



**PhD in Information Technology and Electrical Engineering**  
Università degli Studi di Napoli Federico II

**PhD Student: Nagananthini Ravichandran**

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Cycle: XXXVII

**Training and Research Activities Report**

**Year: FIRST**

*R. Ravichandran*

**Tutor: Prof. Amedeo Andreotti**

*Amedeo Andreotti*

**Co-Tutor: Prof. Daniela Proto**

*Daniela Proto*

**Date: November 2, 2022**

# Training and Research Activities Report

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Cycle:

Author:

## 1. Information:

- PhD student: Nagananthini Ravichandran
- DR number: DR996074
- Date of birth: 26.11.1993
- Master Science degree: Electrical Engineering - Power Electronics and Drives
- University: Anna University, Tamil Nadu, India
- Doctoral Cycle: XXXVII
- Scholarship type: UNINA
- Tutor: Prof. Amedeo Andreotti
- Co-tutor: Prof. Daniela Proto

## 2. Study and training activities:

Activity	Type <sup>1</sup>	Hours	Credits	Dates	Organizer	Certificate <sup>2</sup>
Matrix Analysis for Signal Processing with MATLAB Examples	Course	8	2	22/03/2022 - 07/04/2022	Prof. Antonio De Maio - DIETI	Y
Lectures on Computational Linguistics 2022	PhD School	19	3	08/06/2022 - 10/06/2022	AILC, DIETI	Y
Big Data Architecture and Analysis	Course	14	5	06/04/2022 - 11/05/2022	Proff. Giancarlo Sperli	Y
Statistical data analysis for science and engineering research	Course	12	4	22/03/2022 - 07/04/2022	Prof. Roberto Pietrantuono - DIETI	N
Machine Learning for Science and Engineering Research	Course	20	5	20/06/2022 - 01/07/2022	Proff. A. Corazza, DIETI	Y
Sustainable ship for the energy transition of maritime transport	Course	10	4	22/09/2022 - 20/10/2022	Prof. Adriano Masone, DIETI	N
Operational Research: Mathematical Modelling, Methods and Software Tools for Optimization Problems	Course	10	4	14/09/2022 - 12/10/2022	Prof. Tommaso Coppola, DIETI	Y
Global And Cluster Synchronization in Complex Networks and Beyond	Seminar	1.5	0.3	10/03/2022	SCIENTIFIC COLLOQUIA AT SSM	Y
Itay Tirosh - Dissecting glioblastoma by single cell RNA-seq	Seminar	1	0.2	11/03/2022	UNINA	Y
Potential and	Seminar	1	0.2	06/04/2022	UNINA	Y

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challenges of next generation railway signaling systems: Moving Block and Virtual Coupling						
Ethics and Politics of A	Seminar	2	0.4	11/04/2022	UNINA	Y
Explainable Natural Language Inference An Introduction to Deep Learning for Natural Language Processing	Seminar	2.5	0.5	13/04/2022	UNINA	Y
Using Delays for Control	Seminar	2	0.4	21/04/2022 & 28/04/2022	UNINA	Y
Towards AI-Driven Cancer Precision Medicine	Seminar	1	0.2	22/04/2022	UNINA	Y
On using simple optimization techniques for tuning of UAVs	Seminar	2	0.4	27/04/2022	UNINA	Y
Population and medical genomics applications to human traits and diseases	Seminar	1	0.2	29/04/2022	UNINA	N
Drive Converters as Ultra-fast Chargers In An Industrial Scenario Of Heavy-duty EV Mobility Development	Seminar	2	0.4	29/04/2022	UNINA	Y
Fixed Wireless Access	Seminar	6.5	1	17/05/2022	UNINA	Y

- 1) Courses, Seminar, Doctoral School, Research, Tutorship
- 2) Choose: Y or N

## 2.1. Study and training activities - credits earned

	Courses	Seminars	Research	Tutorship	Total
Bimonth 1	0	0	10	0	10
Bimonth 2	0	0	6	0	6
Bimonth 3	6	3.2	4	0	13.2
Bimonth 4	8	1	10	0	19
Bimonth 5	5	0	10	0	15
Bimonth 6	8	0	2	0	10
<b>Total</b>	27	4.2	42	0	73.2

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Expected	30 - 70	10 - 30	80 - 140	0 - 4.8	
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### 3. Research activity:

The power quality issues are fundamental and need to be addressed with precise solutions for reliable operation. Voltage sags, transients, permanent interruptions, and temporary interruptions are the issues, and lightning events are major cause factors for all these issues. Lightning-produced overvoltages (LPOV) on the phase conductors are from direct lightning events and lightning overvoltages (LIOV) are from indirect lightning events on the ground at a distance away from the power lines. These lightning overvoltages on overhead phase conductors cause insulation failures which are followed by high replacement costs and subsequent outages of grids. Thus, an accurate analytical formulation and numerical modeling of LPOV and LIOV are important. Eventually, an effective lightning protection system to improve lightning performance is of equal importance for the uninterrupted operation of the grid.

#### 3.1 Analytical formulation of Lightning Induced and lightning produced overvoltage

Among analytical expressions in calculating the lightning overvoltages, a simpler and more unrealistic configuration has been solved using approximate models. The objective of the research is the extension of work started in [1]. The aim of this study is

- To solve lightning-induced and lightning-produced overvoltages in an exact way with accurate and realistic analytical expression in terms of impulse current excited by an external field [2,3].
- To analyze the performance with real-time implementation on the Portobuffolé network

#### 3.2 Mitigation Solution and Optimal Strategies

Lightning protection devices like surge arresters, shield wires, and underbuilt shield wires are used to mitigate the insulation failure and flash-over rate caused by direct and indirect lightning events. An economical and effective solution to protect the electrical network components from lightning events is to either optimally locate the protection devices or hybridize them with other types [4,5]. The aim of the study is as follows:

- To formulate an economical and effective solution to protect the system from the impacts of LPOV and LIOV by optimal location of surge arrester through a probabilistic multiobjective constraint optimization problem.
- To analyze the response of LIOV and LPOV by hybridizing the system with optimally located surge arresters along with shield wires or underbuilt shield wires and finally validate in the real network (Portobuffolé).

