

Mona Maghraby



# بسم الله الرحمن الرحيم

مركز الشبكات وتكنولوجيا المعلومات

قسم التوثيق الإلكتروني



Mona Maghraby



# جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها  
على هذه الأقراص المدمجة قد أعدت دون أية تغييرات





Cairo University

# **IMPROVING DISTANCE RELAY PERFORMANCE FOR STATCOM- COMPENSATED TRANSMISSION LINES**

By

**Ali Hussein Hadi Alkhalil**

A thesis submitted to the

Faculty of Engineering at Cairo University

In Partial Fulfillment of the

Requirements for the Degree of

**DOCTOR OF PHILOSOPHY**

In

**Electrical Power and Machines Engineering**

**FACULTY OF ENGINEERING, CAIRO UNIVERSITY**

**GIZA, EGYPT**

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Electrical Power and Machines Department

Faculty of Engineering, Cairo University

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Approved by the

Examining Committee

---

**Prof. Dr. Mahmoud Ibrahim Gilany**

Thesis Main Advisor

---

**Prof. Dr. Essam El Din Abou El Zahab**

Internal Examiner

---

**Prof. Dr. Mohamed Abdel Fattah Farahat**

External Examiner

Head of Electrical Power & Machines

Engineering Dept. - Faculty of Engineering -

Zagazig University

---

**FACULTY OF ENGINEERING, CAIRO UNIVERSITY**

**GIZA, EGYPT**

**2019**

**Engineer:** Ali Hussein Hadi Alkhalil  
**Date of Birth:** 26 / 3 / 1977  
**Nationality:** Iraqi  
**E-mail:** ali.aljoboury1977@gmail.com  
**Phone. :** +201006863087/+9647827810330  
**Address:** Cairo – Maadi – Egypt  
**Registration Date:** 01 / 3 / 2016  
**Awarding Date:** / / 2019  
**Degree:** Doctor of Philosophy  
**Department:** Electrical Power and Machines Engineering



**Supervisor:**  
**Prof. Dr. Mahmoud Ibrahim Gilany**

**Examiners:** Prof. Dr. Mahmoud Ibrahim Gilany  
Prof. Dr. Essam El Din Abou El Zahab  
Prof. Dr. Mohamed Abdel Fattah Farahat (Zagazig University)

**TITLE OF THESIS: Improving Distance Relay Performance for  
STATCOM- Compensated Transmission Lines.**

**Key Words:** Improved Mho Distance Rely, STATCOM Device, SPMUs, Fault Resistance Estimation, Fault Location Calculation.

**Summary:**

This thesis proposes a new technique for estimating an accurate apparent impedance in systems equipped with STATCOM device at its midpoint. The main goal of this thesis is to eliminate the impacts of both the shunt current of the STATCOM device and the fault resistance on apparent impedance calculation in order to obtain accurate fault distance. The technique depends on synchronizing phasors measurement units (SPMUs) to transmitted data from the midpoint connection and from the receiving end to the relay at sending end. The fault resistance is mathematically calculated based on active power values at sending and receiving ends. Unlike the published methods, which are valid only if the fault resistance is much larger than the TL resistance, the proposed method is valid whatever the value of fault resistance compared to the TL resistance. Moreover, the proposed method is valid for both ground and phase faults.

The proposed algorithm is extensively investigated on part of a 400 kV, 50 Hz power grid consists two series transmission lines with three generating sources. The STATCOM FACTS device is assumed to be connected at midpoint of line. The achieved results ensure the effectiveness of the proposed method.

## **Disclaimer**

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name:

Date:

Signature:

## Dedication:

My dear parents, My lovely  
Wife, My brothers and My  
children “Baneen”, “Mustafa”  
“Taha”, and “Hussein”.

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