CFD: Morphing Aerofoils

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Research Overview

Inspired by birds' natural ability to achieve controlled flight, my research involves characterising the Aerodynamic and Aeroacoustic properties of a Morphing Aerofoil. This includes:

- Investigating potential improvements over conventional control surface methods in current use.
- Creating an initial numerical framework to prescribe a dynamic morphing motion to a pitching or static aerofoil.

Industry Relevance

Novel morphing designs to tackle the need to be more aerodynamically effective (efficiency).

- Morphing can be applied to a wide range of applications, from rotary UAVs blades to fixed-wing.
- Improvements in aerodynamic efficiency and a reduction in acoustic noise generation have been noted.

Methods & Technologies

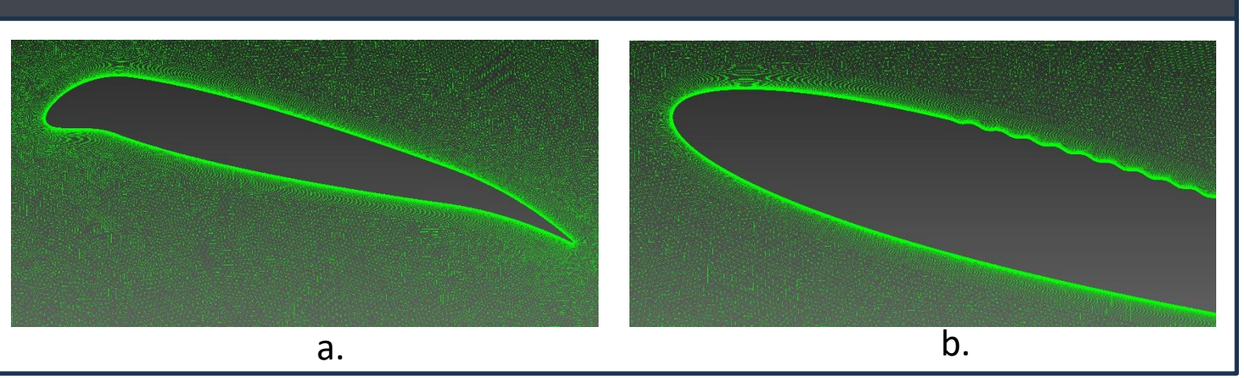
Numerical simulation tools combined with user-defined functions are used to control the morphing of an aerofoil shape under various conditions. For example, for subsonic cases, leading-edge morphing (LE) can enhance dynamic stall characteristics of a pitching aerofoil, while trailing-edge (TE) morphing can improve aerodynamic efficiency and reduce noise generation. Moreover, applying travelling waves by morphing certain surface regions has the potential to control shock wave behaviours for transonic cases.

Innovations

2D instantaneous examples of dynamic mesh motion:

a. LE & TE morphing while undergoing pitching

b. Travelling wave on the upper surface



a. b.

Opportunities

Designing a prototype for testing in a dynamic wind tunnel setup would be valuable to further validate current numerical findings, which would require:

- A prototype of a morphing aerofoil with a compliant structure.
- A dynamic rig to be used in the UWE wind tunnel facilities to test the prototype.

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