#### 3.3 Network Modelling

A suitable network is identified and implemented in EMTP software to analyze LPOV for direct lightning events. The modelled network will be used for applying a strategy for the optimal allocation of surge arresters.

The optimization constraints are analyzed from previous research and the implementation method to minimize the risk of failure and cost is identified.

The LPOV calculation based on the amplitude of the lightning current is simulated using MATLAB which is to be followed for the LIOV.

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## References

- 1) Andreotti, A., Assante, D., Mottola, F. and Verolino, L., 2009. An exact closed-form solution for lightning-induced overvoltages calculations. *IEEE transactions on power delivery*, 24(3), pp.1328-1343.
- 2) Andreotti, A., Pierno, A., Rakov, V.A. and Verolino, L., 2012. Analytical formulations for lightning-induced voltage calculations. *IEEE transactions on electromagnetic compatibility*, 55(1), pp.109-123.
- 3) Andreotti, A., Pierno, A. and Rakov, V.A., 2013. An analytical approach to calculation of lightning induced voltages on overhead lines in case of lossy ground—Part I: Model development. *IEEE transactions on power delivery*, 28(2), pp.1213-1223.
- 4) Zhang, X.S., Dong, L., Zeng, G.Q., Huang, S.P., Wu, L., Xiong, R., Wang, H. and Dai, Y.X., 2018, November. Optimal Location of Surge Arresters on an Overhead Distribution Network by Using Binary Particle Swarm Optimization. In *2018 Chinese Automation Congress (CAC)* (pp. 1841-1846). IEEE.
- 5) Cao, J., Du, Y., Ding, Y., Qi, R., Li, B., Chen, M. and Li, Z., 2022. Practical Schemes on Lightning Energy Suppression in Arresters for Transformers on 10 kV Overhead Distribution Lines. *IEEE Transactions on Power Delivery*, 37(5), pp.4272-4281.

## 4. Research products:

1. D'Orazio, Luigi; Di Felice, Gianluca; Frain, Jean Baptiste; Andreotti, Amedeo; Ravichandran, Naganathini; Gentilini, Ivano; Proto, Daniela; Greco, Antonello; Spitilli, Ludovico "Analysis Of Data Gathered During the Application of LLPDs On MV Feeder Of E-distribuzione" CIREN 2023 International Conference & Exhibition on electricity Distribution, Rome June 12 – 15, 2023. **[Abstract Submitted]**
2. A. Andreotti, A. D. Pasquale, M. Pagano, N. Ravichandran and F. Volpe Analysis of Lightning Transients in 2×25 kV Railway Network using EMTP. AEIT 2022 International Annual Conference, Rome, Italy. **[Paper Presented]**
3. Nagananthini Ravichandran, Nagavinothini Ravichandran, Balamurugan Panneerselvam, Comparative assessment of offshore floating photovoltaic systems using thin film modules for Maldives islands, Sustainable Energy Technologies and Assessments, Volume 53, Part A, 2022, 102490, ISSN 2213-1388, <https://doi.org/10.1016/j.seta.2022.102490>. **[Article Published]**
4. Nagananthini Ravichandran, Amedeo Andreotti, Mario Pagano, Antonio Di Pasquale and Francesco Volpe, "Interconnection Topologies for Floating Photovoltaic System to Enhance the Power Output by Reducing the Mismatch Losses" 14th IEEE PES Asia-Pacific Power and Energy Engineering Conference 2022 (APPEEC) 20 - 23 November 2022 Melbourne, Australia **[Paper Accepted for presentation]**
5. A. Andreotti, A. D. Pasquale, M. Pagano, N. Ravichandran and F. Volpe, "An Optimal Centralized Control Strategy for Regenerative Braking Energy Flow Exchanges in DC Railway Traction Systems," 2022 International Symposium on Power Electronics, Electrical Drives, Automation and Motion (SPEEDAM), 2022, pp. 436-441, doi:10.1109/SPEEDAM53979.2022.9841998 **[Presented and Published]**

## 5. Conferences and seminars attended

1. **20th International Conference on Harmonics & Quality of Power (ICHQP), May 29 – June 1, 2022, Naples [Organizing Committee]**

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2. **International Symposium on Power Electronics, Electrical Drives, Automation and Motion (SPEEDAM), June 22 – 24, 2022, Sorrento [Presented a Poster]** A. Andreotti, A. D. Pasquale, M. Pagano, N. Ravichandran and F. Volpe, "An Optimal Centralized Control Strategy for Regenerative Braking Energy Flow Exchanges in DC Railway Traction Systems," 2022 International Symposium on Power Electronics, Electrical Drives, Automation and Motion (SPEEDAM), 2022, pp. 436-441, doi:10.1109/SPEEDAM53979.2022.9841998.
3. **AEIT International Annual Conference, October 3 – 5, 2022, Rome. [Presented a Paper]** A. Andreotti, A. D. Pasquale, M. Pagano, N. Ravichandran and F. Volpe Analysis of Lightning Transients in 2×25 kV Railway Network using EMTP. AEIT 2022 International Annual Conference, Rome, Italy.

## 6. Activity abroad:

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## 7. Tutorship

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