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Numerical Investigation of the Bio-fouling Roughness Effect on Tidal Turbine

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Abstract : Unlike other renewable energy sources, tidal current energy is an extremely reliable, predictable and continuous energy source as the current pattern and speed can be predicted throughout the year. A key concern associated with tidal turbines is their long-term reliability when operating in the hostile marine environment. Bio-fouling changes the physical shape and roughness of turbine components, hence altering the overall turbine performance. This paper seeks to employ Computational Fluid Dynamics (CFD) method to quantify the effects of this problem based on the obtained flow field information. The simulation is carried out on a NACA 63-618 aerofoil. The Reynolds Averaged Navier-Stokes (RANS) equations with Shear Stress Transport (SST) turbulent model are used to simulate the flow around the model. Different levels of fouling are studied on 2D aerofoil surface with quantified fouling height and density. In terms of lift and drag coefficient results, numerical results show good agreement with the experiment which was carried out in wind tunnel. Numerical results of research indicate that an increase in fouling thickness causes an increase in drag coefficient and a reduction in lift coefficient. Moreover, pressure gradient gradually becomes adverse as height of fouling increases. In addition, result by turbulent kinetic energy contour reveals it increases with fouling height and it extends into wake due to flow separation.

Keywords : tidal energy, lift coefficient, drag coefficient, roughness
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