Univerza v Mariboru

FRAMEWORK PROGRAMME OF EARLY STAGE RESEARCHER TRAINING[1]

1. BASIC DATA

Mentor's name and surname	**Riko Šafarič**	Mentor's register number at ARIS (SICRIS):	**06824**
Mentor's e-mail:	**riko.safaric@um.si**	Mentor's tel. no.:	**02 220 7302**
Research programme (RP) leader's name and surname:	**Mitja Truntič**	RP leader's register number at ARIS (SICRIS):	25427
Title of research programme:	**Mechatronics systems**	RP's Register number at ARIS (SICRIS):	**P2-0028**
Research organisation (RO) of University of Maribor, where training shall be conducted:	**FERI**	RO Register number at ARIS (SICRIS):	**796**
Research field according to ARIS classification:	**2.06, 2.10**	Research field according to Ortelius classification (EURAXESS)	**15.11, 37.31**

2. DEFINITION OF RESEARCH PROBLEM AND GOALS OF DOCTORAL RESEARCH[2]

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 young researcher will study in the Electrical Engineering doctoral program at FERI, UM, and will conduct research experiments at the Laboratory for Cognitive Systems in Mechatronics at FERI, UM, whose leader is the mentor. The entire team of experts, consisting of 4 researchers with PhD degrees from this laboratory, has experience in the field of robotics control (kinematic and dynamic models,

[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.*

computer vision, adaptive control) and the application of artificial intelligence in robotics (control based on artificial neural networks, genetic algorithms, fuzzy logic, particle swarm algorithms, etc.). Based on years of experience in the aforementioned scientific field, we also focus on the scientific field of SLAM (Simultaneous Localization and Mapping) algorithms and robot trajectory planning (3D and 2D SLAM).

The purpose of the young researcher's doctoral work is to develop a self-learning algorithm for creating a map of the robot's surroundings (whether it be a drone, mobile robot, industrial robot arm, or nanoprecision robot), localizing the robot itself in the workspace (3D or 2D), detecting obstacles in this space, and subsequently calculating robot motion trajectories. The emphasis of such a self-learning algorithm – a cognitive (spatially self-aware) system – is on the use of artificial intelligence techniques. Several artificial intelligence techniques will be tested, and ultimately, the young researcher will decide on one or a combination of several techniques (e.g., using a neural network for environment recognition with a camera or Lidar, using a particle swarm algorithm or genetic algorithm for robot localization in space). All algorithms will be implemented on state-of-the-art NVIDIA computer multiprocessor systems for applications operating in soft real-time with response times of a few milliseconds, or with FPGA systems for applications operating in hard real-time (e.g., control response time of a robotic system under 1 ms).

The final product of the young researcher's cognitive robot system will be applied and tested on a selected robot and compared with classical cognitive systems based on classical cognition techniques. The advantage of the developed cognitive system based on artificial intelligence techniques will be its self-learning algorithm, as opposed to a pre-programmed cognitive system that cannot adapt to unforeseen situations in the robot's environment.

3. STUDY PROGRAMME

Foreseen study programme, to which early stage researcher shall be enrolled in academic year 2024/2025:

Program Electrotecnics, doctoral study

4. DESCRIPTION OF WORK AND TASKS

The young researcher will develop a robotic cognitive system based on artificial intelligence techniques, using MATLAB software tools, and programming in the C language on NVIDIA-based computers (e.g., Jetson Nano or similar). Testing will be conducted on the utilized robot.

5. REQUESTED LEVEL OF EDUCATION

The required level of education is MSc in Engineering.

6. REQUESTED FIELD OF EDUCATION

The required field of education is mechatronics or electrical engineering (automation, electronics, power engineering).

7. KLASIUS SRV

18202 Doctoral education (third Bologna cycle) / Doctoral degree (third Bologna cycle)

8. KLASIUS P

0714 Electronics and Automation

9. REQUESTED KNOWLEDGE

Kliknite ali tapnite tukaj, če želite vnesti besedilo.

10. REQUESTED SPECIAL REQUIREMENTS

Kliknite ali tapnite tukaj, če želite vnesti besedilo.

11. REQUESTED LANGUAGES

Knowledge of English.

12. REQUESTED WORK EXPERIENCE

Kliknite ali tapnite tukaj, če želite vnesti besedilo.

13. FORESEEN POSTDOCTORAL TRAINING

Planned at least 3-month training abroad in the fourth year of study.

Mentor's signature:

Riko Šafarič

Digitalno podpisal Riko Šafarič
DN: c=SI, st=Slovenija, ou=individuals, givenName=Riko, sn=Šafarič, serialNumber=2508066312019, cn=Riko Šafarič
Datum: 2024.03.05 12:36:49 +01'00'

Research programme leader's signature:

MITJA TRUNTIC
2024.03.05
13:40:04 +01'00'

Name and surname of Dean or authorised person[3]:
prof. dr. Gorazd Štumberger
po pooblastilu prof. dr. Marjan Mernik
Signature of dean or authorised person:

Marjan Mernik

Digitalno podpisal Marjan Mernik
Datum: 2024.03.05 13:56:06 +01'00'

Place and date:

Maribor 4. 03. 2024

Stamp:

SUZANA PUŠAUER

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