ADAPTIVE AIRFRAME TECHNOLOGY USING SHAPE MEMORY ALLOYS

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ABSTRACT

Aircraft designers and manufactures worldwide have searched for methods to allow multiple missions from the same airframe. This is a current need and will become an even more dominant need in the future for desired performance improvements and enhanced desired mission capabilities. The operational speed ranges of aircraft are driven, to a significant degree, by the wing geometry. Some aircraft use mechanisms such as leading and trailing edge flaps, telescoping devices, sweep and camber changing devices in an attempt to increase mission capability. As these devices are added to improve mission requirements, the weight and complexity of the wing rise, giving way to available payload. The desired wing geometry would be constantly able to adapt to different obstacles that increase its mission capabilities, such as take off, landing, high-speed cruise, attacks, and loiters, while not gaining weight or complexity. There are other desired goals as well. The surface of the wing should be smooth without discontinuities during a shape change. Its range of movement should be such that it can influence wing area, aspect ratio, sweep, twist, and camber. Some hydrodynamic and stealth applications require such things as low noise signature, the ability to apply RAM (Radar Absorptive Materials), and the ability to remotely mount the wing structure. As a wing structure becomes more flexible in its geometry, its structural ability to support the vehicle must be maintained with minimum weight gain. Airframe structures that have the ability to morph from one shape to another are an important step in the advancement of airframe structural design. In the past, rigid wing structures have had simple wing controls to provide rotation about three axes. Using a morphing wing, would allow translations as well as rotations. Wing movements can now be applied both symmetrically and differentially. This will provide a new level of maneuverability. The ability of the wing structure to morph will allow single airframes to perform multiple missions over a wide range of operation. This will significantly increase the capability of adaptive airframe structures to operate over a wide range of flight regimes. Determination of the proper host structure and actuation of its movements with shape memory alloys shows great promise for the future.[i]

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[i] Edward F Crawley " Intelligent Structures for Aerospace: A technology Overview and Assessment" AIAA Journal Vol. 32 NO * August 1994

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