International Journal of Innovative Computing, Information and Control
Volume **6**, Number **4**, April **2010**
ICIC International ©2010 ISSN 1349-4198
pp. 1925–1933

ROBUST VARIABLE SPEED CONTROL OF A WIND TURBINE

Leonardo Acho[1], Yolanda Vidal[2] and Francesc Pozo[1]
[1]CoDAlab, Escola Universitària d'Enginyeria Tècnica Industrial de Barcelona
[2]LaCàN, Escola Universitària d'Enginyeria Tècnica Industrial de Barcelona
Universitat Politècnica de Catalunya
Comte d'Urgell, 187, 08036 Barcelona, Spain
{ leonardo.acho; yolanda.vidal; francesc.pozo }@upc.edu

Received September 2008; revised February 2009

Abstract. *This paper presents a robust control design for variable speed control of a two-bladed horizontal axis wind turbine similar to the DOE MOD-0 model. Robustness is achieved by introducing a sign term to the dynamic error. To simulate numerical experiments that closely approximate the reality, a dynamic oscillator is employed as a source of a time varying wind speed signal.*
Keywords: Wind turbine, Robust control, Variable speed control, White noise

1. **Introduction.** Variable speed control of wind turbines has been studied extensively in order to maximize energy extraction from the wind (see, for instance, [4] and [15], and references therein). There are two types of wind control for turbines, termed constant speed control and variable speed control [7]. Due to external perturbations, such as random wind fluctuations, wind shear and tower shadows, variable speed control seems to be the trusted option to optimize the operation of wind turbines [17]. Moreover, these external perturbations can excite the oscillation mode of the mechanical system of the turbine, requiring a robust controller to mitigate the effects [4]. Principal turbine configurations include the doubly-fed induction generator with voltage source converter [14], the grid-connected double-output induction generator [4], and the two-bladed horizontal axis similar to the DOE MOD-0 [15]. In this work, we use the DOE MOD-0 turbine configuration to design a robust variable speed control. The controller forces the rotor speed to track a desired speed reference signal chosen according to the fundamental operating modes.

From the point of view of control design, the proposed controller belongs to the class of chattering controllers previously developed for mechanical systems with friction [10]. Although there exist other alternatives for robust control design, like H_∞ controllers and fuzzy techniques [1,6,16], or even robust controllers based on sliding model control [8], we prefer to keep the line of chattering control design because of its simplicity. In this sense, chattering controllers have been proven to be robust against model variation and external perturbations. This robustness quality is attractive for wind control due to the stochastic wind variation and the uncertainties introduced in modeling for control design. To validate the performance of the proposed controller, a dynamic wind model has also been developed. This model is based on employing an harmonic oscillator with an additive white noise to capture some stochastic behavior of the wind perturbation. In the numerical simulations, the robustness of the proposed controller is compared with the performance of the controller given in [15]. According to these numerical experiments, the proposed controller appears to be robust in the presence of parameter uncertainties and stochastic wind variation. Furthermore, our chattering controller appears to reject