Researchers scale up ocean wave energy harvester

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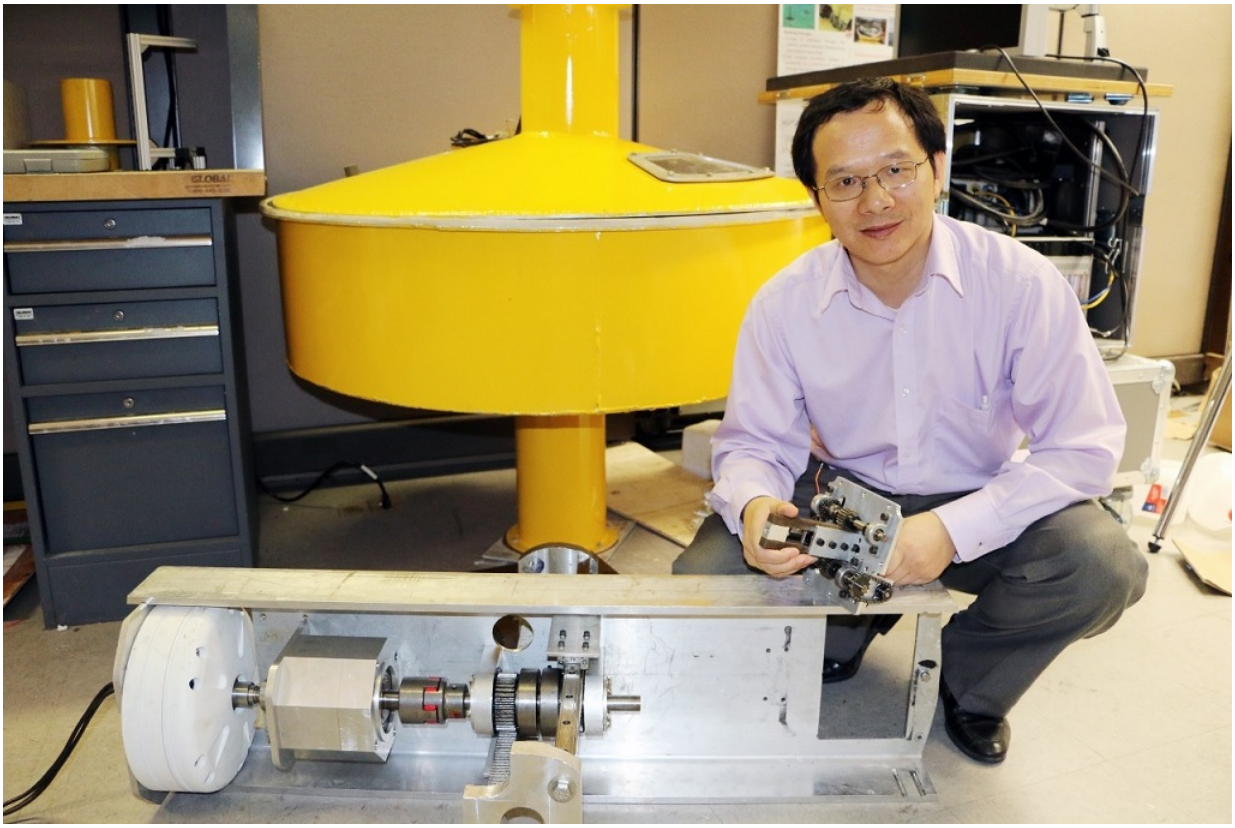

Lei Zuo holds the first version of the wave energy harvester, while a larger version of the device sits at his feet. When in use, the harvester will be encased in a yellow buoy like the one behind him. Credit: Virginia Tech

The world's oceans contain an enormous amount of energy in the form

of waves, and researchers are trying to harness that energy for human use. However, most wave power stations today are still in the early stages of development, with only a handful of commercial systems having been implemented in the past few years.

Working toward a practical wave harvesting system, a team of researchers at Virginia Tech led by Associate Professor Lei Zuo has recently built and tested a small proof-of-concept device that converts the irregular motion of ocean waves into unidirectional rotation that can drive a generator and produce electricity.

The device recently won the 2015 R&D 100 Green Energy Technology Special Recognition Award, and the researchers received a $2 million grant from the U.S. Department of Energy to scale up their design. Their goal is to produce electricity with high reliability and at a competitive cost in the next several years, motivated by the large potential power available from waves.

"If you look at other clean energy options, you can get about 1.5 kilowatts of power source out of a square meter of sunshine," Zuo said in a press release. "With a square meter of wind, you get about 1 kilowatt of power. With a meter of ocean wave front, you can get between 10 and 100 kilowatts of power, and that's an exciting possibility for us as we continue to mature the technology."

The researchers are currently building a 500-watt unit using a design that is significantly improved compared to their proof-of-concept device, and they plan to test the larger unit later this fall. After collecting data from this device and using it to make further improvements, the next steps will be to build and test a 10-kilowatt device in 2017 and early 2018, followed by a full-sized version that can generate about 0.5 megawatts of power. This version will have a diameter of about 25 meters.

Despite their different sizes, all of these devices will operate using the same basic mechanism developed by the researchers, called a Mechanical Motion Rectifier. Similar to the way that an electrical rectifier converts alternating current (which oscillates back and forth) into direct current (which flows in only one direction), the wave version converts the waves' irregular motion into unidirectional motion, which brings significant efficiency and reliability benefits in driving the generator. The Mechanical Motion Rectifier is housed inside either a large casing that bobs up and down like a buoy on the ocean surface, or inside a container that is positioned under the water.

One of the biggest challenges facing the technology is improving the reliability, which is difficult due to the inconsistent nature of ocean waves. Under the new grant, the researchers' goals include increasing the reliability of the device by at least 50 percent, and improving the power output by 25 percent, which will help make the cost of the generating electricity competitive with other alternative energy sources.