Press release

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IMPROVING AERODYNAMIC PERFORMANCE OF AIRCRAFT AND WIND TURBINES

AIT and its partners present optical quality monitoring to determine the efficiency of riblet surfaces.

The AIT Austrian Institute of Technology (AIT) and its partners have successfully developed a quality monitoring system for microstructured functional surfaces, so-called riblets, on wind turbines and aircraft. This enables the flow resistance to be monitored with the aim of optimising energy yield and fuel efficiency. In the RiSPECT research project, the experts present a portable lab setup for non-destructive quality control, which will serve as a basis for future developments. The optical inspection is based on a photometric stereo method developed at the AIT Center for Vision, Automation & Control.

Good aerodynamic attributes are crucial in nature and technology for efficient locomotion and optimal performance. In engineering, they are required to achieve maximum speeds, reduce fuel consumption and noise emissions, optimise flight and glide characteristics and improve stability. Modelled on shark skin and its ability to reduce friction in water, riblets are micro-structured functional surfaces with tiny V-shaped longitudinal grooves. They are aligned in the direction of flow and are used in aircraft and ship construction, wind turbines and much more to minimise air resistance. In addition to reducing noise emissions, riblet surfaces lead to lower fuel consumption and thus reduced CO2 emissions in aircraft and to higher electricity production in wind turbines. Even minor damage and wear of the riblets impair the efficiency of the riblet effect. Regular inspection is therefore essential.

Precise, early monitoring is crucial

"The aerodynamic efficiency of the riblets depends on their structural integrity. Therefore, the riblets need to be checked regularly. In an experiment it was shown that with only 3% destroyed riblets, the riblet effect decreases by ~ 8% of the full aerodynamic performance. Already with 6% defect share, the riblet effect is reduced by 15%. A defect percentage of 10% to 15% reduces the potential of the riblets so much that a replacement of the microstructures is necessary. A high degree of accuracy in monitoring is therefore required. In addition, the inspection must make statements about the ratio of defective and intact riblet structures and how high the aerodynamic reduction effect is," explains Christoph Feichtinger from bionic surface technologies GmbH.

Non-destructive, high-performance and portable quality inspection

For that purpose, a consortium has joined forces in 2020 to combine broad knowledge in riblet aerodynamics from industrial sectors such as commercial aviation or wind turbines with world-leading experts in high-precision measurement methods, machine learning, image processing and system testing in the RiSPECT research project.
The partners are bionic surface technologies GmbH, the Center for Vision, Automation & Control/ AIT Austrian Institute of Technology (VAC), the Software Engineering Institute/ TU Graz and the University of Wyoming. Their goal is to lay the foundations for a portable automated system for assessing the quality of riblet surfaces based on image data and measurements, thereby reducing the overall costs of quality assurance measures.
In the project, they focused on using optical methods to determine the condition of riblet surfaces and the remaining performance using experimental methods. The inspection system is based on the photometric stereo method developed at the VAC. It records the riblets with a camera from above and creates images with alternating illuminations from different illumination directions. This allows the surface structure to be precisely recorded. Defects can thus be detected quickly and automatically. Together with the findings from the measurements, predictions can be made about the existing riblet potential. The inspection solution is portable, easy to operate and makes efficient on-site monitoring of the riblets possible.

Inspection solutions for the Riblet world market

Nicole Brosch, scientist, image processing expert and project manager at VAC, emphasises the importance of the new inspection solution for various industries: "Wind energy, aviation, motor sports, shipping - all these markets are very large and will need solutions with riblets in the coming years. To optimise fuel consumption and energy yield, regular monitoring of riblet structures is crucial, especially directly on site. Until now, however, no really useful fault detection method was known that was also portable and easy to use. We are proud to have been able to contribute our know-how and research in many ways and to contribute significantly to the development of a new system."

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