

# CCEFP -- Making Advances for Industry

By Kim Stelson, Director

The Center for Compact and Efficient Fluid Power (CCEFP) was founded in June 2006. Funding from the National Science Foundation (NSF) has been approved for the first five years with the possibility of a five-year renewal. The Center has a \$17.5 million commitment from NSF, \$3.5 million in matching funds from universities and over \$3.5 million from industry. Funding for the first five years is projected to be over \$25 million. CCEFP universities are Minnesota, Illinois Urbana-Campaign, Purdue, Vanderbilt, North Carolina A&T and Milwaukee School of Engineering.

The Center has three thrust areas: efficiency, compactness and effectiveness. The efficiency thrust will dramatically reduce energy consumption. The compactness thrust will make systems smaller and

lighter, thus creating entirely new applications on the human scale. The effectiveness thrust will make fluid power clean, safe, quiet and easy to use.

CCEFP research is demonstrated on the five test beds: excavator, hydraulic hybrid passenger car, compact rescue crawler, fluid power hand tools and orthosis. The excavator will demonstrate how research can be used to immediate advantage on current applications. The hydraulic hybrid vehicle will show how fluid power could greatly improve the fuel economy of passenger vehicles. The goal is to achieve 100 mpg in urban driving. Since passenger cars use \$160 billion in crude oil annually in the

United States, these savings will dramatically affect our overall energy use. The Center's other test beds (the compact rescue crawler, fluid power hand tools and orthosis) will demonstrate entirely new applications on the human scale that are efficient, compact and effective.

The Center's headquarters is at the University of Minnesota, but leadership of research thrusts is shared between Purdue, Georgia Tech, and Illinois Urbana-Campaign. The Center has over 70 graduate students conducting fluid power research advised by more than 30 faculty members and post-doctoral students.

The Center has strong support from more than 60 fluid power industry mem-

bers. The Center has excellent benefits to companies that are members of the Center, including early access to research results, intellectual property rights, bi-weekly research updates, the CCEFP Industry Internship Program, and the annual meeting. For entry-level engineers, member companies can choose from the best fluid power talent available at seven universities. For more information on industrial membership, please contact Michael Gust at [mjgust@me.umn.edu](mailto:mjgust@me.umn.edu) or call 612-624-4956.

As we enter our second year, we continue to make significant advances toward making the fluid power industry and its products more effective, compact and efficient.



Kim Stelson

## CCEFP Test Bed Focus: Excavator

By Chris Williamson, Purdue University



Chris Williamson

A year has passed since the official commencement of the CCEFP. Much has been accomplished so far, but there is still so much to do. At the annual meeting in Atlanta, we heard updates on research projects, such as multi-modal control interfaces, biomimetic nano-surface texturing, powertrain management, and throttleless actuation concepts, just to name a few. These projects (and many others) have the potential to dramatically change the

face of fluid power technology. Of course, the ultimate measure of the Center's success will be how well the research is transferred to real world applications. This is where the test beds come in. The test beds have three goals: (1) to validate and demonstrate the technology developed by the Center, (2) to integrate the work of diverse research projects, and (3) to facilitate the transfer of knowledge from fundamental research to practical development.

Test Bed #1 is a mini-excavator located at Purdue University. It's a Bobcat model 435H, a rubber-tracked excavator with a gross weight of just over five tons. This machine was provided through a generous donation from the Bobcat Company, a

subsidiary of Ingersoll-Rand Corporation. This excavator was selected because it includes many of the features of larger machines (such as load-sensing hydraulics) with a size that is more manageable for transportation, as well as modification and operation in a laboratory setting. This excavator also serves as a representative example of many other fluid power machines in construction, agriculture, and forestry. It is anticipated that the excavator will demonstrate improvements in fuel efficiency that can be applied to the thousands of machines currently in use in these applications. Further, advancements in actuator controls implemented on the excavator may open up new opportunities for machines that operate autonomously or by remote control.

Of the 19 active CCEFP research projects, 11 are slated for implementation to some degree of the excavator test bed. In the coming year, Purdue plans to replace cylinder control valves with variable displacement pumps to demonstrate energy savings through displacement-controlled actuation. Georgia Tech will imple-

ment haptic user interfaces for controlling the machine. Other projects will be demonstrated on the test bed over a longer term, as the research develops to a point where it can be reduced to a practical application. These projects include on/off valve-based control (UM), new engineered fluids (MSOE), nano-textured hoses (UIUC), pumps and motors with advanced lubricated surfaces (Purdue), powertrain management (Purdue, UIUC), new sealing concepts (GTI), and noise reduction techniques (Purdue, GT).

Integrating so many projects on the same machine will require a great deal of cooperation, and that's exactly the point. All of us--faculty, staff, students, industrial partners--will be working together to bring new ideas to reality. The relationships we build and the knowledge and experience we share with each other will move us toward our common goal: a bright future in fluid power.

