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Cylinder Drag Reduction Using Cross-Section Variation From Circle to Ellipse A. BOUABDALLAH, Université des Sciences et de la Tech nologie Houari Boumediene, Algiers, Algeria, H. OUALLI, M. MEKADEM, H. CHETITAH, C. BOULAHBAL, École Militaire Polytechnique, Algiers, Algeria, M. GAD-EL-HAK, Virginia Commonwealth University, Richmond, Virginia, USA — Vortices in the wake of blunt bodies are responsible for significant portion of the drag. An active flow control strategy is designed to inhibit the shedding of such vortex structures. Last year, we presented a numerical study to investigate the effect of periodic cross-section variations on the shed vortices. We extend the research to experiment using a cylinder with finite length. The controlling frequency range is extended up to 40 times the natural shedding frequency f_0. Amplitude and frequency modulations are the key parameters directly affecting the efficiency of the system and the topology of the flow, which permanently adjusts in response to the superimposed pulsatile motion exhibiting a cascade of bifurcations accompanied by shedding modes shifting from the natural mode 2S to 2P, 2T, and 2C. Optimal operational conditions are identified and the results show that drag drastically drops to zero then negative, i.e. thrust, with complete suppression of the vortex shedding. Von Kármán vortices are no longer shed, but rather pulled out in small-scale, weakened vorticity packets released from the lateral cylinder wall. For a deforming amplitude of 100% and an exciting frequency of $20f_0$, the negative drag reaches 14 times its value for an uncontrolled cylinder.

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