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Energy Production Calculations with Field Flow Models and Windspeed Predictions with Statistical Methods

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The continuous usage of fossil fuels as primary energy source is the reason of the emission of CO and powerless economy of the country affected by the great flactuations in the unit price of energy sources. In recent years, developments in wind energy sector and the supporting new renewable energy policies of the countries allow the new wind farm owners and the firms who expect to be an owner to consider and invest on the renewable sources. In this study, the annual production of the turbines with 1.8 kW and 30 kW which are available for Istanbul Technical University in Energy Institute is calculated by Wasp and WindPro Field Flow Models and the wind characteristics of the area are analysed. The meteorological data used in calculation includes the period between 02.March.2000 and 31.May.2004 and is taken from the meteorological mast ( ) in Istanbul Technical University's campus area. The measurement data is taken from 2 m and 10 m heights with hourly means. The topography, roughness classes and shelter effects are defined in the models to make accurate extrapolation to the turbine sites. As an advantage, the region is nearly 3.5 km close to the Istanbul Bosphorous but as it can be seen from the Wasp and WindPro Model Results, the Bosphorous effect is interrupted by the new buildings and hight forestry. The shelter effect of these high buildings have a great influence on the wind flow and decrease the high wind energy potential which is produced by the Bosphorous effect.
This study, which determines wind characteristics and expected annual production, is important for this Project Site and therefore gains importance before the construction of wind energy system. However, when the system is operating, developing the energy management skills, forecasting the wind speed and direction will become important. At this point, three statistical models which are Kalman Fitler, AR Model and Neural Networks models are used to determine the success of each method for correct wind prediction. Statistical methods' preditictions as time series are included and the similartiy rates are compared for each method. The algorithms which are performed in MATLAB, gave the similarity results of each model. According to the Neural Networks results which are found to be the most successful method for prediction within these three statistical models, the windspeed similarity rate between the original measurements and the prediction set which includes 1 year period between 2003 and 2004, is evaluated as % 94.7. For wind direction, the similarity rate is %81.61. High noise margin and ability to learn the characteristics of the signal are important advantages of Neural Networks for compatible windspeed and direction predictions compared with measurements.