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Investigation of the Kutta Condition Using Unsteady Flow

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Abstract : An investigation into the Kutta effect on the trailing edge of a subsonic aerofoil was conducted which led to an analysis using Ansys Fluent to determine the effect of flow separation over a NACA 0012 aerofoil. This aerofoil was subjected to oscillations to create an unsteady flow over the aerofoil, therefore, creating turbulence, with unsteady aerodynamics playing a key role to determine the flow regimes when the aerofoil is subjected to different angles of attack along with varying Reynolds numbers. Many theories were evolved to determine the flow parameters of a 2-D aerofoil in these unsteady conditions because they behave unpredictably at the trailing edge when subjected to a different angle of attack. The shear area observed in the boundary layer at the trailing edge tends towards an unsteady turbulent flow even at small angles of attack, creating drag as the flow separates, reducing the aerodynamic performance of aerofoil. In this paper, research was conducted to determine the effect of Kutta circulation over the aerofoil and the effect of that circulation in reducing the effect of pressure and boundary layer distribution over the aerofoil. The effect of circulation is observed by using Ansys Fluent by using varying flow parameters and differential schemes to observe the flow behaviour on the aerofoil. Initially, steady flow analysis was conducted on the aerofoil to determine the effect of circulation, and it was noticed that the effect of circulation could only be properly observed when the aerofoil is subjected to oscillations. Therefore, that was modelled by using Ansys user-defined functions, which define the motion of the aerofoil by creating a dynamic mesh on the aerofoil. Initial results were observed, and further development of the dynamic mesh functions in Ansys is taking place. This research will determine the overall basic principles of unsteady flow aerodynamics applied to the investigation of Kutta related circulation, and gives an indication regarding the generation of vortices which is discussed further in this paper.

Keywords : circulation, flow seperation, turbulence modelling, vortices
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