National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Aerospace

Improved Fixed-Wing Gust Load Alleviation Device

Enabling thinner, lighter fixed wings for novel aircraft design

Gust load alleviation is an increasing concern for the design of fixed-wing aircraft with ultra-high aspect wings. Innovators at NASA's Langley Research Center developed a mechanical solution to control gust-load on fixed plane wings. By manipulating the wing's natural response to gust loads, the technology may minimize aerodynamic and structural loads and improve flight efficiency of future aircraft.

Current computer-controlled, active gust-alleviation devices delay the wing response such that gust loads experienced are mitigated less than 10% while the present invention has demonstrated the ability to improve gust load alleviation up to 30%. Along with the reduced response time that alleviates gust load, NASA's mechanical innovation offers the advantage of a simplified design and potentially improves passenger flight experience during turbulence.

BENEFITS

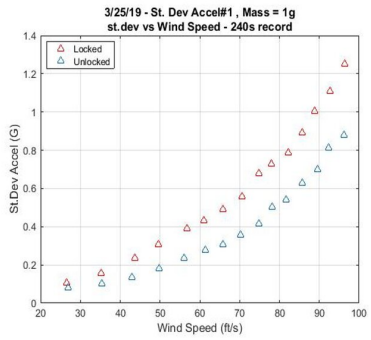
- Improved: passive gust alleviation proven three times better than that of current, active technologies
- Enabling: opportunity for use of ultra-high aspect ratio wings that are currently weight prohibitive
- Versatile: can be applied to nearly every fixed wing aircraft
- Immediate: no lag time between gust input and counter response
- Simple: compared to active technologies requiring advanced algorithms for operation

THE TECHNOLOGY

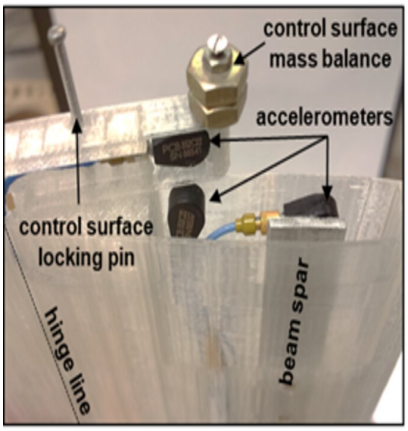
Gust loads may have detrimental impacts on flight including increased structural and aerodynamic loads, structural deformation, and decreased flight dynamic performance. This technology has been demonstrated to improve current gust load alleviation by use of a trailing-edge, free-floating surface control with a mass balance. Immediately upon impact, the inertial response of the mass balance shifts the center of gravity in front of the hinge line to develop an opposing aerodynamic force alleviating the load felt by the wing. This passive gust alleviation control covering 33% of the span of a cantilever wing was tested in NASA Langley's low speed wind tunnel and found to reduce wing response by 30%.

While ongoing experimental work with new laser sensing technologies is predicted to similarly reduce gust load, simplicity of design of the present invention may be advantageous for certification processes. Additionally, this passive technology may provide further gust alleviation upon extending the use of the control to the entire trailing edge of the wing or upon incorporation with current active gust alleviation systems.

Importantly, the technology can be easily incorporated into to the build of nearly all fixed wing aircrafts and pilot control can be maintained through a secondary trim tab. Though challenging to retrofit, passive gust alleviation could enable use of thinner, more efficient wings in new plane design.



Standard deviation of the wing tip acceleration time of the free-to-rotate, passive gust load alleviation device, by comparison to the locked, current gust alleviation device.



Upon gust impact, the mass balance shifts the center of gravity in front of the hinge line to illicit an opposing aerodynamic force, reducing load.

APPLICATIONS

The technology has several potential applications:

- Aerospace: Civil and military fixed-wing aircrafts

PUBLICATIONS

Patent No: 11,685,516; 8,672,107

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