

## OBSERVER DESIGN BASED IN THE MATHEMATICAL MODEL OF A WIND TURBINE

JOSE DE JESUS RUBIO<sup>1</sup>, MARICELA FIGUEROA<sup>1</sup>, JAIME PACHECO<sup>1</sup>  
AND MANUEL JIMENEZ-LIZARRAGA<sup>2</sup>

<sup>1</sup>Instituto Politecnico Nacional – ESIME Azcapotzalco  
Seccion de Estudios de Posgrado e Investigacion  
Av. de las Granjas No. 682, Col. Santa Catarina, Mexico D.F. 02250, Mexico  
jrubioa@ipn.mx

<sup>2</sup>School of Physical and and Mathematical Sciences  
Autonomous University of Nuevo Leon  
San Nicolas de los Garza Nuevo Leon, Mexico  
manalejimenez@yahoo.com

Received July 2010; revised November 2010

**ABSTRACT.** *As a result of increasing environmental concern, the impact of conventional electricity generation on the environment is being minimized and efforts are being made to generate electricity from renewable sources. One way of generating electricity from renewable sources is to use wind turbines that convert the energy contained in flowing air into electricity. The major contributions of this paper are as follows: 1) The mathematical model of a prototype of a wind turbine is presented. This mathematical model is obtained by using the Euler Lagrange method and the circuits theory. The data of a prototype are used for the simulations of the obtained model. The prototype is a windward wind turbine of three blades. 2) An observer to see the angular position of a blade and the angular velocity of a blade using the armature current in the wind turbine is proposed, and this observer is important because it is easy to have the measure of the third, but it is difficult to have the measure of the first and the second. 3) It is proven that the state error of the observer applied to the nonlinear model is exponentially stable. The stability of the proposed observer is based on the solution of the Lyapunov method.*

**Keywords:** Mathematical model, Wind turbine, Observer, Stability

**1. Introduction.** As a result of increasing environmental concern, the impact of conventional electricity generation on the environment is being minimized and efforts are being made to generate electricity from renewable sources. One way of generating electricity from renewable sources is to use wind turbines that convert the energy contained in flowing air into electricity [26].

Up to this moment, the amount of wind power generation integrated into large-scale electrical power systems only covers a small part of the total power system load. However, a tendency to increase the amount of electricity generated from wind can be observed. Therefore, the penetration of wind turbines in electrical power systems will increase and they may begin to influence overall power system behavior [26].

Researchers are often trying to improve the total power. The dynamic model of a wind turbine plays an important role in the control of this system, and the control plays an important role to improve the total power of the wind turbine. However, these control systems only perform to their potential if they have access to the accurate information about the wind turbine behavior in real time.