Abstract Submitted
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Flutter-Limited Reconfiguration of a Flat Plate Bending in a Fluid Flow[1] FREDERICK GOSSELIN, FABIEN SANSAS, AVIRAL PRAKASH, AWAN BHATI, ERIC LAURENDEAU, Ecole Polytechnique de Montreal — Plants rely on their flexibility to change form and reduce their drag when subjected to fluid flow. Flexibility allows plants to reconfigure and reduce their drag, however it is well known that flexibility can also lead to a loss of stability and thus increased dynamical loads. Fluttering flags are a good example. In the present work, we consider the limitation to reconfiguration brought by a dynamic loss of stability in constant uniform flow. To understand the trade-off that flexibility brings to real plants in terms of drag reduction and loss of stability, we study an idealised two-dimensional system: a beam clamped at its centre and subjected to a normal flow. We combine wind tunnel experiments and numerical simulations to study how the beam bends in the flow statically when the flow velocity is increased until a critical value is reached and the beam starts fluttering. We observe the competition between reconfiguration and flutter in flat plates in a wind tunnel. We also adopt a computational approach coupling an ALE finite volume aerodynamics code to a finite difference solution of the large deformation beam equation. We find that for a lighter structure in a heavier fluid, the critical velocity is higher and more reconfiguration is possible without reaching an instability.

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Frederick Gosselin
Ecole Polytechnique de Montreal

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