Numerical Study on Performance of Horizontal Axis (Propeller) Tidal Turbine

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Abstract

The aim of this paper is to numerically explore the feasibility of designing a Mini-Hydro turbine. The interest for this kind of horizontal axis turbine relies on its versatility. For instance, in the field of renewable energy, this kind of turbine may be considered for different applications, such as: tidal power, run-of-the-river hydroelectricity, wave energy conversion. It is fundamental to improve the turbine performance and to decrease the equipment costs for achievement of "environmental friendly" solutions and maximization of the "cost-advantage". In the present work, the commercial CFD code ANSYS is used to perform 3D simulations, solving the incompressible Unsteady Reynolds-Averaged Navier-Stokes (U-RANS) equations discretized by means of a finite volume approach. The implicit segregated version of the solver is employed. The pressure-velocity coupling is achieved by means of the SIMPLE algorithm. The convective terms are discretized using a second order accurate upwind scheme, and pressure and viscous terms are discretized by a second-order-accurate centered scheme. A second order implicit time formulation is also used. Turbulence closure is provided by the realizable k − turbulence model. In this study, a mini hydro turbine (3kW) has been considered for utilization of horizontal axis impeller. The turbine performance and flow behavior have been evaluated by means of numerical simulations. Moreover, the performance of the impeller varied in the pressure distribution, torque, rotational speed and power generated by the different number of blades and angles. The model has been validated, comparing numerical results with available experimental data.

Keywords : Mini hydro-Electric Plant, Hydraulic Turbine, ANSYS, Power Generator

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