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DYNAMIC OPTIMIZATION OF MORPHING WINGS: AERODYNAMIC ADVANCEMENTS, STRUCTURAL CHALLENGES, AND FUTURE RESEARCH DIRECTIONS IN AEROSPACE ENGINEERING

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Abstract

Morphing wings represent a groundbreaking advancement in aerospace engineering, offering the ability to dynamically adapt wing shapes for optimal performance across various flight conditions. Inspired by the adaptable structuresfound in nature, such as the wings of birds and insects, morphing wing technology aims to overcome the limitations of traditional fixed-wing designs. By employing lightweight composite materials and advanced actuation systems, morphing wings can alter their geometry in real-time, leading to improved aerodynamic efficiency, control, and versatility. This technology has the potential to revolutionize aircraft design, particularly for unmanned aerial vehicles (UAVs) and next-generation manned aircraft. The aerodynamic investigation of morphing wings plays a crucial role in understanding their behaviour and optimizing their performance. Computational Fluid Dynamics (CFD) simulations and wind tunnel experiments provide valuable insights into the complex interactions between wing shape, airflow, and aerodynamic forces. The historical development of morphing wings traces back to early observations of nature and the advent of variable-sweep wing designs in the 20th century.

Author Keywords

Morphing Wings; Fixed Wing; Biomimicry; Composite Materials; Unmanned Aerial Vehicles (UAVS); Actuation Systems; Aircraft Performance; Aerodynamic Efficiency; Computational Fluid Dynamics (CFD); Improved Maneuverability; Fuel Efficiency.

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