Univerza v Mariboru

FRAMEWORK PROGRAMME OF EARLY STAGE RESEARCHER TRAINING[1]

1. BASIC DATA

Mentor's name and surname	**Assist. Prof. Dr. Matej Borovinšek**	Mentor's register number at ARIS (SICRIS)**:**	25799
Mentor's e-mail:	matej.borovinsek@um.si	Mentor's tel. no.:	02 220 7711
Research programme (RP) leader's name and surname:	Prof. Dr. Zoran Ren	RP leader's register number at ARIS (SICRIS):	08779
Title of research programme:	Design of Cellular Structures (Konstruiranje celičnih struktur)	RP's Register number at ARIS (SICRIS):	P2-0063
Research organisation (RO) of University of Maribor, where training shall be conducted:	Faculty of Mechanical Engineering	RO Register number at ARIS (SICRIS):	0795
Research field according to ARIS classification:	2.11.03 Engineering sciences and technologies, Mechanical design, Special development know-how	Research field according to Ortelius classification (EURAXESS)	15.18 – Mechanical Engineering

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 research project focuses on the development of novel cellular auxetic metamaterials, with an emphasis on isotropic auxetic properties. Auxetic metamaterials are materials that exhibit a negative Poisson's ratio, which gives them unique mechanical properties such as enhanced stiffness, impact resistance, and controlled deformation.

The working hypothesis of the research is that isotropic auxetic metamaterials can be developed by optimizing the geometries and morphologies of cellular structures in combination with advanced

[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.*

numerical modelling and optimization methods and can be validated through experimental techniques.

The research will involve the development of mathematical models to describe the geometry and mechanical properties of 2D and 3D cellular auxetic metamaterials, numerical modelling, and optimization of these structures using the finite element method and parametric optimization. Experimental validation of the results will also be conducted through mechanical testing of specimens manufactured using 3D additive manufacturing technologies. Additionally, the study will analyse the influence of various geometric parameters on the isotropy of auxetic properties and explore the potential applications of these metamaterials in real-world scenarios, such as structural components for impact load absorption.

The expected outcomes include the development of a new generation of isotropic auxetic metamaterials, which will be the first metamaterials with equal auxetic properties in all coordinate directions, as well as an in-depth understanding of the relationship between structural geometry, material properties, and mechanical response in auxetic metamaterials. The research will introduce new optimization methods for designing cellular metamaterials with improved properties, enable practical validation of results, contribute to the development of industrial applications and the broader adoption of auxetic metamaterials. The research will result in the publication of research articles in high-impact scientific journals, as well as the transfer of acquired knowledge to educational and industrial practice.

The research project will be directly integrated into the research program Design of Cellular Structures, which aims to enhance the design processes and applicability of cellular structures in next-generation products based on integrated experimental-computational engineering of cellular structures.

3. STUDY PROGRAMME

Foreseen study programme, to which early stage researcher shall be enrolled in academic year 2025/2026:

3rd cycle doctoral study programme - Doctoral School of the Faculty of Mechanical Engineering - 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
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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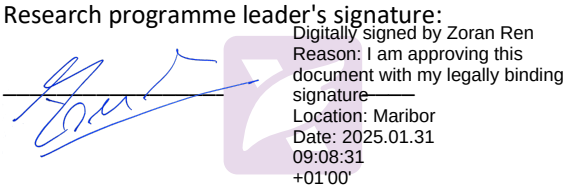
13. FORESEEN POSTDOCTORAL TRAINING

Four years.

Mentor's signature:

Research programme leader's signature:



Name and surname of Dean or authorised person[3]:
Prof. Dr. Matej Vesenjak

Signature of dean or authorised person:

Place and date:

Maribor, 31. 01. 2025

Stamp:

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