AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Computer Engineering and Systems

Machine Learning Techniques for mitigating voltage collapse

A Thesis submitted in partial fulfilment of the requirements of the degree of
Master of Science In Electrical Engineering
(Computer Engineering and Systems)

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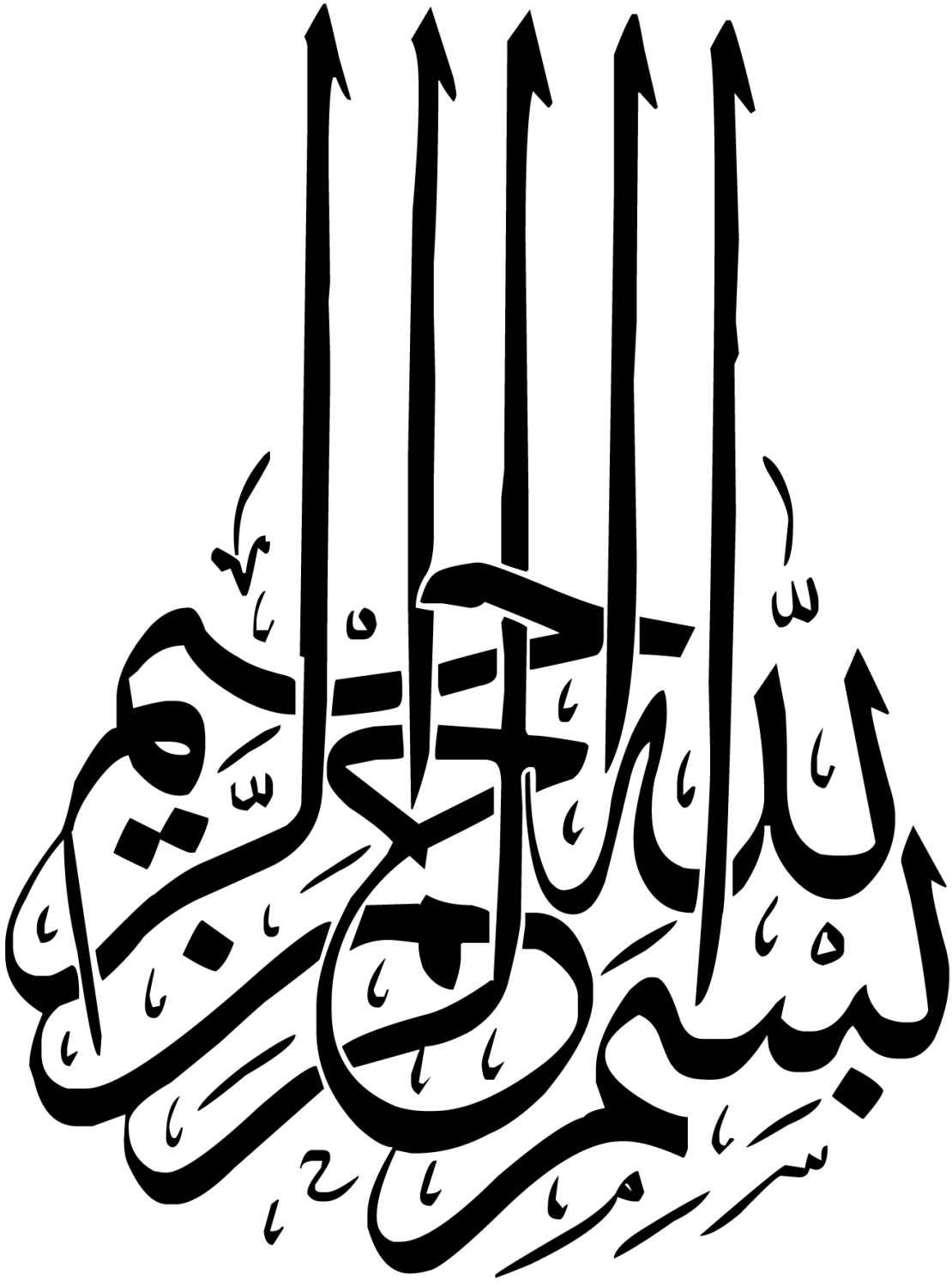
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Bachelor of Science In Electrical Engineering
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Date: 25 February 2018

