

## WHY YOUR HELP IS IMPORTANT

Making a difference—that's what the Center for Compact and Efficient Fluid Power is all about. The CCEFP conducts leading-edge basic and applied research to accelerate interdisciplinary fluid power research and development. The Center is improving education by incorporating fluid power content in core engineering courses and hands-on experiences in undergraduate labs with the latest state-of-the-art equipment donated by industry. The Center is seeking support to help it reach a new level of excellence.

The Center leads the national effort to reinvigorate discovering and learning in fluid power. Leadership demands talent and resources. In keeping with its history of achievement and excellence, the CCEFP has set ambitious goals for the future of its fluid power research and teaching. With your help, we can attain this vision.

Your support of the Center's teaching and research efforts will help chart the future of the fluid power industry and foster CCEFP's leadership in compact and efficient fluid power.



## Invest in Tomorrow

We invite you to join us as we invest in the fluid power innovations of tomorrow.

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# Center for Compact and Efficient Fluid Power

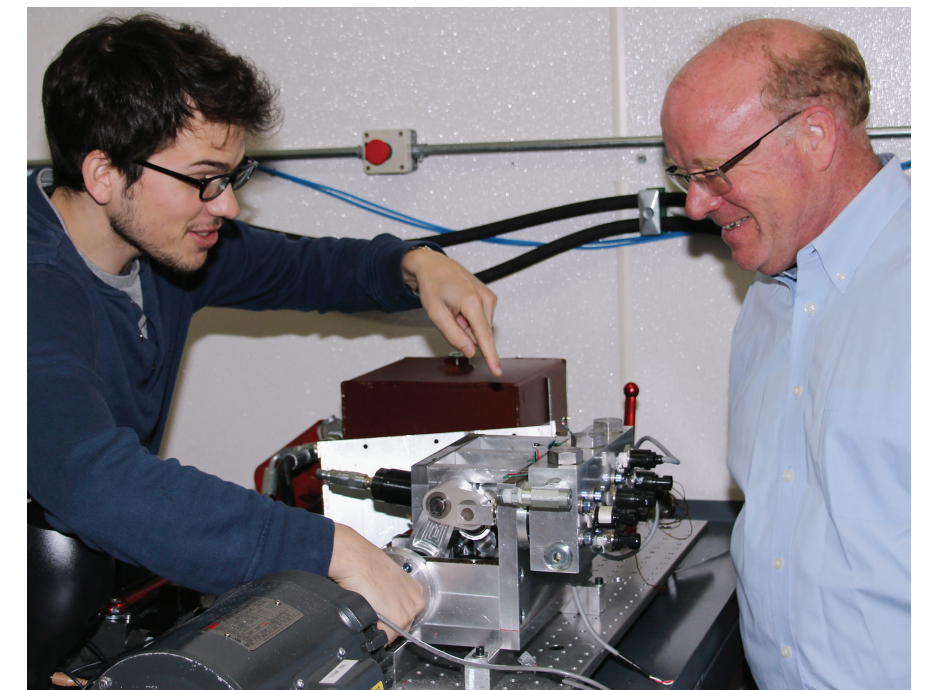
CCEFP is changing the way fluid power is **researched, applied, and taught.**

The CCEFP is the **premier fluid power research organization** in the United States.

The Center, headquartered in the Department of Mechanical Engineering at the University of Minnesota, was launched in 2006 with a 10-year grant from the National Science Foundation. It is led by Director Kim A. Stelson, College of Science and Engineering Distinguished Professor.

The Center for Compact and Efficient Fluid Power (CCEFP) is a consortium of academic researchers and industry supporters working together to change the way fluid power is researched, applied, and taught. The CCEFP vision is to make fluid power the technology of choice for power generation, transmission, storage, and motion control. The CCEFP achieves its vision through leadership, research, education, and workforce development.

The CCEFP vision will transform fluid power into a compact, efficient, and effective source of power transmission. The Center's work will benefit society by reducing energy use and pollution, improving quality of life through human scale applications, and creating new industries.





CCEFP  
Research Highlights

The **wind power hydrostatic transmissions** is an approach that has the potential to be lighter, cheaper, and more reliable than conventional gearboxes.

A **hydromechanical powertrain transmission** introduces novel propel and work circuit architecture on various off highway vehicles.

The **non-contact magnetic sensor** is an accurate, inexpensive, and reliable method to measure position unlike anything else on the market. A start-up company, Innotronics, has been created to commercialize this patented technology.

