Numerical study of the flow around a set of two flat plates at
different angles of incidence∗

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The hydrodynamic interaction between airfoils or blades arranged in a given configuration, and, particularly, the effect that the wake behind an airfoil has on the lift of the following one in the array, is a relevant problem in many engineering applications. In this work we consider this problem for an array of just two flat plates with a configuration of interest in some non-rotary tidal currents converters consisting of an array of blades or sails which is set into motion by the current in a given direction.1

In particular, we consider here the three-dimensional turbulent flow around a set of two flat plates with the configuration sketched in the inset of Figure 1, for different angles of attack $\alpha$, with the objective of characterizing the optimum angle for which the amount of energy absorbed from the current is a maximum for a given Reynolds number ($Re$). To that end we have carried out numerical simulations using a k-omega turbulent model whose parameters have been adjusted by fitting the numerical results with published experimental data for a single flat plate.2

Figure 1 shows some results for $Re = 8 \times 10^4$. The drag ($C_D$) and lift ($C_L$) coefficients for each flat plate are shown as functions of $\alpha$. Also included is the comparison of the numerical results for a single plate with the experimental results by Pelletier and Mueller (2000)2. It is of interest to note that $C_L$ for the front plate is larger than that for a single plate if $\alpha$ is high enough. For each $Re$ we optimize the value of $\alpha$ for which the total work exerted by the current on the two plates in the appropriate direction of the tidal energy converter is a maximum.

Figure 1: $C_D$ (a) and $C_L$ (b) as functions of $\alpha$ for $Re = 8 \times 10^4$. 

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