

# Preface

This book is written in a somewhat tutorial style suitable for engineering students and professionals who are working with wind energy. It is also intended to be used by anyone with a good background in mathematics and physics who wants to be an expert in the field of wind energy.

This is a comprehensive approach to stabilizing a wind farm that may consist of fixed or variable speed wind turbine generator systems. This book provides advanced technical depth on wind turbine generator systems considering both mechanical and electrical sections. In the mechanical section, wind turbine drive train modeling and pitch control are emphasized. On the other hand, the electrical section is enriched with different types of facts controllers that can be adopted at a wind farm terminal.

Most of the chapters of the book are centered on a particular tool applicable to a wind farm. Besides the general discussion on the tool, detailed modeling and a control strategy for that system are discussed. The chapters are not limited to modeling and control systems of different types of tools, but incorporate extensive simulation results that will be very helpful to students. For the simulation analysis, the most popular digital simulator for power system, named PSCAD/EMTDC is used.

Chapter 1 consists of a general discussion on the recent status of wind power worldwide and some recent technological overviews on wind turbine generator systems. Chapter 2 discusses the modeling of both fixed and variable speed wind turbine including the drive train. Chapter 3 is focused on the design and control of different types of pitch controllers. Power smoothing of a wind turbine generator system by using pitch controller is a salient feature of this chapter. In Chap. 4, the STATCOM is emphasized for use with a fixed speed wind farm. Chapter 5, the heart of this book, focuses on different types of energy storage systems suitable for wind power application. In Chap. 6, hydrogen generation using wind power is described. Chapter 7 is related to both Chapters 5 and 6. A new wind farm operating strategy integrating an energy storage system and a hydrogen generator is pre-

sented, including detailed modeling and a control strategy. Wind power and terminal voltage smoothing of a wind farm are the salient features of this chapter. In Chap. 8, the stability analysis of variable speed wind turbine driving a permanent magnet synchronous generator is emphasized. The Appendix and the reference list are shown in Chap. 9 and Chap. 10 respectively.

In this book, one may find the essence of fixed and variable speed wind turbine generator systems, pitch control, hydrogen generation, etc. Significant technical depth can also be obtained on the energy storage systems (ESS) such as superconducting magnetic energy storage (SMES) system, energy capacitor system (ECS), flywheel energy storage system (FESS), and STATCOM/BESS, which can be integrated at the wind farm terminal.

Stability Augmentation of a Grid-connected Wind Farm

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