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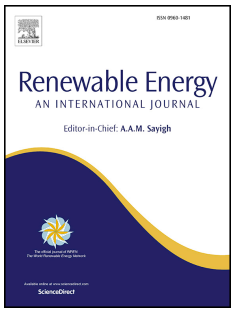

Experiments on lift dynamics and feedback control of a wind turbine blade section

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Experiments on lift dynamics and feedback control of a wind turbine blade section

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Abstract

An experimental campaign is performed to the study of feedback lift control applied to a wind turbine blade. A 5-digit NACA profile whose trailing edge is rounded for circulation control purposes is used in combination with fluidic actuation. It is first shown in this article how the modified profile performs, in terms of aerodynamic forces, in both natural and manipulated cases. Then, the dynamics of controlled pressure (and thus lift) establishment is identified. A discussion is given on the speed of lift dynamics in comparison with previous studies and on its ability to overcome lift perturbations due to external perturbations. Finally, a feedback lift control experiment is performed showing the feasibility of such control in a wind turbine environment.

Keywords: Feedback control, Wind turbine, Lift

1. Introduction

Wind turbines evolve in the atmospheric boundary layer at a height where strong wind velocity fluctuations in both amplitude and direction can be found [1]. These fluctuations not only modify the actual forces acting on the blade but can also lead to dynamic stall [2, 3], therefore creating undesirable mechanical loads on the turbine that can lead to severe damages. Controlling the lift of the individual wind turbine blades may thus be considered to soften these undesired