The **displacement controlled hybrid excavator** doubles fuel efficiency.

The **variable-linkage pump** achieves unparalleled efficiency through a novel mechanism.

The **sealing and tribological studies** explore the interaction between sliding surfaces and thin film lubrication.

Advanced **engineered fluids** research demonstrates the important role of fluid in hydraulic systems.

A **free piston engine hydraulic pump** promises to revolutionize future powertrains for both on and off highway vehicles.

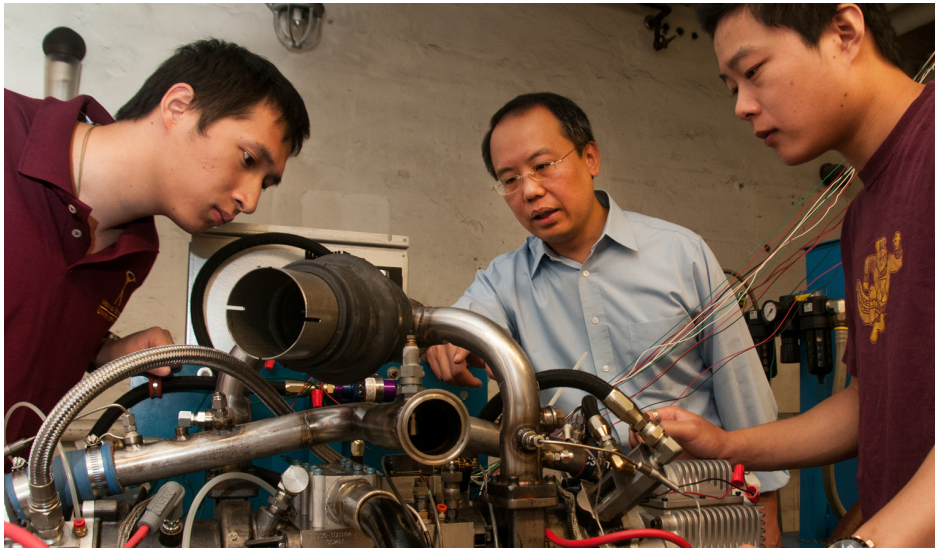
A **lightweight pneumatic actuators for robotics and rehabilitation** enables cutting edge human scale applications.

The **hydraulic ankle-foot orthosis** demonstrates the extraordinary ability of fluid power to achieve high forces in an exceptionally light weight package, making fluid power a perfect solution for next-generation wearable robots.



WHY FLUID POWER IS IMPORTANT

Fluid power technology is utilized in a wide range of industries: construction, manufacturing, transportation, agriculture, packaging, and many more. Current sales estimates for fluid power components exceed \$33 billion with fluid power system sales easily an order of magnitude greater. Improvements in the technology would dramatically increase its market adoption and societal impact. Compared to other technologies, fluid power has unparalleled power density. Improvements in efficiency and energy storage density will significantly expand the use of fluid power.



WHY THE CCEFP IS IMPORTANT

The Center is the leading academic consortium for fluid power research and innovation. Its strategy is to identify, cultivate, and secure strategic government-funded research programs for fluid power.

CCEFP efforts are influencing national energy policy resulting in significant investments for fluid power research involving industry, universities, and national laboratories. Because of the Center’s efforts, the Department of Energy (DOE) is investing \$5,000,000 per year in energy saving fluid power technology for commercial off-highway vehicles. The Center is raising awareness of fluid power technologies for human-scale applications such as robots, exoskeletons, and medical devices. The CCEFP is expanding the use of fluid power in manufacturing while improving the manufacturing of fluid power components and systems.

WHY RESEARCH IS IMPORTANT

The CCEFP is transforming fluid power. The CCEFP research strategy has catalyzed the fluid power industry and research community. For the first time in decades, industry is collaborating with universities on research. U.S. universities are emerging as research leaders as shown by best paper awards for Center researchers and students at prominent international conferences.

The Center currently collaborates with nine leading partner research universities and more than fifty industry supporters as part of its growing network.



WHY EDUCATION IS IMPORTANT

The CCEFP addresses a long-standing need for fluid power research and education in the United States. Fluid power is taught to 3,000 engineering students annually by incorporating research into core curriculum. Industry practitioners have access to free online courses and webinars. The Center is empowering a new generation of faculty and engineers to focus on hydraulics and pneumatics. Two-thirds of CCEFP graduates work in fluid power.

