Patent awarded for 'method and system of controlling airfoil actuators'

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Syracuse University has been awarded a patent for the development of a “Method and System of Controlling Airfoil Actuators.” This research will lead to greater maneuverability options for wing design on airplanes and is being considered for applications to wind turbine research. Mark Glauser, professor of mechanical and aerospace engineering (MAE) and associate dean for research and doctoral programs in the L.C. Smith College of Engineering and Computer Science, and MAE professor Hiroshi Higuchi co-led this project. This patent in closed-loop flow control has potential to inform numerous applications that require enhanced lift or are impacted by fatigue due to unsteady flow.

The goal of the research was to focus on creating opportunities for enhancing lift and reducing fatigue due to unsteady aerodynamic loads on an airfoil through making intelligent observations from changing wing surface conditions. Glauser and Higuchi worked on testing an intelligent airfoil design that would be able to sense changes in airflow over an airfoil’s surface, make inferences about airflow conditions around the airfoil and make adjustments to the airfoil through the use of actuators.

Glauser and Higuchi began by placing pressure sensors along the chord of an airfoil and collected data to make observations about how airflow conditions affected the wing. Rather than utilizing conventional flaps as seen on many airplane wings, they used synthetic jets, small actuators that expel or take in air to change airfoil surface conditions, distributed in span near the leading edge of the airfoil, to make changes to the

airfoil's performance in the face of changing airflow conditions as sensed by the unsteady airfoil surface measurements.

"It is really quite gratifying to see this basic research, originally funded by the U.S. Air Force Office of Scientific Research, evolve to the point where the technology can positively impact actual aerospace vehicles, as well as its potential for dual use in the renewable energy sector with application to the next generation of wind turbines," says Glauser.

Current wind turbine design does not allow for relatively fast adjustments to changing weather conditions, which leads to accelerated fatigue and degradation of system components. In his current research utilizing sensors and actuators, Glauser has observed opportunities to improve turbine performance and reduce unsteady loads by up to 15 percent by testing a scaled model turbine blade inside a wind tunnel. Next steps will be to test this technology at close to full-scale conditions and such experiments are being conducted in conjunction with the University of Minnesota through support from the Department of Energy.

Applying this sensor/actuator design to various aerospace vehicles exposed to highly unsteady flows will, for example, lead to greater maneuverability of aircraft and reduction of unsteady loads on turrets and aircraft landing gear. Research in this area is currently being funded by the Department of Defense.

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