Experimental flow control of a triangular cluster of cylinders using genetic programming

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November 8-9, 2018

Abstract

The wake stabilization of a triangular cluster of three rotating cylinders was investigated in the present study. Experiments were performed at Reynolds number $Re \approx 6000$, and compared with URANS-2D simulations at same flow conditions. 2D2C PIV measurements and constant temperature anemometry were used to characterize the flow without and with actuation. Open-loop actuation was first considered for the identification of particular control strategies. Machine learning control was also implemented for the experimental study. Linear genetic algorithms have been used for the optimization of open-loop parameters for constant speeds and sinusoidal actuation. Genetic programming was also used to find optimum closed-loop feedback controllers. Considering two different cost function $\mathcal{J}$ based on the velocity measured by three hot-wire sensors, for a drag reduction or the symmetrization of the wake, significant performances were achieved using the machine learning approach.

Keywords

flow control, experimental fluid mechanics, machine learning, genetic algorithms, genetic programming