## CCEFP Calendar of Events

The Center for Compact and Efficient Fluid Power hosted its first annual meeting at Georgia Tech on April 11, 12, and 13, 2007. Next year's annual meeting site: Milwaukee!

Mark your calendar for the following future dates and locations of Annual CCEFP Conferences:

April 2008: Milwaukee School of Engineering  
 April 2009: Purdue University



## MSOE Celebration of Fluid Power

Over the past few months, the leadership staff from the Center headquarters have packed their bags and made site visits to the partner schools. The purpose of the site visits are to get hands-on exposure to the research that is conducted throughout the Center and to meet all faculty, staff and students affiliated with CCEFP.

Most recently, the team traveled to Milwaukee School of Engineering (MSOE), where students and faculty alike made presentations on the research and activities going on at MSOE. The Center was well represented and acknowledged during MSOE's Celebration of Fluid Power, which was held on Friday, July 13. The leadership team has previously visited North Carolina A&T State University and toured the facilities and research areas on campus. The next stop on the list is a visit to Georgia Institute of Technology and Vanderbilt University.



Photo: Local, national CCEFP pose for a group shot at the MSOE Celebration of Fluid Power.

## Vice Chairman Lu Yongxiang Visits CCEFP

Vice Chairman Lu Yongxiang was recently awarded an honorary doctorate at the University of Minnesota. While here, he also visited CCEFP, where he heard a presentation by Linyu Gu, a visiting scholar from Zhejiang University, as well as a presentation from Professor Kim Stelson, CCEFP's director. Lu has a background in mechanical engineering and was very interested in the research.

Professor Lu Yongxiang is currently vice chairman of the Standing Committee of the National People's Congress; president of the Chinese Academy of Sciences (CAS); chairman of the CAS Presidium; member of the Chinese Academy of Sciences; member of the Chinese Academy of Engineering; vice chairman of

the Academic Degrees Committee of the State Council; co-chair of InterAcademy Council (IAC); president of the Chinese Mechanical Engineering Society; professor of Zhejiang University; and honorary professor of the University of Hong Kong, etc.

In his academic career, Professor Lu has made important contributions to the development of mechanical engineering, especially in the field of fluid power transmission and control, and higher education of engineering. He has achieved about 25 patents in China, Europe and USA, and published at home and abroad over 250 papers in research and engineering education, and has five monographs.

## Student Retreat Held at Vanderbilt University

The CCEFP 2007 Student Retreat was held August 9-11, 2007 at Vanderbilt University in Nashville, Tenn. Students participated in campus and lab facility tours, as well as hosted the bi-weekly webcasts from Vanderbilt. All attendees gave a presentation on their research and had informative question-and-answer sessions.

Mike Gust, industrial and technology transfer director, gave an overview of the roles and responsibilities of industry members within the Center and gave an intellectual property review.

Alyssa Burger, education outreach director, led an activity in which teams of three designed and created innovative fluid power educational exercises for ages K-6th grade using simple components such as valves, motors, tubes, syringes and balloons.

The Student Retreat was a great success as students from across the Center spent several days networking and building working relationships that will continue to foster collaboration between the seven universities.

Photo Identification:

Pictured are David Hafvenstein (MN), Adam Steele (IL), Jose Riofrio (VU), Chris Williamson (PU), Mark Elton (GT), Scott Manwaring (IL), Aaron Kimball (MSOE),

Andrew Fredrickson (PU), Serena Tyson (IL), Ken Marek (GT) and Koray Benson (NCAT).



# 2007 Minnesota State Fair

The CCEFP staffed a booth at the 2007 Minnesota State Fair, where visitors to the Hydraulic Hybrid Car display tried their hand at hydraulic braking and re-acceleration.



## HOW TO BECOME A MEMBER

### Industry members benefit from CCEFP Research and Resources!

CCEFP Industry Members enjoy many benefits in return for their financial contributions. All will share in opportunities to meet the researchers and their students, and will receive regular updates on the progress of the work that is being done on the research projects. All will have royalty-free licenses to non-patented discoveries and

inventories. The CCEFP will use its principal and sustaining representatives to participate in the Industrial Advisory Board, making recommendations on research projects and the resource apportionment. All will have the opportunity to directly benefit from the patented inventions based on each company's level of pledged support.

Member's Annual U.S. Fluid Power Related Revenues	Sustaining Pledge (each year for five years)	Principal Pledge (each year for five years)	Supporter Pledge (each year for five years)
Less than \$25 million	\$10,000	\$5,000	\$1,000
\$25-100 million	\$30,000	\$15,000	\$6,000
\$100-500 million	\$80,000	\$40,000	\$12,000
Over \$500 million	\$100,000	\$50,000	\$15,000

To join the CCEFP as an industry member, contact Mike Gust at 612-624-4956 or by e-mail at [mjgust@me.umn.edu](mailto:mjgust@me.umn.edu).