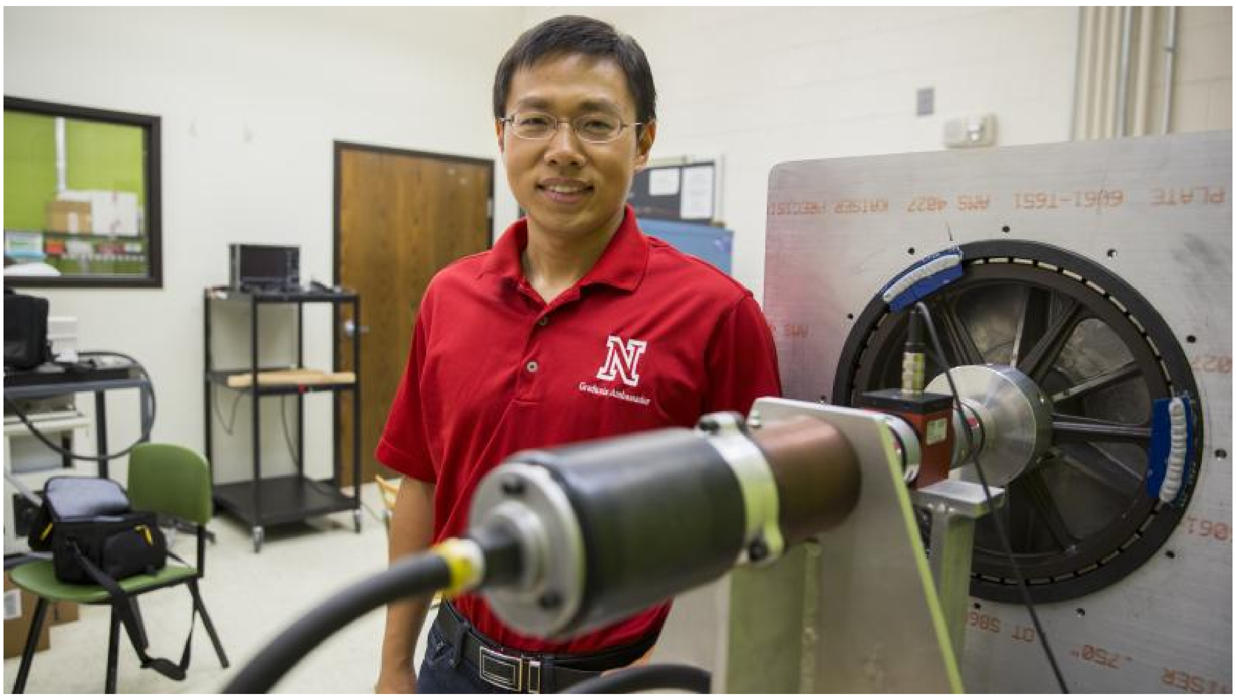
Wind turbine system recycles 'spillage' to improve energy efficiency

September 17 2015, by Scott Schrage



Jie Cheng, doctoral student in electrical engineering, stands next to the partial prototype of a wind turbine system that research suggests could yield 8.5 percent more electricity than conventional counterparts. Credit: Troy Fedderson/University Communications

