ACTIVE CONTROL OF TRAILING VORTICES BY SYNTHETIC JETS IN THE AXIAL DIRECTION NEAR THE WINGTIP

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Abstract We applied an oscillating synthetic jet in the axial direction to a wingtip vortex and observed a decrease in its strength (active control, synthetic jets, wingtip vortex).

We have designed, manufactured and set up an experimental device to be tested in a towing tank using a NACA0012 wing model at chord-based Reynolds numbers Re_c=40×10^3 [1]. We used this device to create an axial injection jet with zero net mass flux since we have based our design on previous work on stability analyses concerning frequency response [2, 3]. Reducing the vortex strength is the primary objective of the active control. To demonstrate the achievement of this goal, we used different frequency/amplitude pairs, resulting in different jet waveform velocities near the wingtip. We conducted experiments to determine which pairs produced the most significant vorticity reduction. The maximum reduction achieved was 15% of the peak vorticity $max(\Omega)$ in the far-field $z/c \sim 35$, see Fig. 1. Thus, the experimental device has successfully achieved vortex attenuation, indicating effective active control. These results make this device a promising technological candidate for various wing models, including larger ones in future applications. The experimental device is currently pending patent.

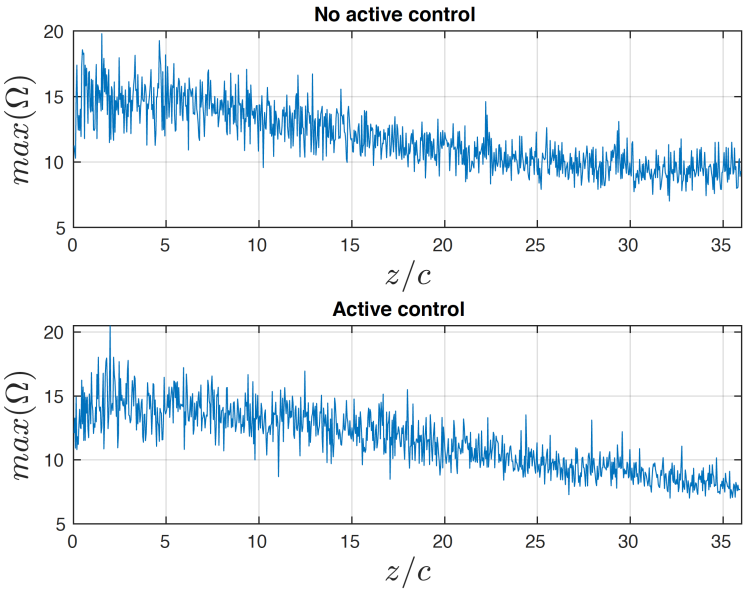

Figure 1. Vorticity peak against axial distance z/c in the reference experiment (top) and using active control (bottom).

References

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