



H.F.R.I.
Hellenic Foundation for
Research & Innovation

Description of the funded research project
2nd Call for H.F.R.I. Research Projects
to Support Post-Doctoral Researchers

Title of the research project:

Towards resilient transportation infrastructure in a multi-hazard environment

Principal Investigator:

Dr. Grigorios Tsinidis

Research Team:

Dr. Anna Karatzetzou, Dr. Sotiria Stefanidou

Reader-friendly title:

INFRARES

Scientific Area:

Engineering Sciences & Technology

Institution and Country:

Aristotle University of Thessaloniki, Greece

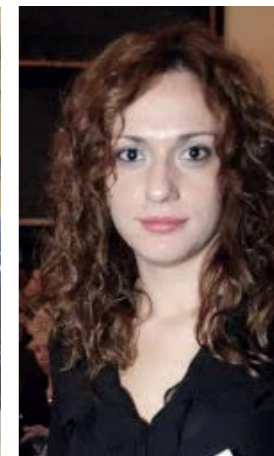
Host Institution:

Aristotle University of Thessaloniki, Greece

Collaborating Institution(s):

University of Surrey, UK

Project webpage: www.infrares.gr



Budget: 197000 €

Duration: 30 Months

Research Project Synopsis

Recent hazardous events in Greece, e.g., the 2003 Lefkada earthquake (M6.5) and the 2019 heavy rainfall in Crete, resulted in severe physical damage on transportation infrastructure, highlighting the vulnerability of key components of such infrastructure, like bridges and tunnels, to natural hazards. Unique natural hazards, like earthquakes, may lead to severe damage on critical transportation infrastructure components. However, severe damage is more likely to be associated with multi-hazard phenomena that act independently and/or subsequently throughout the life of the infrastructure component.

In this context, there is an increasing need for effective evaluation, management, and mitigation of the risk of transportation infrastructure components subjected to a variety of natural hazards, by employing methodologies that account for ageing effects and SSI phenomena. Although some advances have been made on the investigation of the effects of ageing and SSI on the structural response and fragility of transportation infrastructure components, vulnerability assessment studies, accounting for the combined effects of the above parameters, are very scarce, especially when considering the effects of multiple hazards (e.g., earthquakes and floods).

INFRARES aspires to bridge this gap and gain further insight into the risk and resilience assessment of bridges and tunnels subjected to independent and/or multiple subsequent natural hazards, proposing a comprehensive methodology towards a more efficient risk and resilience assessment of the above critical transportation infrastructure components. A new user-friendly software for multi-hazard risk assessment of transportation infrastructure will be presented, allowing an easier implementation of the proposed methodology. The whole approach will be applied to a roadway network of Western Macedonia, i.e., Egnatia Odos, one of the largest roadway networks in Greece.

Project originality

Novel aspects of INFRARES:

1. **New fragility functions** will be developed for various typologies of bridges and tunnels subjected to independent natural hazards, as well as subsequent multiple natural hazards, considering in the effects of ageing and SSI, to facilitate a more rigorous vulnerability assessment for these crucial transportation infrastructure components
2. **The damage states definition** within fragility analysis will be case- and hazard-specific, considering different failure modes and damage mechanisms, to fill the relevant knowledge gap
3. **The resilience of roadway networks**, consisting of the examined components (i.e., bridges and tunnels), will be quantified by means of a resilience index, which will be appropriately estimated so that to be applicable for multi-hazard assessment purposes
4. An **innovative and user-friendly software for multi-hazard risk and resilience assessment of transportation infrastructure** will be developed allowing for an easy application of the proposed methodology by Stakeholders, Operators and Public Authorities

Expected results & Research Project Impact

1. The scientific achievements of INFRARES will be communicated to the scientific community through publications in journals and announcements in conferences.
2. Relevant newsletters and technical guidelines will also be issued, to disseminate the outcomes of the project to wider society and engage interested Stakeholders, Operators and Consultancies.
3. A new user-friendly software for multi-hazard risk assessment of transportation infrastructure will be presented, allowing an easier implementation of the proposed methodology.

INFRARES will have impact on the following levels:

Science: The most important scientific impact of the project is related to the development of a comprehensive methodology for risk and resilience assessment of critical transportation infrastructure components (bridges and tunnels) under uncorrelated or subsequent hazards, providing relevant fragility functions; therefore, consisting a valuable tool for rapid and rigorous pre-event assessment of transportation infrastructure or post-event risk management.

Society: The protection and safety of the population will be improved significantly, as the proposed risk and resilience assessment methodology will contribute towards making proper decisions to enhance the resilience and safety of transportation infrastructure.

The importance of this funding

1. This funding supports the development of tools, which will contribute significantly towards the improvement of safety and resilience of transportation infrastructure in a multi-hazard environment, while accounting for the specific conditions of the transportation infrastructure, as well as of the nature of natural hazards in Greece.
2. This project constitutes a unique opportunity for the members of the research team, with diverse expertise in different areas, i.e., hazard analysis, fragility of bridges and tunnels, soil-structure interaction, to collaborate closely in the framework of a demanding project and deepen their knowledge in diverse engineering areas, developing a holistic methodology for the estimation of road network resilience within a multiple-hazard environment.
3. More importantly, it allows for the establishment of an independent research team, by adding great value in project management and administrative skills of the team members, hence increasing the potential in attracting funding for future research in relevant fields.

Overall, the H.F.R.I.'s funding supports research projects, with an important societal impact, while allowing the researchers to improve their skills for a future academic and/or research career.



H.F.R.I.
Hellenic Foundation for
Research & Innovation

COMMUNICATION

185 Syggrou Ave. & 2 Sardeon St. 2
171 21, N. Smyrni, Greece
+30 210 64 12 410, 420
communication@elidek.gr
www.elidek.gr