System identification, fuzzy control and simulation of a kite power system with fixed tether length

AMR MOHAMED METWALLY ISMAIEL ,Tarek N Dief, Uwe Fechner, Roland Schmehl, Shigeo Yoshida, Amr M Halawa

Abstract

In wind energy research, airborne wind energy systems are one of the promising energy sources in the near future. They can extract more energy from high altitude wind currents compared to conventional wind turbines. This can be achieved with the aid of aerodynamic lift generated by a wing tethered to the ground. Significant savings in investment costs and overall system mass would be obtained since no tower is required. To solve the problems of wind speed uncertainty and kite deflections throughout the flight, system identification is required. Consequently, the kite governing equations can be accurately described. In this work, a simple model was presented for a tether with a fixed length and compared to another model for parameter estimation. In addition, for the purpose of stabilizing the system, fuzzy control was also applied. The design of the controller was based on the concept of Mamdani. Due to its robustness, fuzzy control can cover a wider range of different wind conditions compared to the classical controller. Finally, system identification was compared to the simple model at various wind speeds, which helps to tune the fuzzy control parameters

Wind Energy Science 2018, May

Future University In Egypt (http://www.fue.edu.eg)

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