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Q-Bo makes condition monitoring of bolted joints and screws on wind turbines efficient, smart and sustainable

Nuremberg/Hamburg: At WindEnergy 2022 in Hamburg, institutes of the Fraunhofer Cluster of Excellence for Cognitive Internet Technologies CCIT will demonstrate how sustainable energy can even be efficiently and sustainably monitored and maintained. With the Q-Bo® technology, Fraunhofer scientists show how bolted joints and screws, e.g. on the rotors or tower flanges of wind turbines, can be maintained without consuming large amounts of energy for installation, operation and transmission. This means that maintenance cycles for onshore and offshore wind turbines can be made many times more targeted and cost-efficient.

At WindEnergy Hamburg, the global show and event for the wind energy industry, the scientists are presenting a smart screw connection technology under the new brand name Q-Bo® that can make maintenance cycles for wind turbines more efficient and cost-effective in many places - both onshore and offshore.

With Q-Bo®, each screw is equipped with a new type of washer that uses a piezo resistive DiaForce thin sensor system to measure the preload force at three points. Any change in the preload force changes the electrical resistance in the DiaForce® thin film. When a screw comes loose, the resulting change in resistance is reported to a radio module located on the screw head. The radio module, in turn, sends the data to a base station, which collects the information from all relevant screws on the object. Using the mioty® radio protocol developed at Fraunhofer IIS, several hundred thousand screws can be connected to just one base station. The mioty® radio technology also makes robust and reliable data transmission possible through a special telegram splitting method. The base station could thus be located on the edge of a wind farm, for example, several hundred meters or even several kilometers away.

Sustainable in two senses

The researchers have also resolved the problem of energy demand in a resource-efficient manner. The system uses energy harvesting technologies. This involves the use of heat or light to generate electricity. For Q-Bo® a thermoelectric generator generates electricity from the minute differences in temperature between the screw head and the environment. It is also possible to generate the electricity through solar cells. Energy

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harvesting makes the system fully self-powered or extends battery runtimes," Dr. Peter Spies explains this sustainability aspect of the technology. "In addition, we ensure security and reliability of the data via a special commissioning box that assigns each Q-Bo® screw connection an individual ID as well as further info on the requirement profile and exact position, so that maintenance personnel can really rely on the data."

Q-Bo® technology can also be integrated into existing systems as a retrofit. At present, Q-Bo® is designed for commercially available DIN screws. The system is ready for use with screws of size M18, and systems for M20 and M36 will soon be available. Evaluation kits have already been shipped to the first companies, which are looking to optimize a wide range of applications there by using Q-Bo®.

"The joint Fraunhofer expertise from various disciplines enables to achieve the current demand for greater sustainability in maintenance of energy plants e.g. wind power. Thus, we ensure in a double sense a significant efficiency advantage in operation, which also helps to reduce costs," Dr. Peter Spies explains the development goal, which will now be presented in a product-ready prototype status from September 27-30 in Hall B5-227 at WindEnergy in Hamburg.

Further information as well as image and video material can be found at:
<https://www.cit.fraunhofer.de/en/research-center/iot-comms/q-bo.html>

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Q-Bo® and mioty® are Fraunhofer brands.

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FRAUNHOFER INSTITUTE FOR INTEGRATED CIRCUITS IIS**Project partners**

Fraunhofer Institute for Surface Engineering and Thin Films IST, Fraunhofer Institute for Integrated Circuits IIS, as well as the Fraunhofer Institute for Structural Durability and System Reliability LBF and the Fraunhofer Institute for Applied and Integrated Security AISEC are involved in the project being run by the Fraunhofer Cluster of Excellence Cognitive Internet Technologies CCIT.

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The Fraunhofer-Gesellschaft, headquartered in Germany, is the world's leading applied research organization. Its research activities are conducted by 76 institutes and research units at locations throughout Germany. The Fraunhofer-Gesellschaft employs a staff of more than 30,000, who work with an annual research budget totaling more than 2.9 billion euros.

The **Fraunhofer Institute for Integrated Circuits IIS**, headquartered in Erlangen, Germany, conducts world-class research on microelectronic and IT system solutions and services. Today, it is the largest institute of the Fraunhofer-Gesellschaft. Research at Fraunhofer IIS revolves around two guiding topics:

In the area of **"Audio and Media Technologies"**, the institute has been shaping the digitalization of media for more than 30 years now.

Fraunhofer IIS was instrumental in the development of mp3 and AAC and played a significant role in the digitalization of the cinema. Current developments are opening up whole new sound worlds and are being used in virtual reality, automotive sound systems, mobile telephony, streaming and broadcasting.

In the context of **"cognitive sensor technologies"**, the institute researches technologies for sensor technology, data transmission technology, data analysis methods and the exploitation of data as part of data-driven services and their accompanying business models. This adds a cognitive component to the function of the conventional "smart" sensor.

More than 1100 employees conduct contract research for industry, the service sector and public authorities. Founded in 1985 in Erlangen, Fraunhofer IIS has now 14 locations in 10 cities: Erlangen (headquarters), Nuremberg, Fürth, Dresden, further in Ilmenau, Bamberg, Waischenfeld, Würzburg, Deggendorf and Passau. 75 percent of the budget of 191 million euros a year is financed by contract research projects. Approximately 25 percent is subsidized by federal and state funds as well as internal projects of the Fraunhofer-Gesellschaft. Detailed information on: www.iis.fraunhofer.de/en
