Univerza v Mariboru

FRAMEWORK PROGRAMME OF EARLY STAGE RESEARCHER TRAINING[1]

1. BASIC DATA

Mentor's name and surname	**Marko Renčelj**	Mentor's register number at ARIS (SICRIS):	**19111**
Mentor's e-mail:	**marko.rencelj@um.si**	Mentor's tel. no.:	**+38622294372** +386 (51) 375 134
Research programme (RP) leader's name and surname:	**Miroslav Premrov**	RP leader's register number at ARIS (SICRIS):	**14095**
Title of research programme:	**Development, modelling and optimisation of structures and processes in civil engineering and traffic**	RP's Register number at ARIS (SICRIS):	**P2-0129**
Research organisation (RO) of University of Maribor, where training shall be conducted:	**University of Maribor, Faculty of Civil Engineering, Transportation Engineering and Architecture**	RO Register number at ARIS (SICRIS):	**0552-0797**
Research field according to ARIS classification:	**Civil Engineering (2.01)**	Research field according to Ortelius classification (EURAXESS)	**Civil Engineering (Code 15.6, ID 169)**

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:

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[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.

Starting point of research task of the early stage researcher and its position in the research programme:
Despite notable progress in recent decades, we still cannot be satisfied with the current level of road safety in EU countries. Every year, thousands of people die on EU roads, and tens of thousands are injured. For example, in 2023, there were 20,418 fatalities on EU roads. If we consider that there are on average 7 seriously injured people for every fatal accident, this means more than 140,000 seriously injured people in road accidents in the EU. Of the 32 countries in Europe monitored by the PIN program, only 18 countries recorded a decrease in the number of road fatalities in 2023 compared to 2022. Of course, the situation with road safety is (significantly) worse on other continents. Road accidents due to speeding, alcohol, failure to wear seat belts and devices for attaching children, and distraction of drivers remain among the most common causes of road accidents. It should be emphasized that vulnerable road users (pedestrians, cyclists and motorcyclists) are at higher risk - especially in urban environments where traffic concentrations are high. The development and application of technologies such as autonomous vehicles presents opportunities to improve road safety, but it also poses new challenges related to the regulation and adaptation of infrastructure. At EU level, countries are working to reduce the number of road fatalities and injuries by adopting comprehensive strategies and transport policies and promoting cooperation between Member States and other stakeholders.

Road safety situation of cyclists in the EU shows a growing trend of killed and seriously injured. Some countries (e.g. The Netherlands, Denmark and Finland) have relatively low numbers of cyclists killed due to their developed infrastructure and driver awareness, while in other countries (e.g. Romania, Latvia and Bulgaria) these numbers are higher. The traffic safety of cyclists is problematic because of their vulnerability compared to other road users (motor vehicles – mainly passenger cars and trucks). The main factors influencing cyclists' road safety include infrastructure, traffic culture, legislation and education, as well as the awareness of road users. The most critical aspects include the lack of separate cycling infrastructure (e.g. cycle paths in urban environments and off-road cycle paths), non-compliance by motor vehicle drivers, lack of safety measures for cyclists and lack of safety awareness among all road users.

In the field of cycling infrastructure, we face several challenges that affect the traffic safety of cyclists. Important factors include the dimensions of the project-technical elements, design of the cycling infrastructure and its "integration" into the existing road-transport infrastructure. For example, in addition to moving the cycling infrastructure away from the carriageway/motor traffic, the width of a bicycle path or bicycle lane is crucial for cyclists' safety, as it limits overtaking space and increases the risk of collisions with other vehicles. The quality of cycling infrastructure can be assessed by various methods, which include analysis of project-technical elements, characteristics of traffic flow, obstacles / objects, visibility and sight distances and traffic signals. The suitability of cycling infrastructure is assessed in terms of usability for different groups of cyclists and their needs and abilities. The safety (or danger) of cycling infrastructure can be assessed by analysing traffic accidents and their causes/consequences, analysing conflicts between road users and conducting in-depth studies on the impact of different forms of infrastructure on cyclist safety. The user experience with cycling infrastructure is most often measured through surveys, interviews, inspections and the use of technological tools that enable monitoring of the use and satisfaction of users with cycling infrastructure.

Road and transport infrastructure (including cycling infrastructure) is also addressed in the research programme "Development, modelling and optimization of buildings and processes in construction and transport (P2-0129), within which the training of young researchers would take place. This programme also extensively addresses other issues in the field of development / optimization of road-traffic infrastructure (e.g. development of alternative types of roundabouts, etc.).

Work hypothesis:
In order to formulate a working hypothesis, a narrower area of research is defined: the development of a methodology for optimizing the project-technical elements of the cycling infrastructure depending on the behaviour of road users. The essential characteristic of the proposed implementation of the research is that the developed methodology for optimizing the project-

technical elements of the cycling infrastructure will be based on the "user experience" or inclusion of the characteristics of the behaviour of both motor vehicle drivers and cyclists.

