Dynamic Models of GE DFAG Wind Turbine Model in Power System Toolbox

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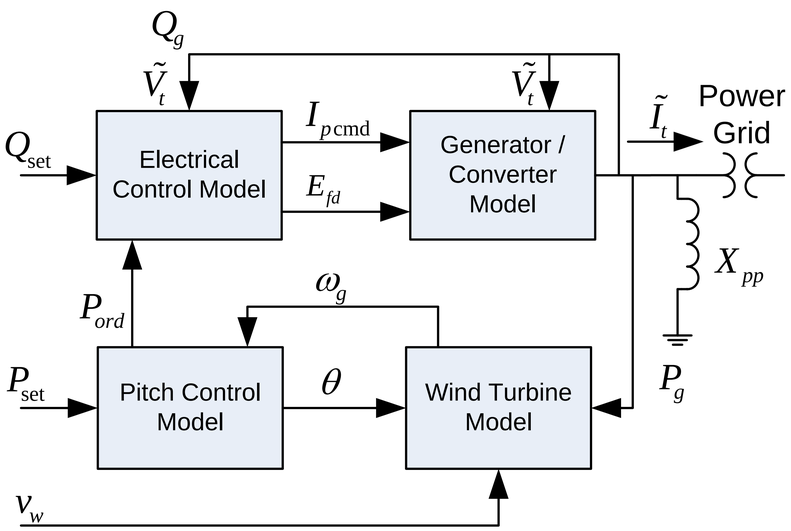
Introduction

- This poster presents the work done to date on the modeling of Wind Turbine Generators (WTG) with the purpose of being used in future stability studies.
- A dynamic model of a WTG Type-3 (doubly-fed asynchronous generator) was implemented on the Power System Toolbox (PST), a MATLAB-based software package available for university research.
- Based on the GE Simulink model for Type-3 WT developed by Dr. Juan Sanchez-Gasca, which is similar to the WECC generic model. (See also K. Clark, N. W. Miller, and Juan "Modeling of GE Wind Turbine-Generators for Grid Studies," version 4.4, 2009.

Wind Turbine Generator Model

GE DFAG module is decomposed in **four** major **modules**



Wind Turbine Module

- Obtains mechanical power from wind pattern
- Has the dynamics of the WT generator

Pitch Control Module

Contains the dynamics that govern:

- Blade pitch angle
- Reference speed (normally 1.2pu)
- Power Command Signal

Generator/Converter Model

- Only module that interacts with the grid
- Injects current to the grid acting as a current source equivalent
- Monitors the terminal voltage (in magnitude and angle)

Electrical Control Model

- Monitors Q_{gen} and $|\tilde{V}_t|$ to meet the desired reactive power control.
- Sets the dynamics of the voltage and current signal commands.

PST Model

Three steps performed in a PST simulation

Initialization

- Initialize state variables from the loadflow of the system.
- Based on algebraic equations stemmed from the steady state differential equations.

Dynamic Computation

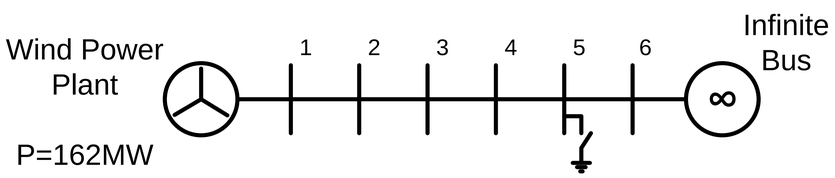
- Solves the DE describing the WT model (and the DE of other components present in the system)

Network Interface

- Accounts for the effect of model outputs into the system
- Propagates to PST dynamic models (such as the WT) the impact of system faults

Model Validation

Test system used to validate the model



Model validated in two ways

- Different wind profiles (wind gusts)
- System faults

- Results obtained from the wind turbine model in response to a **wind gust**

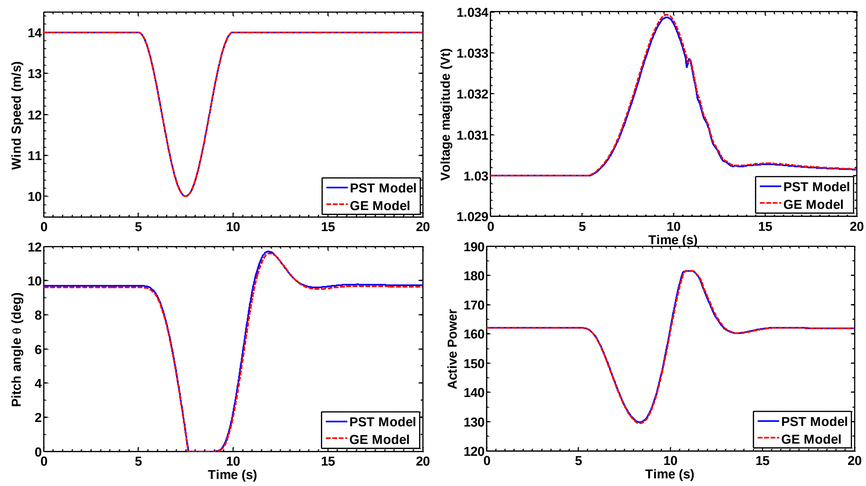


Figure 1.

- Response of the wind turbine to a **three-phase to ground fault** occurred at bus 5.

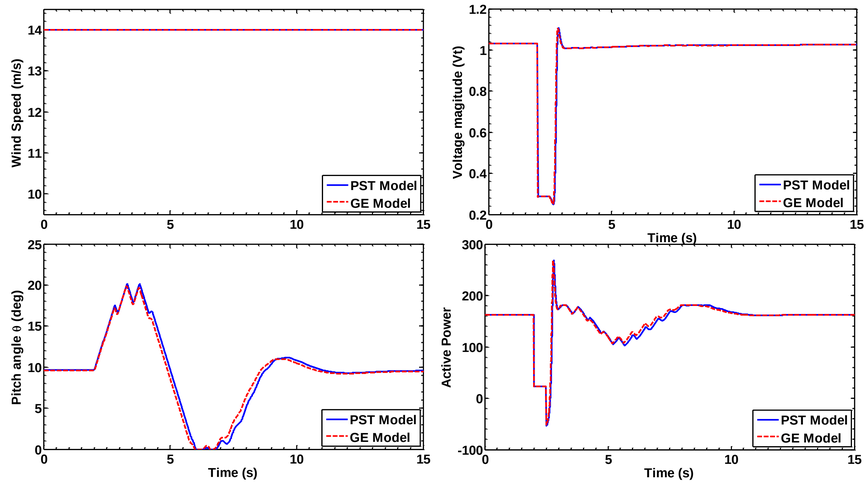


Figure 2.

Current and Future Work

- Implement in PST the model for a Type-4 (full converter) WTG. To be done based on the Type-3 model.
- Run stability simulations on networks containing WT as a source of generation.
- Research on the impact of different wind profiles on system stability (frequency and voltage).