Fundamentals of actively controlled flows with trapped vortices

Results in Brief

Preventing vortex shedding and reducing drag

Blended wing-body, or thick-wing, aircraft suffer from the formation, shedding and reformation of vortices. These are tubes of circulating air that can develop into trapped vortices and bring about an unsteady wake.

With aircraft increasing in size, the vortex problem needs to be investigated so that flights can become more efficient and economical. A trapped vortex is one that is kept near to the aircraft body.

The ‘Fundamentals of actively controlled flows with trapped vortices’ (VortexCell2050) project aimed at delivering a new technological platform that combines two cutting-edge technologies: the trapped vortex and the active flow control. Trapping vortices prevents vortex shedding and reduces drag in flows past bluff bodies. Active flow control is a form of control that requires energy input.

EU-funded VortexCell2050 developed a tool for vortex cell design and gathered data on three-dimensional (3D) and actively controlled flows in vortex cells. It demonstrated that a thick airfoil with a properly designed vortex cell with active control is preferable to a thick airfoil without a vortex cell. This approach has positive implications for future applications in specific applications.
The software tool developed here optimises the vortex cell shape for the case of zero mean flow-rate of the stabilisation system, while the developed control scheme requires a non-zero mean flow-rate. Other study results indicate that there are significantly more efficient control schemes and subsequent work should focus on unsteady, feedback control schemes.

Having highlighted promising avenues for further improvement in vortex cell performance, the progress made by VortexCell2050 could facilitate design of very large aircraft that are capable of taking-off and landing almost anywhere away from traditional landing strips.

Project Information

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