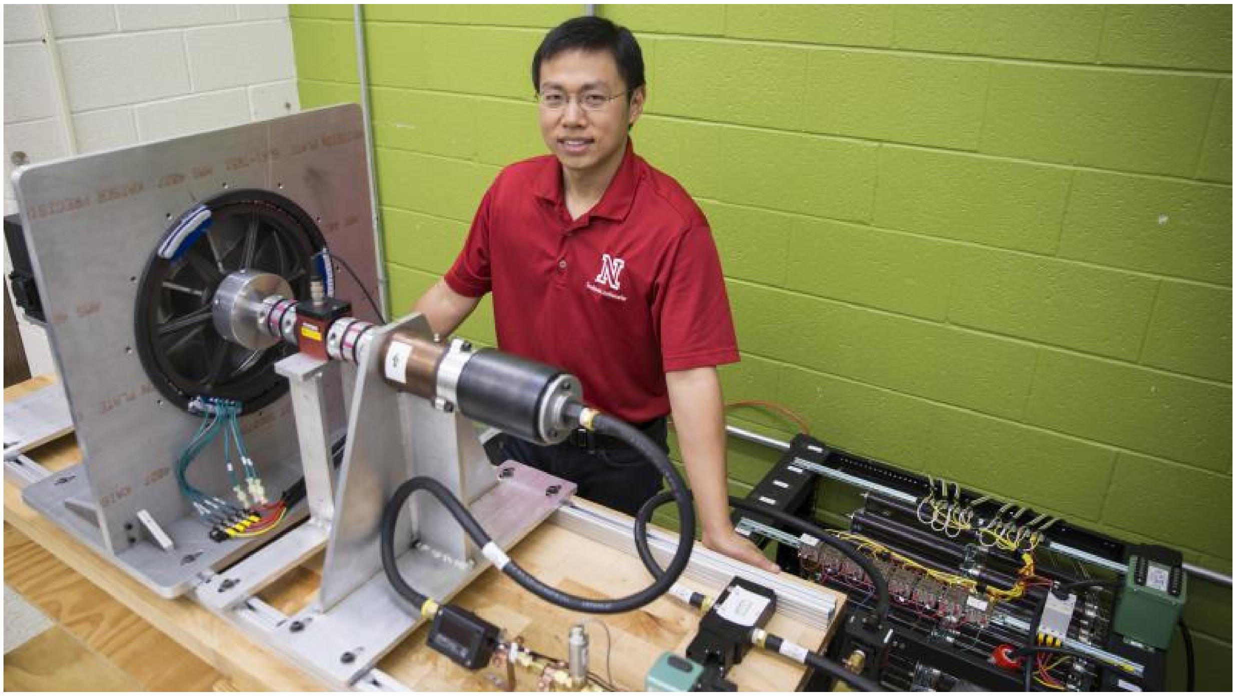
A new prototype from the University of Nebraska-Lincoln's Jie Cheng could give a second wind to turbines that currently waste Mother Nature's strongest breaths.

Cheng, a doctoral candidate studying electrical engineering, has designed a system that could improve wind turbine efficiency by capturing and storing surplus energy for later use as electricity.

In a recent study based on historical wind data from rural Springview, Nebraska, Cheng compared the prototype's performance against a conventional wind turbine for a week. Cheng found a 250-kilowatt system would yield an additional 3,830 kilowatt-hours of electricity per week – about 16,400 extra kwh a month.

That extra juice would account for more than 18 times the monthly energy use of the average American household, according to the U.S. Energy Information Administration. The system would also marginally cut total energy costs while significantly reducing fluctuations in power generation, the study reported.

Physicists have shown that only 59.3 percent of the kinetic energy from wind can be captured by a rotor, with modern wind turbines designed to approach this limit. However, these turbines also have a capacity for generating electricity that corresponds to a given wind speed—a speed far slower than what nature regularly whips up.



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When the wind exceeds this speed threshold, turbines adjust their blade angles to maintain a constant energy output and prevent potential mechanical damage. The resulting "mechanical spillage" means that turbines fall well short of utilizing their full capacity.

Cheng's system helps resolve this problem by converting and directing the spillage to an air compression tank, where the excess energy remains until wind speeds dip enough to pull the turbine back beneath its optimal capacity. At that point, the tank kicks in to regenerate the electricity.

That way, Cheng said, the system addresses the wasted potential energy normally lost during strong winds as well as the energy deficit that turbines typically suffer during relatively calm periods.

"The biggest problem for wind energy is that it's not a reliable energy resource," Cheng said. "Even if there's not enough wind to generate electricity, the community still needs it. If we can (scale up) this system, it could improve reliability by producing electricity even when there's no wind."

Cheng said vast swaths of open land and strong, consistent winds that characterize the Cornhusker State have made it ideal for testing his system and could make it a good place to begin incorporating the design.

"We have a lot of wind energy here, and we live among grasslands, so there's little environmental (interference)," he said. "I see a lot of potential for this, especially in Nebraska."

Cheng is collaborating with Lincoln Electric System, the American Public Power Association and UNL's NUtech Ventures office to explore the market viability and introduction of his design.

The *Journal of Power and Energy Engineering* published Cheng's recent study, which he authored with adviser Fred Choobineh, a Blackman Distinguished Professor of Engineering.

Provided by University of Nebraska-Lincoln