

## FRAMEWORK PROGRAMME OF EARLY STAGE RESEARCHER TRAINING<sup>1</sup>

### 1. BASIC DATA

Mentor's name and surname	<b>Simon Klančnik</b>	Mentor's register number at <a href="#">ARIS (SICRIS)</a> :	<b>29571</b>
Mentor's e-mail:	simon.klancnik@um.si	Mentor's tel. no.:	<b>+38622207601</b>
Research programme (RP) leader's name and surname:	<b>Mirko Ficko</b>	RP leader's register number at <a href="#">ARIS (SICRIS)</a> :	<b>20231</b>
Title of research programme:	<b>Technological systems for smart manufacturing</b>	RP's Register number at <a href="#">ARIS (SICRIS)</a> :	<b>P2-0157</b>
Research organisation (RO) of University of Maribor, where training shall be conducted:	<b>Faculty of mechanical engineering</b>	RO Register number at <a href="#">ARIS (SICRIS)</a> :	<b>0552-0795</b>
Research field according to <a href="#">ARIS classification</a> :	<b>2.10 Proizvodne tehnologije in sistemi</b>	Research field according to Ortelius classification (EURAXESS)	<b>15.18 Mechanical engineering</b>

### 2. DEFINITION OF RESEARCH PROBLEM AND GOALS OF DOCTORAL RESEARCH<sup>2</sup>

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:

#### **Research project foundation and its placement within the research program**

The doctoral research will focus on enhancing the efficiency and adaptability of smart manufacturing systems through the use of advanced artificial intelligence (AI) technologies, particularly deep learning and machine vision. The young researcher will operate within the broader research program "Technological systems for smart manufacturing," which will enable them to contextualize their work within the wider framework of technological innovations in Industry 4.0, with a special emphasis on automation, optimization, and digitalization of manufacturing processes.

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

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

The doctoral research will concentrate on the use of GAN deep neural networks for the synthetic generation of training data, which will be utilized for training AI models in cases where training data from the real production environment are limited, expensive to acquire, sensitive, or when privacy protection is required. A significant focus of the research will be on the use of real and synthetically generated training data for AI-supported programming of machining tools.

### **Working hypothesis**

The use of advanced artificial intelligence technologies that synthetically generate training data can significantly improve the efficiency and flexibility of production processes in smart manufacturing, especially in the automatic programming of machining tools.

### **Research objectives**

- Development and testing of deep learning models: To develop deep learning models that can effectively generate synthetic training data for use in smart manufacturing.
- Evaluation of the effectiveness of synthetic data: To verify how synthetically generated data affect the efficiency of artificial intelligence in real production environments.
- Automation of machining tools: To implement and evaluate models for automatic programming of machining tools using deep neural networks trained on both real and synthetically generated training data.
- Comparison with existing methods: To compare the effectiveness of the developed methods with existing practices and demonstrate the advantages of using synthetically generated data.

### **Anticipated results and original contribution to science**

- Development of innovative methods: Presentation of new approaches for generating synthetic training data using deep learning, which will serve as a basis for further research in the field of smart manufacturing.
- Improvement of smart manufacturing efficiency: To demonstrate that synthetically generated training data can improve the efficiency of machining tools and reduce the need for expensive and time-consuming methods of collecting real data in an industrial environment.
- Publication of research results: The goal is to publish the results in recognized scientific journals and at conferences to increase the visibility of the research and contribute to the dissemination of knowledge in the community.

The young researcher will have the opportunity to participate in development projects with industrial partners, enabling direct technology and knowledge transfer into practice, providing realistic scenarios for testing and validation of research findings, and promoting innovation in the industry.

## 3. STUDY PROGRAMME

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

Doctoral School of the Faculty of Mechanical Engineering, 3. cycle doctoral study programme (Mechanical Engineering)

#### 4. DESCRIPTION OF WORK AND TASKS

Implementing projects of scientific research.  
Taking part in the design of research programmes.  
Cooperating with research sponsors.  
Drawing up research and other reports.  
Monitoring and coordinating research work according to the grant agreement.  
Ensuring safety and health at work.  
Organising and instructing employees and students on using personal safety equipment and other safety measures.  
Performing other tasks at the behest of the superiors.  
Participating in ad-hoc and permanent committees of university or faculty bodies.  
Acting on behalf of colleagues and superiors during their absence (upon authorisation).  
Participating in annual and other inventories.  
Performing other related tasks delegated by superiors.

#### 5. REQUESTED LEVEL OF EDUCATION

VII/2. tariff group

#### 6. REQUESTED FIELD OF EDUCATION

Technical, Natural sciences

#### 7. KLASIUS SRV

Seventh level: Second cycle of higher and similar education/Second cycle of higher and similar education

#### 8. KLASIUS P

145 – Education of teachers of individual subjects  
340 - Business and Administrative Sciences (not specified)  
4 - Natural science, mathematics and computing  
5 - Engineering, manufacturing and construction

#### 9. REQUESTED KNOWLEDGE

Computer skills: MS Windows, Word, Excel, Internet, e-mail, e-commerce

#### 10. REQUESTED SPECIAL REQUIREMENTS

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#### 11. REQUESTED LANGUAGES

Active knowledge of one world language

## 12. REQUESTED WORK EXPERIENCE

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## 13. FORESEEN POSTDOCTORAL TRAINING

Kliknite ali tapnite tukaj, če želite vnesti besedilo.

Mentor's signature:

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Research programme leader's signature:

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Name and surname of Dean or  
authorised person<sup>3</sup>:  
red. prof. dr. Matej Vesenjak

Signature of dean or authorised person:

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Place and date:

Maribor,

28. 02.  
2024

Stamp:

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