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DISCRETE SENSITIVITY ANALYSIS OF A NACA0015 AEROFOIL

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A methodology for computing the discrete Jacobian and Sensitivity matrices has been recently conceived by the authors [1]. The mathematical formulation, the details of the algorithms and a validation of the method, using an analytical test case, were all presented. Furthermore, the method was validated by comparing the sensitivity maps, for a 2D circular cylinder at $Re = 45$ (see Figure 1), of the novel discrete approach, with the continous approach of [2].

The above sensitivity maps enables the manipulation of the stability of a flow field by introducing small perturbations into the identified regions. Marquet et al.[2] and Strykowski and Sreenivasan[3], numerically and experimentally respectively, identified the regions to place a small control cylinder, aft of the larger cylinder to stabilize the flow and subsequently obtain a steady solution above the critical Reynolds number. This work will extend this approach for a NACA0015 aerofoil using the abovementioned discrete approach. This extends a relatively academic problem (flow past a cylinder at Re = 45), and approaches a more industrial problem (flow past a NACA0015 aerofoil at various AoA).

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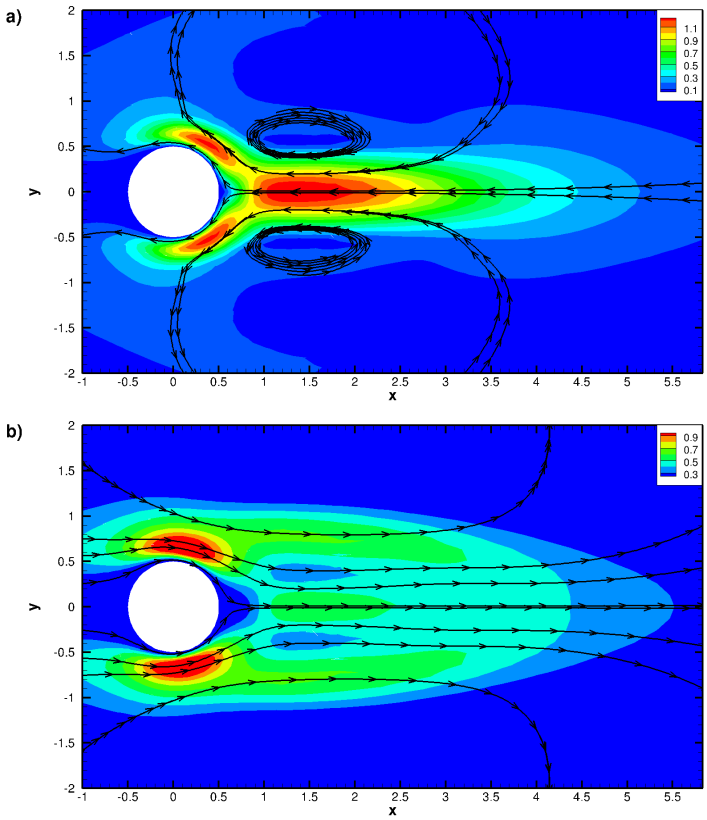

Figure 1: Sensitivity to a steady force; a) real part and b) imaginary part. Taken from [1]