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Design of a zero-net-mass-flux actuator based on a DBD jet in a partially enclosed cavity.[1] ANOOD ALKATHEERI, ABDUL RAOUF TAJIK, ABDULLA ALJABERI, VLADIMIR PAREZANOVIC, Khalifa University, UAE — Recently, Lucas et al. [1] have shown that a shallow cavity at the base of a 3D bluff body can significantly stabilize the symmetry breaking mode of its wake. A natural recirculation of the flow near the base opposes the selection of an asymmetric state, which symmetrizes the wake and yields a higher base pressure (reduced drag). Our work investigates the possibility of recreating this effect, using a partially enclosed cavity with a Dielectric Barrier Discharge (DBD) jet inside. When the DBD jet is activated it produces suction and blowing action at the two lateral slits of the cavity which can hopefully yield a similar effect on the bluff body wake. Current work focuses on the optimal design of such a cavity, using 2D URANS-based simulations in conjunction with the electrodynamic force model of a DBD jet [2]. The dynamics of the DBD jet inside a several different cavity shapes are simulated for steady and periodically pulsed actuation, and the velocity profiles are analyzed. The goal is to establish the most important geometric properties of the cavity for a desired balance between suction and blowing action from the two slits using a single DBD jet.

[1][1] J.M. Lucas, et al, J. Fluid Mech. 831:675-97 (2017). [2] K.P. Singh and S. Roy, J. Appl. Phys. 103(1):013305 (2008). This work has been supported by the Khalifa University of Science and Technology under Award No(s). FSU-2018-21 and CIRA-2019-025.

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