Modelling and Simulation of Power Electronic Converters using KiCAD and ngSPICE

A Progress Report submitted in partial fulfilment

of the requirements for the degree of

Bachelor of Technology

in

Electrical Engineering

by

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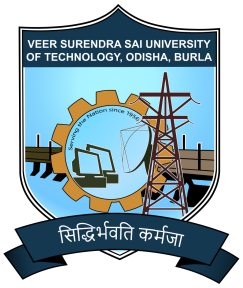

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Dept. of Electrical Engineering

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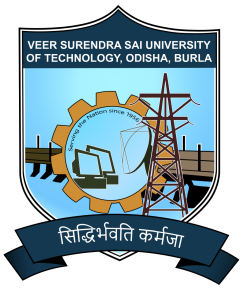

CERTIFICATE

This is to certify that the work contained in the Project Work entitled **"Modelling and Simulation of Power Electronic Converters using KiCAD and ngSPICE"**, submitted by **Subha Biswal** (Regd. No.: 1704050016) for the award of the degree of master of Technology in Electrical Engineering during the Academic Year 2021-2022 to the **Veer Surendra Sai University of Technology, Burla**, is a record of bonafide research work carried out by him under my direct supervision and guidance.

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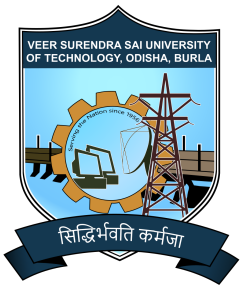

CERTIFICATE OF APPROVAL*

This is to certify that we have examined the dissertation entitled **"EVALUATION OF CATASTROPHIC INDICATOR FOR POWER SYSTEM STABILITY ASSESSMENT"**, submitted by **Subha Biswal** (Regd. No.: 1704050016) in partial fulfillment for the degree of **Master of Technology** with specialization in **Power System Engineering** at the Department of Electrical Engineering of **Veer Surendra Sai University of Technology, Burla, Odisha.**

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Subha Biswal (1704050016)

ABSTRACT

Though broad work is accounted for on different catastrophic indicators for the appraisal of power system stability, the relative evaluation has not gotten a lot of consideration by the analysts. With the approach of wide area management system (WAMS) innovation and close to real-time instruments accessible, these indicators can assume a significant part in operation and control of the framework. Indicator's choice depends on various performance deciding factors like accuracy, security, mis-detection, reliability and false-alarm), which utilize a typical stage for assessment. The methodology begins by producing a contingency dataset of an organization, trailed by acquiring the organization estimations to the contingency dataset. These estimations are utilized as a contribution to the indicators for recognizing stability or instability cases. The performance measures are processed to every indicator for their appraisal. Notwithstanding the above performance measures, strength and affectability are acquired to every pointer. Ongoing work has reached till getting curves for the variety of generator angles regarding the system COI. Additionally, IEEE 10 bus 4 generator system and IEEE 145 bus 50 bus generator are used for observing the procedure.

Keywords:

Contents

List of Figures

List of Tables

Some Important Abbreviations

AHP	Analytical Hierarchy Process
ACM	Approved Consolidated Methodology (CDM)
AMS	Approved Methodology for Small scale projects
Beta-PD	Beta probability distribution
BAU	Business-as-usual
CA	Cost Additionality
CCV	Coefficient of variation of cost
CDF	Cumulative Distribution Function
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CF	Capacity Factor
CO	Compromise solution
CS	Cost Savings
DFIG	Doubly Fed Induction Generator
EA	Emission Additionality
ECV	Coefficient of variation of emission
ED	Economic Dispatch
EED	Economic Emission Despatch
ER	Emission Reduction
EF	Emission Factor
FACTS	Flexible AC Transmission System
GOF	Goodness-of-fit test
GSC	Grid side converter

JM	Justus and Mikhail
IC	Installed Capacity
IPM	Interior Point Method
MC	Minimum Cost solution
MCDA	multi-criteria decision analysis
MCS	Monte Carlo Simulation
ME	Minimum Emission solution
MO	Multi-objective solution
PD	Probability Distribution
PDF	Probability Distribution Function
PLA	Real Power Loss Additionality
PLCV	Coefficient of variation of P_{loss}
PEM	Point Estimate Method
QLA	Reactive Power Loss Additionality
QLCV	Coefficient of variation of Q_{loss}
RES	Renewable Energy Sources
RSC	Rotor side converter
RV	Random variable
SD	Standard deviation
TG	Thermal generator
TPP	Thermal Power Plant
VWS	VSSUT weather station
VPL	Valve point loading
W-PD	Weibull probability distribution
WES	Wind energy share
WG	wind generator
WRA	Wind Resource Assessment
WSC	Wind Shear Coefficient
WSF	Wind Speed Forecasting
WTPC	Wind Turbine Power Curve

Chapter 1

Introduction

1.1 Introduction

1.2 Project Motivation

ion V enumerates the conclusions drawn from this work.

1.3 Objective of the Work

- Objective-1
-
-
-

1.4 Report Organisation

Chapter 2 Explains the basics of

Chapter 3 Tells about the

Chapter 4 Deals with the results of

Chapter 5 Highlighted the conclusion based on project and future scope based on present thesis.

Chapter 2

Overview of Power Electronic Converters

2.1 Power electronic components

2.1.1 BJT

The details of modelling BJT can be found in [1].

2.1.2 MOSFET

2.1.3 IGBT

2.2 3-phase rectifier

2.3 Buck Converter

2.3.1 Principle of operation

2.4 Boost Converter

Chapter 3

Software Description

3.1 KiCAD

3.2 ngSPICE

Chapter 4

Results and Discussion

4.1 Modelling of Components

4.2 Simulation Results

4.3 Discussion

TABLE 4.1: Pertaining to Q1 on LOLE

Unit No.	Capacity	Failure rate	Repair Rate	FOR
	(MW)	(f/day)	(r/day)	
1	25	0.01	0.49	0.02
2	25	0.01	0.49	0.02
3	50	0.01	0.49	0.02

TABLE 4.2: Load Data to Q1 on LOLE

Daily Peak Load	57	52	46	41	34
No of occurrences	12	83	107	116	47

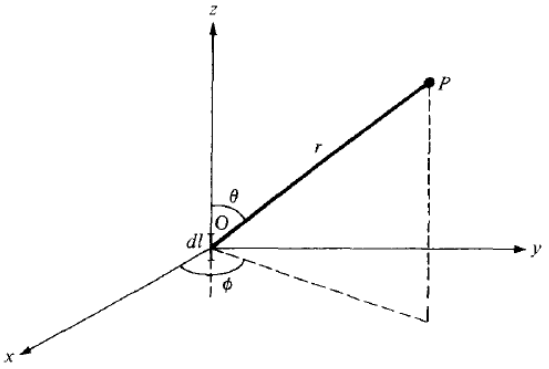

FIGURE 4.1: A Hertzian Dipole

Chapter 5

Conclusions and future scope

5.1 Conclusion

5.2 Future Scope

References

[1] R. D. Zimmerman, C. E. Murillo-Sánchez and R. J. Thomas, "MATPOWER: Steady-State Operations, Planning, and Analysis Tools for Power Systems Research and Education," in IEEE Transactions on Power Systems, vol. 26, no. 1, pp. 12-19, Feb. 2011, doi: 10.1109/TPWRS.2010.2051168.

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