

PhD Projects/Opportunities

Project Title: Immersive Technologies for Climate Focused Bridge Monitoring

Full Time: 3 years

Part Time:

Start Date: September 2025

Application Deadline: 31 August 25

Project Introduction: The objective of this project is to investigate the use of immersive technologies to aid in knowledge transfer from infrastructure monitoring.

Project Description: The resilience of existing transport infrastructure to the projected impacts of climate change remains relatively unexplored. Bridges are not only vital links in our transport systems but also carry energy, water, and communication networks, making them critical points of cascading failure.

The reliability and availability of bridges are key elements that must be considered when preparing for uncertain future climate risks. Vulnerable to natural hazards, bridge scour is the leading cause of bridge collapse globally. The National Adaptation Framework highlights scour as a high-priority risk for the transport sector by mid-century. Recent research estimates the future cost of bridge adaptation to mitigate scour risk at €541 million per year between 2040-2027, emphasising the lack of data on bridge structures as a bottleneck for adaptation under uncertainty.

Bridge investment decisions must consider economic benefits, mobility, public safety, and environmental impacts while addressing climate change effects. The aim of CRANN is to adapt current bridge management processes to include sensor data, advanced analytics, vulnerability analysis, and citizen science to improve the assessment of scour risk under uncertain and changing climate conditions. To influence policymakers effectively, it is crucial to leverage new technologies to demonstrate the utility of this new process in a highly visual yet physically accurate manner. This research will focus on incorporating the findings of a bridge management database into an immersive application that can serve as a demonstrator for the general public and policymakers.

Immersive applications, such as virtual reality (VR) and augmented reality (AR) allow users to explore and understand the impacts of climate change on bridge infrastructure in a more intuitive and impactful manner. By providing a realistic and immersive environment, these applications can help bridge the gap between technical data and public understanding, making it easier for policymakers and the public to grasp the urgency and importance of adaptation measures.

Immersive applications can also facilitate better decision-making by allowing users to simulate different scenarios and observe potential outcomes in a controlled and safe environment. This can lead to more informed and effective policies and investments in bridge infrastructure. Additionally, the use of immersive technologies can enhance stakeholder engagement and collaboration, as they provide a common platform for discussing and addressing complex issues.

The research will be conducted in four steps:

1. **Data Determination:** Identify relevant data to be represented in the immersive application through collaboration with project partners at the Department for Infrastructure, University of Galway, and TU Delft. This involves analysing data from the bridge management system and converting it to appropriate formats for use in the immersive application.
2. **Scenario Generation:** Develop and simulate different scenarios to understand potential outcomes and impacts on bridge infrastructure under varying climate conditions. This step will help in visualising and assessing the effectiveness of adaptation measures.
3. **Prototype Development and Testing:** Develop a series of prototypes and conduct user testing to evaluate their utility for knowledge dissemination and their accuracy compared to real-world data.
4. **Application Development and Dissemination:** Utilise findings from user testing to develop the fully-fledged application and conduct dissemination events to gauge interest and knowledge transfer among the public and policymakers.

This research will be a collaborative effort between three universities: Queen's University Belfast (QUB), University of Galway, and TU Delft. The consortium also includes the Department for Infrastructure, the government body responsible for managing bridge infrastructure in Northern Ireland.

Funding Body: Environmental Protection Agency (EPA)

Project Funding Type: Funded

Funding Information:

Applicants must hold a 2.1 Honours degree or equivalent qualification acceptable to the University. While a Master's degree (or equivalent qualification acceptable to the University) is not essential, it is desirable and applicants without this qualification will be considered on a case-by-case basis. Applicants should submit an application on the Queen's University Direct Applicant Portal.

As part of this they should also submit a 300 word supporting statement, clearly indicating this as part of their research proposal – e.g. what is their proposed research, and why are they the right person to do the research. An interview process will follow shortlisting. Interested candidates can contact Dr Darragh Lydon – d.lydon@qub.ac.uk about the project.

The following skills and traits are also required:-

- a. A willingness/demonstrable ability to explore theoretical frameworks, such as in the fields of games technologies, infrastructure monitoring and data analysis, and apply them in a practical context.
- b. A demonstrable ability to work collaboratively with a diverse team of researchers, industry partners, and stakeholders.
- c. An interest in / demonstrable ability in games technologies.

- d. Some foundational knowledge of data and working with data is required.
- e. Strong written and verbal communication skills to effectively disseminate research findings to both technical and non-technical audiences.

Tuition fees will be covered by the award, together with a yearly stipend of £21,000.