



A CFD Study of Wind Turbine Aerodynamics

With an ever increasing energy crisis occurring in the world it will be important to investigate alternative methods of generating power in ways different than, fossil fuels. In fact, one of the biggest sources of energy is all around us all of the time, the wind. It can be harnessed not only by big corporations but by individuals using Vertical Axis Wind Turbines (VAWT). VAWT's offer similar efficiencies as compared with the horizontal axis wind turbines (HAWT) and in fact have several distinct advantages. One advantage is that unlike their HAWT counterparts, they can be placed independently of wind direction. This makes them perfect for locations where the wind direction can change daily.

To analyze the effectiveness of a VAWT, methods of computational fluid dynamics (CFD) were used to simulate various airflows and directions. The analysis began with a literature analysis into the subject, in order to determine the types of airfoils that were most effective. After the research was done, the system was modeled in SolidWorks and imported into Star CCM+ to perform a CFD analysis. The first part of the CFD analysis analyzed the 2D flow over the chosen airfoil(s). Next, the analysis looked at the flow over a 3D representation of the airfoil(s). The 2D and 3D simulations used different angles of attack and speeds (15 & 30 mph) to determine when separation occurred at the various speeds. Finally, a full VAWT assembly was created and analyzed at various wind directions at the same wind speeds. The full assembly included 3 airfoils that were attached into a 5ft high, 3 ft diameter structure. Each step of the analysis included importing the CAD file into Star CCM+ as an IGES file, selecting physical models, generating a numerical mesh, and applying boundary conditions. All three portions of research studied scalar and vector properties, such as pressure and velocity. This paper describes the research of a VAWT using the NAC A0012-34 airfoil.

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Abstract

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