Keynote Speaker Bio

Stergios-Aristoteles Mitoulis

University of Birmingham

S.A.Mitoulis@Bham.ac.uk

Stergios is the leader of the MetaInfrastructure.org and bridgeUkraine.org initiatives. Stergios has a sustained record of grant-winning with more than € 8 million of funding which he received by the UKRI and Horizon Europe. He led and won recently a € 1.65 million MSCA-SE-2021, the ReCharged project, leads the € 5 million HORIZON-CL5-2023-D4-01-01 ZEBAI project demos and leads the € 2.5 million HORIZON-MISS-2021-CLIMA-02 the RISKADAPT project pilots. He is the Editor in Chief of the ICE Journal of Bridge Engineering.

Stergios' expertise is in climate resilience, sustainability, and digitalisation of critical infrastructures. During his academic career he has supervised more than 30 doctoral and postdoctoral researchers with a publication record exceeding 200 papers. He is known for his expertise in bridges. He is a member of the BSI B/525/10 CEN/TC250/HG-Bridges, the BSI Mirror Group of Eurocodes, and UK delegate of the BSI CEN/TC250/SC8 WG6, Bridges & the BSI committee B/525/8 and B/538/5.

Keynote Title:

Non-destructive bridge damage characterisation: from traditional approaches to novel ensemble learning

Abstract

This presentation explores the evolution of bridge condition assessment from traditional engineering methods to state-of-the-art digital and data-driven approaches. It begins by revisiting conventional techniques, including visual inspections, forensic investigations, and finite element back-analysis, as applied in landmark case studies such as the Polyfytos Bridge in Greece. These foundational methods provide the baseline upon which more advanced technologies—such as Synthetic Aperture Radar (SAR) Interferometry, UAV-based photogrammetry, and Digital Twins—are introduced and critically evaluated. The transition from analogue to digital methods is examined in the context of ageing infrastructure, sustainability, resilience, and the need for rapid, scalable, and cost-effective solutions. Through selected European research projects and real-world applications, the talk proposes a multi-scale and multi-sensor methodology that combines traditional engineering judgment with next-generation monitoring and modelling systems. Next, a novel, cause-agnostic, machine learning framework for non-destructive bridge damage state identification is presented, purposefully developed for applications with extremely limited datasets. We demonstrate the evolution of an ensemble-based methodology, from the use of general regression neural networks (GRNN) to an enhanced artificial neural network (ANN)-based cascade model, which integrates a new input-doubling data augmentation technique grounded in response surface linearisation. Applied to a real-world balanced cantilever bridge, our method successfully predicted tendon losses in three interdependent deck zones using only 81 observations. The presentation will discuss the theoretical underpinnings, model architecture, validation results, and potential for deployment across infrastructure portfolios, with a particular emphasis on the method's applicability to data-scarce environments and digital twin platforms.