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A Parametric Study of the Effect of Size, Position, and Number of Flexible Membranes Attached to a Circular Cylinder on the Fluid Flow Behavior

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Abstract : This paper discusses the effect of an attached flexible membrane on the control of fluid around a circular cylinder. A parametric study has been investigated for different positions, sizes, modes as well as frequencies of oscillation of the flexible membrane. The numerical investigation was conducted for a Reynolds number equal to 150 using the commercial code Fluent 16.0 and parallel calculation into 4 processors. The motion of the flexible membrane was managed by the dynamic mesh and compiled into Fluent as a user-defined function. The first part of this paper discusses the effect of changing the position of a flexible membrane sized 8° as an angle of aperture on the aerodynamic coefficients. Results show that the flexible membrane placed at 110° from the stagnation point presents more non-linearity on the behavior of the drag coefficient compared to the drag behavior when placed at 180°, relative to the stagnation point. The effect of the size of the flexible surface was studied for the corresponding angles of aperture: 32° and 42°, respectively. The effect of modes (modes 1, 2, and 3) of vibrations has been investigated at a constant frequency of vibration f=2Hz for angles 32° and 42°. All the calculations have been done with a constant amplitude A =0.001m. A non-linearity of the drag coefficient was clearly observed for all the sizes, modes as well as frequencies of excitation. The Fast Fourier transformation shows the appearance of the natural shedding frequency and the multiples of the frequency of excitation. An increase in the modes of oscillation leads to a more linear behavior of the drag coefficient.

Keywords : fluid flow control, numerical simulation, dynamic mesh, aerodynamic forces, flexible membrane
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