NASA Tests Show Wing Warping Controls Aircraft at High Speeds

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A NASA flight research project, designed to test a derivative of the Wright Brothers' concept of wing-warping to control aircraft turns, indicates the concept works, even at supersonic speeds.
This high-tech version of century-old technology may have an impact on aircraft design. It may make airplanes more maneuverable at high speeds, enable them to carry heavier payloads or use fuel more efficiently.

The Active Aeroelastic Wing (AAW) project is located at NASA's Dryden Flight Research Center, Edwards Air Force Base, Calif. The project is evaluating active control of lighter-weight flexible wings for improved maneuverability of high-performance aircraft. The project is jointly sponsored and managed by NASA, the U.S. Air Force Research Laboratory (AFRL), Wright-Patterson Air Force Base, Ohio; and Boeing's Phantom Works, St. Louis.

"It works!" concluded project manager Larry Myers during AAW flight tests at Dryden. "We have demonstrated a number of subsonic and supersonic flight conditions, where we have actually taken advantage of the aeroelasticity of the wing," Myers explained. "We've gotten excellent results, good agreement with predicted results, and roll rates are comparable to what we predicted in simulation. It looks like we've proven the AAW concept," he added.

Active computerized control of wing flexibility is a step toward the "morphing" concept, where aircraft can change their shape to adapt to differing aerodynamic conditions. The AAW is primarily intended to benefit aircraft that operate in the transonic speed range. The range is approximately 80 to 120 percent of the speed of sound, where traditional control surfaces become minimally effective or ineffective.

Wing flexibility is generally a negative at those speeds. Wing flexibility tends to offset or counteract the effects of normal aileron movements at high aerodynamic pressures. The AAW concept reverses the traditional approach to this problem. The traditional approach has been stiffening the wings of high-performance aircraft with more structure and more weight. AAW reduces the structure and weight. It then actively controls the wing flexibility via computerized flight controls.

Data obtained from flight tests at Dryden will help guide the design of future aircraft including high-performance fighters, high altitude-long endurance uninhabited aerial vehicles, large transport aircraft and high-speed, long-range aircraft.

The test aircraft is an F/A-18A Hornet obtained from the U.S. Navy. It carries extensive instrumentation to measure the twisting and bending of the wing during flight. Once the flight research is successfully completed, the inventors will turn toward spreading the AAW design philosophy to the technical community.

"Transitioning AAW will likely be a relatively long process, since it represents a design philosophy," said Pete Flick, Air Force AAW program manager. "The application to future aircraft will depend on specific design requirements of those future systems. The benefits are greatest when a vehicle design is initiated with AAW in mind, and limited when applied to an existing vehicle," he added.

Source: NASA

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