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Optimization analysis of the combinations of concentrator and wind turbine with flap in CFD

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Due to rapidly increasing population and technological advances the demand for energy is increasing day by day. To meet this demand the technology is turning to renewable energy sources rather than fossil fuels. The importance given to wind and hydrokinetic energies is increasing with each passing day. In this context, many studies are done to improve the turbine performance. Today, depending on technological developments, the minimum speed of wind and hydrokinetic current to produce electricity from wind and hydrokinetic turbines is about 3-4 m/s and 1-2 m/s respectively. To generate electricity at lower speed from wind turbine two different studies are performed. The first one is the design of the high-performance blade (such as slatted blade and twin blades), and second one is the design concentrator suitable for turbine to increase wind speed. In this study, the optimization of the combinations of concentrator with wind turbine is curried out. The concentrator and flap geometries and positions highly effect the turbine performance so a numerical optimization method coupled the response surface method with genetic algorithm was employed to obtain concentrator and flap position leading maximum velocity increase at the wind turbine zone. Taguchi optimization method applied to the system without wind turbine gives speed increase in the concentrator is about approximately 2 times. More realistic results will be obtained by Response Surface Methods. Some outputs from the study are presented in Figure 1 and 2. Velocity and pressure distributions in the concentrator obtained at the optimum parameters are given in Figures 1 and 2 respectively. Although Taguchi design can achieve results in less experimentation than full factorial design, this method yields only the optimum result for at the one of the factor levels defined in the optimization study. Therefore, the other optimization method, Response Surface Method, outlined above is used in the optimization. The method will give optimum results in the range of the factor levels defined not at the defined levels. More details will be given in the full paper.

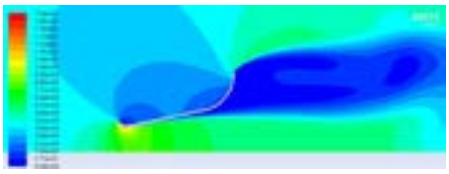

Figure 1: *Velocity distribution*

Figure 2: *Pressure distribution*

Biography

Tahir Yavuz has completed BSc in Mechanical Engineering from Karadeniz Technical University Turkey, and PhD in Aeronautical Engineering, Leicester University, England. He worked at Erciyes and Karadeniz Technical Universities, Turkey and is currently working as a full time Professor at Baskent University, Turkey. He is interested in bluff body aerodynamics, renewable energies such as wind energies and wind turbines. He has developed high-performance wind turbine blades such as airfoil with slat arrangements.

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