National Aeronautics and Space Administration

Aeronautics

# Green aviation - improved aerodynamic efficiency and less fuel burn

## Variable Camber Aerodynamic Control Surfaces and Active Wing Shaping Control

NASA has created and combined two new concepts aircraft aerodynamic control surfaces and active wing-shaping control to reduce aircraft drag and lower fuel consumption. The first concept is referred to as a variable camber continuous trailing edge flap or, alternatively, a variable camber continuous leading edge slat. Aerodynamic simulations and wind tunnel experiments have shown that this type of flap can reduce aerodynamic drag substantially as compared to a conventional flap. The second element is a new active wing-shaping control concept that is proposed in connection with the presently disclosed variable camber continuous trailing edge flap (or leading edge slat). The active wing-shaping control is designed to aeroelastically change a wing shape in-flight in order to achieve a desired wing shape for optimal drag reduction.

## BENEFITS

- Provides the same lift capability for lower drag
- Provides a continuously curved trailing edge
- Improved aerodynamic efficiency by optimizing span-wise aerodynamics
- An aeroelastic wing shaping method for analyzing wing deflection shape under aerodynamic loading

technology solution

## THE TECHNOLOGY

Currently, as fuel is burned, wing loading is reduced, thereby causing the wing shape to bend and twist. This wing-shape change causes the wings to be less aerodynamically efficient. This problem can be further exacerbated by modern high-aspect flexible wing design. Aircraft designers typically address the fuel efficiency goal by reducing aircraft weights, improving propulsion efficiency, and/or improving the aerodynamics of aircraft wings passively. In so doing, the potential drag penalty due to changes in the wing shapes still exists at off-design conditions. The unique or novel features of the new concepts are:

1. Variable camber flap provides the same lift capability for lower drag as compared to a conventional flap. The variable camber trailing edge flap (or leading edge slat) comprises multiple chord-wise segments (three or more) to form a cambered flap surface, and multiple span-wise segments to form a continuous trailing edge (or leading edge) curve with no gaps which could be prescribed by a mathematical function or the equivalent with boundary conditions enforced at the end points to minimize tip vortices
2. Continuous trailing edge flap (or leading edge slat) provides a continuously curved trailing edge (or leading edge) with no gaps to minimize vortices that can lead to an increase in drag.
3. The active wing-shaping control method utilizes the novel flap (or slat) concept described herein to change a wing shape to improve aerodynamic efficiency by optimizing span-wise aerodynamics.
4. An aeroelastic wing shaping method for analyzing wing deflection shape under aerodynamic loading is used in a wing-control algorithm to compute a desired command for the flap-actuation system to drive the present flap (or slat) system to the correct position for wing shaping.

Inflected-wing Elastically Shaped Aircraft Concept

## APPLICATIONS

The technology has several potential applications:

- Aircraft
- Aerospace Engineering
- Unmanned Aerial Vehicles (UAV)

## PUBLICATIONS

Patent Pending

More Information

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