

FRAMEWORK PROGRAMME OF EARLY STAGE RESEARCHER TRAINING¹

1. BASIC DATA

Mentor's name and surname	Boštjan Polajžer	Mentor's register number at ARRS :	18698
Mentor's e-mail:	bostjan.polajzer@um.si	Mentor's tel. no.:	022207076
Research programme (RP) leader's name and surname:	Gorazd Štumberger	RP leader's register number at ARRS :	10814
Title of research programme:	Control of electromechanical systems	RP's Register number at ARRS :	P2-0115
Research organisation (RO) of University of Maribor, where training shall be conducted:	FERI	RO Register number at ARRS :	0552-0796
Research field according to ARRS classification :	2.12./2.03	Research field according to Ortelius classification (EURAXESS)	15.11

2. DEFINITION OF RESEARCH PROBLEM AND GOALS OF DOCTORAL RESEARCH²

Starting point of research task of the early stage researcher and its position in the research programme, where the mentor is included, work hypothesis, research goals and foreseen result with emphasis on an original contribution to science:

The starting point of the research task

Increasing the integration of renewable energy resources in future power systems is highly required to reduce greenhouse gas emissions. The essential solutions are wind and pumped hydropower plants, where generators operate at variable speeds due to specific environmental operating conditions. Consequently, such variable-speed generators are connected to the grid mainly through power electronic converters. The EU Regulation 2016/631, for converter-interfaced units, requires reactive power provision, inertial-frequency response, power oscillation damping, fault-ride-through capability and fast-fault current injection to ensure stable electric power generation, which has already been implemented in national grid codes. Moreover, the latest ENTSO-E's Inertia Team Report from 2021 highlights that additional inertia should be

¹ Term early stage researcher (ESR) is written in male form and used as neutral for women and men.

² Research and study programme of training have to harmonise with contents of the research programme, where the mentor is a member.

provided to improve grid resilience. Therefore, this research will concern control solutions to enhance variable-speed power plants' inertial-frequency response, which is of utmost importance to ensure reliable and resilient grid operation.

The expected results will be indispensable for the accelerated development of modern, resilient grids comprising a large share of renewable resources, as required by the different regulations. The proposed control solutions will enable a significantly more straightforward integration of wind and pumped hydropower plants in future power systems, leading to "greener" electric power generation without compromising grid reliability and resilience, which will positively affect the EU's and global levels in terms of The Green Deal.

Placement in the research program

Within the framework of the P2-0115 program, Generators and Control systems are the key areas within the P2-0115 program where the young researcher will be active. His training in this field will be coordinated with the work of the P2-0115 program. Moreover, as soon as possible, he will be involved in research work within the ARRS-FWF joint research project J2-4475, which refers to the electromagnetic design of a variable-speed generator system based on controllability metrics.

Work hypothesis

Developing control solutions to enhance the inertial-frequency response of variable-speed power plants with converter-interfaced generators can improve grid resilience and, thus, grid reliability and power system stability.

Research goals

- (i) To develop control solutions to enhance the inertial-frequency response of variable-speed power plants with different generator types.
- (ii) To experimentally investigate the inertial-frequency response of variable-speed power plants with different generator types using laboratory facilities.
- (iii) To demonstrate the impact of the proposed control solutions of variable-speed power plants with different generator types on grid resilience.

Anticipated original contributions to science

- (i) Control solutions to enhance the inertial-frequency response of variable-speed power plants with a converter-interfaced permanent magnet synchronous generator.
- (ii) Control solutions to enhance the inertial-frequency response of variable-speed power plants with a converter-interfaced electrically excited synchronous generator.
- (iii) Control solutions to enhance the inertial-frequency response of variable-speed power plants with a doubly fed induction generator.

3. STUDY PROGRAMME

Foreseen study programme, to which early stage researcher shall be enrolled in academic year 2023/2024:

Electrical Engineering

4. DESCRIPTION OF WORK AND TASKS

Year 1: Completion of study obligations following the training program, review of literature and standardization in the field of research, state-of-the-art analysis in the field, preparation of simulation models and execution of simulation calculations, inclusion in the research work of the P2-0115 program, preparation of a publication for a local conference.

Year 2: Fulfilling study obligations following the training program, performing simulation calculations and research work on laboratory simulators, testing on a laboratory system, preparing a publication for an international conference, inclusion in the ARRS-FWF joint research project J2-4475, and possible research visit on a research organization abroad.

Year 3: Completion of study obligations following the training program, approved topic for the dissertation, preparation of a publication with original contributions in relevant journals, protection of any intellectual property that may have been created, preparation of the doctoral dissertation.

Year 4: Publication of original achievements in relevant journals, protection of any resulting intellectual property, and defence of the doctoral dissertation.

5. REQUESTED LEVEL OF EDUCATION

Completed the second stage of the Bologna study program

6. REQUESTED FIELD OF EDUCATION

Electrical Engineering

7. KLASIUS SRV

17003

8. KLASIUS P

522

9. REQUESTED KNOWLEDGE

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10. REQUESTED SPECIAL REQUIREMENTS

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11. REQUESTED LANGUAGES

Slovenian, English

12. REQUESTED WORK EXPERIENCE

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13. FORESEEN POSTDOCTORAL TRAINING

We intend to prepare the extension to postdoctoral training, which can be carried out in research organizations abroad or at home. Implementing postdoctoral training depends solely on the candidate's interest in continuing research work in a research organization at home or abroad and the desire to continue a career path in the industry.

Mentor's signature:

Research programme leader's signature:

Name and surname of Dean or
authorised person³:
prof. dr. Gorazd Štumberger

Signature of dean or authorised person:

Place and date:

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vnesti besedilo.

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Stamp:

³ The training program is signed by the dean of the member where the ESR's employment and training will take place.