POLITECNICO DI MILANO

PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 39th cycle

THEMATIC Research Field: AUTOMATIC METHODS FOR THE DESIGN AND VERIFICATION OF THE CORRECTNESS OF PROTECTION SYSTEMS IN SMART GRIDS

Monthly net income of PhDscholarship (max 36 months)
€ 1900.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Power systems, and smart grids in particular, constitute a complex and critical infrastructure, with the purpose of supplying the necessary electrical energy to users such as large factories, transportation systems, small workshops, and households. Security and protection are fundamental properties for modern power systems, aiming to ensure, on one hand, that no harm is inflicted on devices connected to the system or individuals, and on the other hand, that the system remains in normal operational conditions even in the event of faults. Currently, the configuration of protection systems used to ensure the aforementioned properties in electrical networks is manually executed by domain experts, a complex and error-prone process. The research has a dual objective: 1. to develop methods for automatic verification of the correctness of protection system configurations capable of analyzing a wide range of network topologies; 2. to define techniques for automatically suggesting appropriate configurations to protection system designers.
Methods and techniques that will be developed and used to carry out the research	The protection systems for electrical networks are critical systems, whose failure can lead to serious consequences if the principle of selectivity is not met — that is, the

	property that, in the event of a fault in one of the lines of the electrical network, only the smallest necessary portion of the network is disconnected. Consequently, ensuring the correctness of the configuration of protection systems is of crucial importance. The design of protection systems can greatly benefit from the use of automatic formal verification techniques originating in the field of computer science. In particular, verification techniques for timed and hybrid systems, such as model checking for timed and hybrid automata, as previous experiences have shown. Additionally, Machine Learning techniques can be used, in combination with formal models, to assist the designer in exploring the space of possible configurations and suggesting parameterizations that are more likely to satisfy the desired properties of the system. This project is partially funded by ABB.
Educational objectives	The aim is to form highly qualified early-stage researchers in: a) simulation of the protection schemes and complex power systems; b) machine-learning algorithms and techniques; c) formal verification of time-varying nonlinear dynamic systems.
Job opportunities	R&D in Italian and international firms, academia.
Composition of the research group	1 Full Professors 3 Associated Professors 2 Assistant Professors 5 PhD Students
Name of the research directors	Prof. Samuele Grillo, Prof. Matteo Giovanni Rossi

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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	950.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities:

Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations, and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years.

Teaching assistantship:

Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: individual use.
Desk availability: individual use.