

**SMALL-SIGNAL STABILITY ASSESSMENT  
USING A  
DYNAMIC PHASOR APPROACH:  
A CASE STUDY OF A 2MVA WIND POWER PLANT**

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Thesis/Dissertation submitted in partial fulfilment of the requirements for the degree  
Master of Science in Electrical Installation

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March 2019

## DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the Master thesis under my supervision.

Signature of the supervisor:

**Dr. W. D. Prasad**

Date:

## **DEDICATION**

This work is dedicated to my beloved parents, Mr: Samarapala Kahawidane and Mrs: Chandra Piyawathi.

## ACKNOWLEDGMENT

I would like to sincerely thank my internal supervisor, Dr. W.D. Prasad (Department of Electrical Engineering, University of Moratuwa) for the continuous support provided throughout my research. If that guidance, encouragement and expertise knowledge in the theoretical side is not there, I would not be able to finish my work in time.

My batch mate Eng. Roshan Akarawita (Windforce.Pvt.Ltd) helped me a lot by providing data on wind power plants in Puttalam area and providing details on Sri Lankan wind power generation. I would also like to thank him for the support that he has given, even with his busy schedule.

For my simulation work and calculations, computer laboratory of Electrical Engineering Department, University of Moratuwa helped me providing PSCAD and MATLAB software access. Also for the literature analysis I got the access to the IEEE library through the computer laboratory. I would be grateful for the support made by the friendlier staff by letting me the access to the laboratory whenever necessary.

Last but not least I would like to offer my sincere gratitude to my parents who had backed me and encouraged me throw-out the research period.

## Abstract

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Due to the technical development, support from the green energy enthusiasts and relative cost attractiveness wind energy harvesting has turn into one of the most popular renewable energy sources nowadays. When considered together with wind power plants, other power plants and transmission lines; power system has become a dynamic system which includes non-linear elements. Evaluating non-linear system with linearized method may not be sufficient to evaluate the system. Hence, advanced linear mathematical model is needed to study the wind plants connected to the grid and its oscillations. In this research, a linearized model developed with dynamic phasor approach combined with conventional small signal stability analysis is presented to analyze wind power system. The model developed is compatible with type 4 wind power plants in any capacity and can be adopted in any power system where system specifications are known.

With the help of 2MVA test system; model validation, stability analysis and a sensitivity analysis using participation factors will be carried out in order to identify dominant oscillations introduced to the grid from the plant.

**Keywords:** wind turbines, small signal stability analysis, dynamic phasors, linearized model, model validation, sensitivity analysis, participation factors

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## List of Abbreviations

<b>Abbreviation</b>	<b>Description</b>
NE	North East
SW	South West
CEB	Ceylon Electricity Board
NREL	National Renewable Energy Laboratory
SEA	Sustainable Energy Authority
ADB	Asian Development Bank
DFIG	Doubly-Fed Induction Generators
SSI	Sub-Synchronous Interaction
VSC	Voltage Source Converter
PMSG	Permanent Magnet Synchronous Generator
GSC	Generator Side Converter
VSI	Voltage Source Inverter
TSR	Tip Speed Ratio
PWM	Pulse-Width Modulation
MPPT	Maximum Power Point Tracking
IGBT	Insulated-Gate Bipolar Transistor