School of Computing, Engineering, and the Built Environment
Edinburgh Napier University

PHD STUDENT PROJECT

Application instructions:
Detailed instructions are available at :
https://www.napier.ac.uk/research-and-innovation/doctoral-college/how-to-apply

Prospective candidates are encouraged to contact the Director of Studies (see details below) to discuss the project and their suitability for it.

Project details

Supervisory Team:

- Director of Study: Dr Faheem Ahmed Malik (Email: f.malik@napier.ac.uk)
- 2ND SUPERVISOR: tbc

Subject Group: Built Environment

Research Areas: Engineering

Project Title: New Cycling Safety Framework Developing a novel framework for modelling Cycling Safety using Data Driven Engineering Sciences

Project description:

Promotion of cycling as a mode of travel has social, economic, and environmental benefits. The increase in the mode share is essential for achieving sustainable development. However, cyclist faced a disproportionate risk. The risk that cyclist faces from varying built environment is paramount and a critical mode and route choice model. The current cycling safety models are primarily based upon the historic crash data and are often reactive models. These models often do not fully leverage the potential of the latest advancements in data-driven engineering sciences. Hence, this research proposes the development of a novel, data-driven framework for modelling cycling safety. This framework will integrate diverse data sources and advanced analytical techniques to create a comprehensive, predictive model that can inform better safety interventions and urban planning decisions. The study will aim to construct a data driven model that can model cycling infrastructure while considering road safety as a variable. It will develop an

understanding of the interaction between infrastructure, meteorological variables, traffic flow conditions, personal rider attributes, and safety. To achieve the aim, following objectives are designed:

1. To develop a novel data-driven framework for modelling cycling safety that integrates diverse data sources
2. Develop a statistical model for the identified critical variables affecting rider safety, and identify key risk factors using advanced data analytics and machine learning
3. Construct a nanoscopic safety model with different outputs for critically identified variables: a) Infrastructure, b) Meteorological conditions, c) Personal rider attributes, and d) Micro-infrastructure variables
4. Construct a real-time road safety model with dynamic input variables that can combine all the output variables of Objective 3
5. To validate the framework through case study application and establish a set of guidelines for the implementation of data-driven safety interventions for cycling infrastructure

Methodology: 1. Review the use of present research methods for modelling cyclist safety and propose a method/combination of methods, 2. Develop a base input file for a) Cyclist Crashes, b) Traffic Flow Patterns, c) Meteorology, d) Cyclist use by personal rider attributes, 3.Developing a novel hybrid modelling framework for modelling using AI-based tools and Data driven engineering science, 4. Data Simulation Analysis, 5. Traffic Microsimulation Analysis

Expected Outcomes: a) Novel Cycling Safety Framework, b) Predictive Nanoscopic Tools and c) Policy and Planning Guidelines:

Application: The research will aim to contribute towards increase in the cycling safety and contribute towards a sustainable integrated cycling transportation system. Through the development of a novel framework, better design of cycling infrastructure / choosing proper cycling routes and selection of the best route for the cyclist in real time, can be achieved. This best route can vary with change in traffic flow and the time-of-day journey is undertaken. Also, the rating of present cyclist road infrastructure network based upon safety can be undertaken and developing the remedial measures to increase the cycling safety. The framework developed will offer urban planners, transportation modellers, and policymakers a sophisticated tool for understanding and mitigating cycling risks in real-time, contributing to safer and more sustainable urban environments.

References:

1. Liang, H., García, B.M., Seah, E., Weng, A.N.K., Baillargeat, D., Joerin, J., Zhang, X., Chinesta, F. and Chatzi, E., 2024. Harnessing Hybrid Digital Twinning for Decision-Support in Smart Infrastructures.
2. Malik, F.A., Dala, L. and Busawon, K., 2021. Intelligent nanoscopic cyclist crash modelling for variable environmental conditions. IEEE transactions on intelligent transportation systems, 23(8), pp.11178-11189.

Candidate characteristics

Education:

A first degree (a minimum 2:1) in Transportation/ Mathematics/ Artificial Intelligence/ Data-driven engineering science

Subject knowledge:

Transportation Engineering. Data Modelling, AI-based modelling

Essential attributes:

- Good Motivation to apply the latest development in data driven engineering science on transportation data
- Motivated to contribute towards sustainable transportation