Within the defined narrower field of research, for the purpose of formulating a working hypothesis / working hypotheses, we can identify the following essential activities that will be carried out:
a) Analysis of existing methods and procedures for optimizing the project-technical elements of the cycling infrastructure
b) Comparison of starting points, procedures and results in the field of cycling infrastructure assessment
c) Analysis of characteristics of different designs of cycling infrastructure in terms of level of user services, traffic characteristics and traffic safety
d) Defining and developing different scenarios of road-traffic infrastructure (with different forms of cycling infrastructure included) for the purpose of conducting experiments on the TouringSim driving simulator at the Laboratory of Transportation Engineering UM FGPA
e) Conduct and analysis of the results of experiments on the driving simulator
f) Defining and preparing for field measurements on different types of road infrastructure in order to validate and compare the results obtained with the results on the simulator
g) Designing a methodology for optimizing the project-technical elements of the cycling infrastructure on the basis of the "user experience" / characteristics of the behaviour of both motor vehicle drivers and cyclists

Research objectives and expected results with an emphasis on original contribution to science:
The main objective of the research is to develop an innovative methodology for optimizing the determination of the project-technical characteristics of cycling infrastructure, taking into account the results of the behaviour of both motor vehicle drivers and cyclists. The original contribution to science is important, especially in the fact that as part of the developed innovative optimization methodology, the behaviour of drivers (results from experiments on the driving simulator and field measurements) as well as cyclists (field measurements, analyses of their user experience) will be taken into account simultaneously.

The aim of the research is to make a more optimal choice of the type of cycling infrastructure and their optimal dimensions – based on the results of analyses of the behaviour of drivers of motor vehicles and cyclists and the methodology developed on this basis. The use of the proposed methodology and the cycling infrastructure planned on this basis can make an important contribution to improving the traffic safety of cyclists, especially by reducing conflicts between motor traffic and cyclists and, consequently, such traffic accidents.

The objectives of the research "cover" the field of "green mobility", "sustainable mobility", reducing the use of personal vehicles due to increased use of bicycles, etc. The objectives of the survey are thus fully in line with the guidelines of cohesion policy post-2020, which are based, inter alia, on the priority area "A greener, carbon free Europe" (Cohesion Policy post 2020; 2021), within which the key investment priorities of the Republic of Slovenia for the period 2021–2027 include "Promoting energy efficiency measures" and "Promoting climate change adaptation, risk prevention and disaster resilience" (Investment needs of the Republic of Slovenia for the period 2021–2027; 2019). The objectives of the project are also in line with the "Slovenian Development Strategy 2030", which also aims at "Healthy and active live" (by reducing health risk for people arising from environmental pollution and climate change (Slovenian Development Strategy 2030; 2017).

The results of the research can also have important socio-economic impacts, as they can contribute to improving road safety, more optimal planning, design, construction and maintenance of road-transport infrastructure (including cycling infrastructure) and thus to increasing the use of bicycles in road transport / cycling, promoting sustainable mobility and reducing environmental impacts from a road transport perspective.

3. STUDY PROGRAMME

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

Civil Engineering

4. DESCRIPTION OF WORK AND TASKS

1st year:
- Completion of selected courses of 1 year of doctoral study in Civil Engineering at UM FGPA
- As part of individual research work, carrying out an relevant state-of-the-art study in the field of cycling infrastructure, cyclist behaviour and interaction between cyclist and motor traffic

2nd year:
- Completion of selected courses of the 2nd year of doctoral study in Civil Engineering at UM FGPA.
- As part of individual research work, preparation and implementation of experiments on the TouringSim driving simulator from Drive Sim Solutions (DSS) at the Laboratory of Transportation Engineering UM FGPA.
- Start of studies to assess the suitability of existing cycling infrastructure solutions in terms of user experience (motor vehicle drivers, cyclists).
- Application of dissertability of doctoral thesis.

3rd year:
- As part of individual research work, preparation and implementation of field experiments with the purpose of confirmation / correction / validation of the results of experiments on the driving simulator.
- Conducting a comparative study and elaborating a methodology for optimizing the planning of cycling infrastructure on the example of different cycling infrastructure, taking into account the results obtained on the simulator and in the field.
- Preparation of the first original scientific article based on the analysis of the suitability of the existing cycling infrastructure from the point of view of user experience – taking into account the results obtained with the simulator and in the field.

4th year:
- Preparation of the second original scientific article with a proposal and confirmed suitability of the submitted proposals of optimized cycling infrastructure based on user experience.
- Final preparation of the doctoral dissertation.
- Defence of the doctoral dissertation.

5. REQUESTED LEVEL OF EDUCATION

Master of Engineering (Bologna Master programme) or Univ.Dipl.Ing. (pre-bologna university programme)

6. REQUESTED FIELD OF EDUCATION

Civil Engineering or Transportation Engineering

7. KLASIUS SRV

170

8. KLASIUS P

582 Civil Engineering, 520 Engineering and engineering trades (broad programmes)

9. REQUESTED KNOWLEDGE

Knowledge about using computer programmes for three dimensional road infrastructure design

10. REQUESTED SPECIAL REQUIREMENTS

Not any.

11. REQUESTED LANGUAGES

Slovenian, English

12. REQUESTED WORK EXPERIENCE

No additional

13. FORESEEN POSTDOCTORAL TRAINING

No

Mentor's signature:

Research programme leader's signature:

Name and surname of Dean or authorised person[3]:
Izr. prof. dr. Andrej Ivanič

Signature of dean or authorised person:

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

Place and date:

Maribor, 28. 01. 2025