Accurate One-Camera Measurement of Wind Turbine Deformations

Fossil fuels will at some point in the future be depleted, therefore new sources of energy need to be found. Wind energy is one of these new (renewable) sources of energy. As the capacity of the wind turbines continues to grow, the importance of regular monitoring and accurately measure the blade deformations and/or vibrations increases. The one-camera measurement invention of the TU Delft makes this possible even when the wind turbine is operative.

To meet the increased demand for wind energy, high capacity wind turbines are needed. These wind turbines are more cost effective per kWh, but also more failure-prone as they are subjected to enormous stresses. Too large deformations may cause large wind turbines to malfunction. Subsequent damages may occur. Repairs are costly and time-consuming. Also, current repair methods do not enable the wind turbine to produce output. For these reasons, wind turbines need to be monitored regularly for blade deformations and vibrations under various wind conditions.

Current Solutions

Currently there are two solutions for monitoring. The first is the mechanical method that attaches strain gauges and accelerators to the blades. However, installation costs are high and calibration is complicated. The second is the optical method that uses a laser or two (expensive metric) cameras, which require a construction place.

The New Invention: Accurate One-Camera Measurement

A team of scientists of TU Delft The new invention is a method that can be used to accurately determine (as least as accurately as the photogrammetric method of the current solutions) a degree of deformation and/or vibration of a moving object following a predefined trajectory. It requires only one (consumer grade) HD camera, on a location opposite or oblique to the wind turbine; no construction platforms are necessary. Highly contrasting markers are attached to the blades at measured locations to measure deviations. As the blades rotate, each marker describes an ellipse at the video image sequence. The collection of ellipses is used to reconstruct the 3D shape of the rotor by means of a computer program. Subsequently, the program can translate deviations from the ellipse of each individual point into lateral and tangential deformations and vibrations of the corresponding rotor point with respect to the body. 3-D models are generated that show deviations compared to the default state. Wind turbine designers, manufacturers and users could greatly benefit from this invention, which could also be offered as a wind turbine monitoring service.

Advantages of the Invention

- At least as accurate as existing monitoring systems
- Cheaper, thus competitive advantage
- A degree of deformation and/or vibration can be determined without the need for expensive cameras
- No need for a construction place for the cameras
- No need for synchronization of the cameras
- Simplicity

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TU Delft / Valorisation Centre
Mekelweg 2
2628 CD Delft

T: 015-2786751
www.patent.tudelft.nl