Toy Makes Gathering Wind Data A Breeze

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The kite retrieves wind speed measurements by sensing the tension in the tether that is connected to the ground.

Meteorologists have developed a portable new tool for measuring atmospheric wind speeds by tethering kites to ground-based metering systems.

The meter, attached to the kite's tether at the ground, is an improvement from the traditional method of mounting wind sensors on a mast. It senses wind in the lower atmosphere, up to 60 meters above the surface of the earth.

"The kite wind sensing system is designed to be both practical and temperature-stable," said Giles Harrison, professor of atmospheric physics at the University of Reading in the U.K who designed the meter

with graduate student Kieran Walesby.

Meteorologists have used kites to study the atmosphere for more than 250 years. The most legendary may be Benjamin Franklin, who used a kite to measure the properties of electricity in the atmosphere in 1752. Since then, scientists have flown kites with instruments attached, but in recent decades they have used the kites themselves to sense wind.

Harrison and Walesby's instrument retrieves wind speed by sensing tension in the kite's tether on the ground. They anchor the tether to an aluminum ring, which is also a base for four strain gauges. As the wind blows the kite and the tether pulls, the gauges sense even the slightest strain to the aluminum ring.

"The gauges measure how the metal ring physically distorts under the tension of the tether," Harrison said. "There's a small variation in each of the string gauges and we put that together electronically to get a signal that we can measure."

The meter senses wind just as a child flying a kite feels the rope tug in the grip of his or her hands, but you won't find this kite at the toy store. The scientists built their blue, hexagonal-shaped kite in the University's laboratory using a Japanese design called Rokkaku. Rokkaku kites, known for their stability, are perfect for gathering data in the lower atmosphere where winds are the most turbulent.

"When the winds drop completely, the kite flutters slowly to the surface rather than crashing catastrophically," Walesby said in an email. "This protects the kite and gives a good chance for the wind to pick up and the kite to recover before it hits the ground."

To perfect their system, the scientists tested the meter for thermal drift, which is when temperature changes affect the electronics. Due to its

symmetrical design, drift in their system was so small that it had only a trivial effect on measurements, unlike older systems that needed calibrating before and after every run.

A light-weight, portable meter that operates remotely from the ground is useful for studying air flow in the wake of a wind turbine, Walesby said. Traditionally, scientists used multiple sensors mounted on masts near the turbine to gather a spatial average.

"A kite, which naturally wanders as it flies and thus samples an area rather than a single point, may provide a simpler method," Walesby wrote.

However, the meter may have little use in other atmospheric research, according to Gary Jedlovec, an atmospheric scientist with NASA.

"This advancement improves on the technology to make it more accurate and less dependent on the atmosphere temperature, but its application to broader meteorological measurements is limited," Jedlovec said.

Jedlovec said that the relationship between the tension ring and wind speed is based on a formula that, according to Harrison, breaks down at wind speeds greater than 15 meters per second.

"The other thing that meteorologists want to know is not just the wind speed, but the direction and how that direction may change with height and time. This instrument doesn't tell you anything about the direction," Jedlovec said.

Though it's limited to slow, low altitude winds, the system may find its niche in forecasting wind energy.

"This application may be looking at … how effectively wind turbine

systems can operate in lighter winds and how gusts of wind and turbulence affect their performance in lighter wind conditions," Jedlovec said.

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