

Modelling and control of an inverted pendulum turbine

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INTRODUCTION

The wind energy is one of the most important and developed sustainable energy sources. One of its drawbacks is the large initial investment in the wind turbine. A significant part of the total cost of a wind turbine accounts on the tower since it has to be very stiff to stand the forces induced by the wind. If the turbine is left free to lean forward, this forces can be dynamically compensated by the gravitational force of the tower itself resulting in a lighter structure. The modelling and control of these futuristic wind turbine is developed in this project.

MODELLING

Having a good model is crucial for studying the stability and the performance of the wind turbine as to get a proper control of it. Having as an initial reference a conventional model of a wind turbine, and then adding an extra degree of freedom, the inclination of the tower, we will make a similar effect to having a hinge in the bottom of the tower. A mathematical model of the inverted pendulum turbine has been obtained.

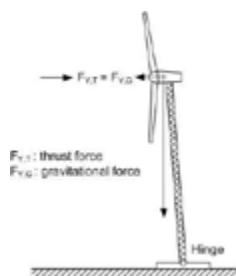


Figure 1 Inverted pendulum turbine

CONTROLLING

Without active control, the turbine would simply collapse. The control law has been designed in order to maximize the generated electrical power while keeping the turbine in an appropriate inclination that avoids the collapse of the tower. It is important to highlight that the implemented control uses the same control variables as the current wind turbines.

CONCLUSIONS

This project studies the feasibility of this uncommon wind turbine system design but also promotes sustainable energy and opens a wide range of new implementations in the world of wind turbines, like the offshore floating support structure wind turbines that would allow to place wind parks in zones with deep sea grounds.