Towards self-sustained oscillations of multiple flexible vortex generators

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Résumé en anglais	Passive methods are widely used for flow control in engineering processes for heat and mass transfer enhancement. Using flexible vortex generators (FVGs) in such applications in order to destabilize the flow can be thought to achieve higher performances taking advantage of the fluid-structure interaction. In this paper, we discuss the assessment of getting self-sustained large oscillation amplitudes of multiple FVGs from an upstream confined laminar flow. The FVGs are located on the opposite channel walls in alternated positions, separated by a distance equal to their span and inclined in the upstream direction with an angle of 30° with respect to the wall. Five cases are studied which differ by the number of alternating FVGs in the system and investigations are also performed adding two co-planar FVGs upstream. The Reynolds number is held constant with a value of 2000 (based on the hydraulic diameter) for all the cases. The effect of increasing the degree of freedom of the system, on creating a large displacement flapping motion is numerically investigated. The results show that a minimum of three alternating FVGs is needed to produce a self-sustained and periodic flow instability, leading to large FVG displacement when the co-planar FVGs are not present. The introduction of upstream co-planar FVGs destabilizes the flow by producing vortices which act as periodic forces on the downstream FVGs. In this case, large displacement amplitudes are thus observed with two alternating FVGs added downstream. A phenomenon of inverted drafting is observed in all the cases: upstream FVGs display smaller drag force values than the downstream ones. Since the downstream FVGs oscillate in resonance with the incoming flow, motion amplitudes become higher. Moreover, it has been observed that for all the configurations studied here, the FVGs located at the same wall location oscillate in phase with each others and out-of-phase with the ones located on the opposite channel wall.

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