Statement

This thesis is submitted as a partial fulfillment of Master of Science in Electrical Engineering Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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“I dedicate this work to my little princes Layan Mohamed”

Mohamed Usama Shahat Abd Elmaged.
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Abstract

In the power system, the instantaneous and permanent stability is a major requirement that cannot be overlooked. Because of the power grid large-scale systems, any disturbance anywhere on the power grid could pose a reason of an overall dynamic imbalance. Major consequences could be occurred to the electricity feeding across wide areas of country which is called partial blackout, even entire country which is called overall blackout. It is perhaps for this reason that the existence voltage stability indices which indicate the power grid system stability level is very essential. knowing the voltage stability level of the transmission lines that involves the power grid in real time (online operation) , the voltage stability of the entire power grid could be obtained easily . There are several mathematical base voltage indices. But in this proposal, another voltage stability index will be build based on the machine learning techniques to mitigate the voltage collapse phenomenon. This predictor is proposed in transient stability analysis based on machine learning techniques such as (Linear regression, neural network, and Decision tree). This predictor is built after a comparison was made between the impacts of various machine learning algorithms using different datasets. Three different mathematical voltage stability indices (FVSI, Lmn, and NLSI) had been used to prepare datasets for the training purpose. An early warning system had been built based on the proposed predictor. This early warning system could be used to inform the system operator with the hazards of voltage instability issues in the electric power grid and visualize these hazards. The E.W.M (Early warning module) had then been used as a kernel to build V.S.A.M.A (Voltage Stability Automatic Maneuver Algorithm) that can handle the voltage instability issue.

Several tools had been used to obtain and implement the V.S.A.M.A .The Power World Simulation tool had been used as a simulator of the electric power grid (IEEE 9-Bus system). The RapidMiner Studio had been used to build the predictors that can evaluate the stability of transmission lines of the electric power grid. Finally, the Matlab had been used to implement the visualizer, the voltage instability predictor and the proposed algorithm (V.S.A.M.A).

Key Words: Decision tree, Early warning, Line stability index, Linear regression, Maneuver algorithm, Neural network, Predictive analysis , Predictive modeling , Predictors , RapidMiner programming, Voltage stability.

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List of Abbreviations

SCADA	Supervisory Control And Data Acquisition
NCC	National Control Center
RCC	Regional Control Center
VSAMA	Voltage Stability Automatic Maneuver Algorithm
VSIS	Voltage Stability Indices
CPF	Continuation Power flow
FVSI	Fast Voltage Stability Indices
LMN	Line Stability Index
NLSI	Novel Line Stability Index
LQP	Line Stability Factor
LVSI	Line Voltage Stability Index
NVSI	Novel Voltage Stability Index
LP	Line Stability Index
PTSI	Power Transfer Stability Index
VSI_1	Voltage Stability Index
VSLI	Voltage Stability Load Index
WSCC	Western System Coordinating Council
LF	Load Flow
ML	Machine Learning
MLR	Multiple Linear Regression
KDD	Knowledge Discovery In Databases
OPF	Optimal Power Flow
SQL	Structured Query Language
RTU	Remote Terminal Unit
CRCC	Regional Control Center
CAN-RCC	Canal Regional Control Center
ARCC	Alexandria Regional Control Center
WRCC	West Delta Regional Control Center
SRCC	South Upper Egypt Regional Control Center
CN	Cairo North

CE	Cairo East
CW	Cairo West
CS	Cairo South
PU	Per-Unit System
EWM	Visualizer And Early Warning Module