High Speed /Finite Element), COMO, and new machining technologies relative to potential collaboration.

Welcome to New MMRI Faculty

The McMaster Manufacturing Research Institute takes pleasure in announcing the following faculty appointments.

Dr. Mukesh Jain
Associate Professor,
Mechanical Engineering

Dr. Philip Koshy
Assistant Professor,
Mechanical Engineering

Dr. Stephen Veldhuis
Assistant Professor,
Mechanical Engineering

Dr. Michael Thompson
Assistant Professor,
Chemical Engineering