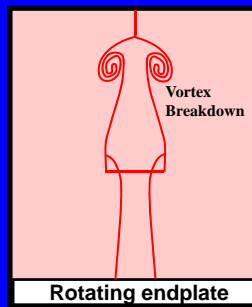


Quenching Vortex Breakdown Oscillations via Harmonic Modulation

Vortex breakdown is a phenomenon inherent to many practical problems, such as leading-edge vortices on aircraft and flame-holders in combustion devices. It is associated with the stagnation of the axial velocity on the vortex axis and the development of a near-axis recirculation zone, and strong unsteadiness.

Here, we use an open loop control strategy to manipulate vortex breakdown oscillations in an enclosed cylinder via modulation of the rotating endplate.



Ω - mean rotation
 Ω_f - modulation frequency
 A - relative modulation amplitude
 t^* - dimensional time

$$\Omega (1 + A \sin(\Omega_f t^*))$$

Results:



Low modulation frequencies **AMPLIFY** vortex breakdown oscillation.



Large modulation frequencies **SUPPRESS** vortex breakdown oscillation.

This control strategy may help to

- (a) improve aircraft's aerodynamic performance.
- (b) enhance mixing in swirling jets or bioreactor.
- (c) stabilize flame in a combustor chamber.

A collaborative project with Temasek Laboratories, Arizona State University (USA) and University of Politècnica de Catalunya (Spain).

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