Assessment of simple Dielectric Barrier Discharge actuator model with a commercial flow solver

Yacine Babou[1], Pablo Lechuga[2], Rauno Cavallaro[1]
[1]*Departamento de Bioingeniería Ingeniería Aeroespacial, Universidad Carlos III de Madrid Avenida de la Universidad 30, 28911, Leganes, Madrid, Spain*
E-mail: *ybabou@ing.uc3m.es*, *rauno.cavallaro@uc3m.es*

[2] *BS candidate at Departamento de Bioingeniería Ingeniería Aeroespacial, Universidad Carlos III de Madrid*

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The present contribution addresses a simplified expression of the distribution of the Electro-Hydrodynamic (EHD) force generated by a single Radio-Frequency (RF) Dielectric Barrier Discharge (DBD) plasma actuator. By combining judiciously different models previously documented, an upgraded EHD body force model has been elaborated in order to get an expression depending exclusively on the plasma actuator design and operating settings which can be effortlessly implemented as a source term in commercial flow solvers. We consider first the model established by Soloviev [1] to estimate the integral force produced per unit length of the exposed electrode. In order to apply this model as body force source term in commercial flow solver, the integral force is distributed leaning on the model proposed by Sing et al. [2].

The performance of the resulting model is assessed through a series of flow computations addressing several arrangements involving multiple actuators and documented in the literature; namely, the case of in-series actuator configuration [3], the case of flipped actuator configuration [4] and the case of actuated cylinder [5]. Comparisons between computed data and available flow measurements demonstrate the relevancy of the adopted modelling approach to predict flow actuation by means of conventional RF-DBD plasma actuator.

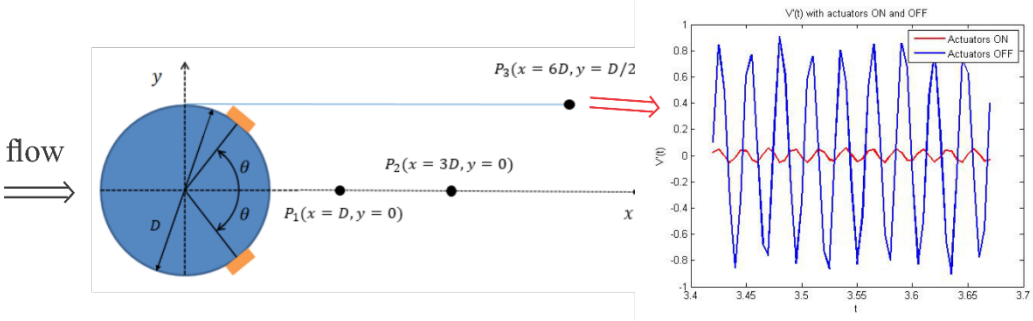

Figure 1: Flow behind a cylinder: V'(t) evolution with actuators ON and OFF at point P3.

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