The Royal Academy of Engineering

Senior Research Fellowship

Morphing Aircraft – Improving Performance Using Adaptive Structures

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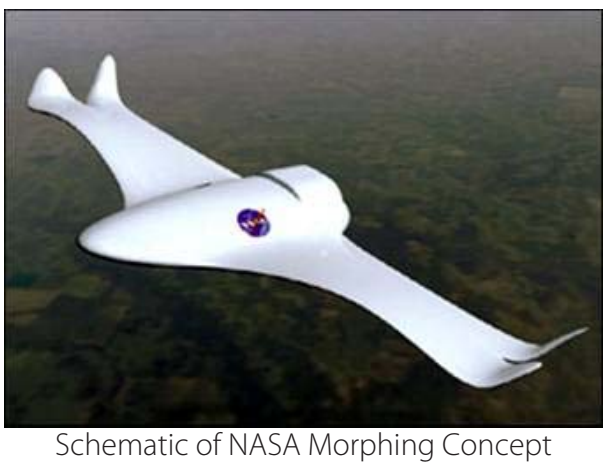
Aeroelasticity

- Interaction of aerodynamic, elastic and inertial forces – effects can be catastrophic (structural failure) or undesirable (reduced performance).
- Consequently, traditional aircraft designs are stiff and heavy – higher fuel consumption and sub-optimal performance.

Morphing

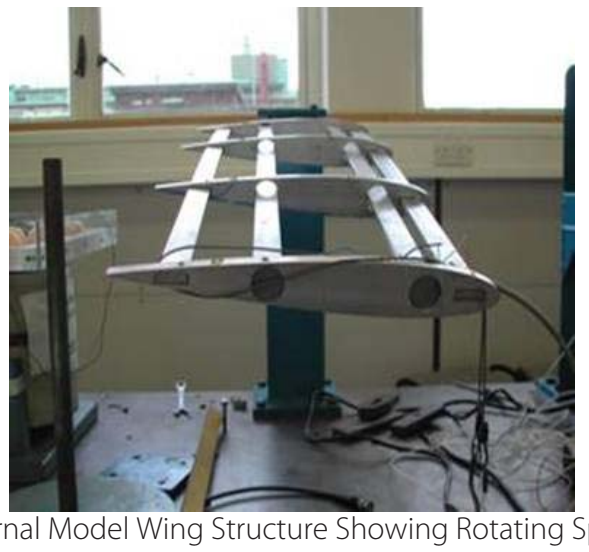
- Recent research aimed at using aeroelastic flexibility to improve aircraft / UAV performance
- *Configuration morphing* – change aircraft planform to improve control and performance including change of mission in-flight
- *Performance morphing* – change wing / fin structural properties to minimize drag and loads and also optimize roll control.



Schematic of NASA Morphing Concept

Adaptive Structures

- Adapt internal structure to alter shear centre position and structural stiffness – changes wing deflection and twist.
- Range of different concepts implemented and demonstrated successfully, showing feasibility of adapting wing twist and bending shape to minimize drag and provide roll-control



Internal Model Wing Structure Showing Rotating Spars

Adaptive Attachments

- Fins / winglets can be made more effective with a single attachment using adaptive stiffness attachments.
- Range of different concepts implemented and demonstrated successfully, including wind tunnel tests of an all-moving vertical tail on a 7m span aeroelastic model at TsAGI, Moscow.

EuRAM Model With Adaptive All-Moving Tail

Conclusions

- Initial work shows Adaptive Aeroelastic Structures are feasible and have promise for reducing aircraft fuel consumption and emissions as well as improving performance

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