MetaInfrastructure.org

September, 2025
Issue: 03

NEWSLETTER

our mission

We innovate for delivering future built ecosystems — encompassing cities, infrastructure, buildings, and services—through people-centric, sustainable, and resilient design. Our work supports equitable infrastructure aligned with the UN SDGs and Net-Zero goals. We assess the exposure of cyber-physical infrastructure to natural, climate, and anthropogenic threats—from sea-level rise to conflicts—using threat-agnostic resilience approaches. Leveraging AI, Generative Design, Digital Twins, IoT, and VR, we develop data-driven solutions to enhance decision-making in complex systems.

Our research promotes sustainability, inclusivity, and co-development, shaping green and blue infrastructure policies within the evolving metaCity. Through Counterfactual Engineering and Engineering for People, we explore innovative strategies to future-proof infrastructure—upholding the core mission of Civil Engineering: serving society by delivering safe, inclusive, and resilient infrastructure that enables communities to thrive.

top news

MetaInfrastructure members will play a leading role in ICONHIC2026 in Chania, co-organising three curated sessions. Stergios Mitoulis, Sotirios Argyroudis, Athanassia Kazantzi, Marianna Loli, and Stavros Sakellariou will contribute their expertise to shape high-level discussions on resilience, innovation, and adaptation.

ICONHIC2026

For the fourth year in a row, three MetaInfrastructure members appear on the Stanford–Elsevier list of top-cited scientists. Stergios-Aristoteles Mitoulis (Civil Engineering); Sotirios Argyroudis (Strategic, Defence & Security Studies); Ivan Izonin (AI & Image Processing)

our expertise

threat-agnostic resilience

- Real-time, resilience-based response framework and metrics
- AI-driven integration and digital twin technology
- Automated decision support systems for complex infrastructure systems
- Proactive mitigation of cascading failures

AI applications & digitalisation

- Advanced data integration and analysis
- Innovative monitoring and predictive technologies
- AI-driven digital twins for infrastructure
- Ethical and explainable AI for crisis management

sustainable development

- Comprehensive Life Cycle Assessment (LCA) frameworks
- Predictive and risk-integrated models
- Multi-criteria optimisation for circularity
- Time-dependent circular intervention planning

metaCity

- Resilient urban systems
- Coupled urban risk mitigation
- Innovative technologies for smart cities
- Sustainable and equitable urban environments

Counterfactual Engineering

- Hazard intensity assessment
- Fragility and recovery modeling
- Sustainability analysis
- Resilience quantification and cost assessment
- Resilience and sustainability trade-offs

engineering4people

- Integrated people-centric risk models
- Data-driven calibration
- People-centric strategies

- Education & capacity building
- Massive Open Online Courses
- Continuous Professional Development (CPD)

featured topic - ICONHIC 2026

29 June – 2 July 2026 | Chania, Greece

themed sessions organised by members of MetaInfrastructure

This session will examine how ports, transport networks, and interconnected urban ecosystems can withstand and adapt to a wide range of natural and human-induced hazards. It highlights the systemic interdependencies between critical infrastructures and the cascading effects of disruptions, from local impacts to global supply chains. Special focus will be given to innovative approaches such as digital twins, AI-driven monitoring, and early-warning systems, alongside socio-ecological perspectives that ensure resilience is sustainable, inclusive, and future-ready.

Related Project: PORTAL
Abstract Submission Deadline: 30 November 2025
Manuscript Submission Deadline: 20 February 2026
More information: here

This special session highlights the need to move beyond fragmented wildfire resilience approaches by integrating forest, spatial, and physical dimensions into a unified framework. It covers ecological management, fuels reduction, ecosystem recovery, wildfire simulation, geospatial optimisation, evacuation planning, and structural vulnerability, supported by tools such as AI, UAVs, and IoT. Emphasising the Interdependent Resilience Nexus, the session showcases systemic solutions to protect communities, ecosystems, and critical infrastructures across all wildfire phases.

Related Project: FIREWISE
Abstract Submission Deadline: 30 November 2025
Manuscript Submission Deadline: 20 February 2026
More information: here

This curated session addresses the challenges of ageing bridge assets under rising demands, climate change, and increasing traffic loads. It explores how digital technologies — from innovative sensing and AI-based assessment to digital twins and decision-support frameworks — can transform bridge integrity management across the lifecycle. By bridging research and practice, the session aims to showcase successful applications, highlight ongoing challenges, and chart future pathways toward safer, smarter, and more resilient bridge infrastructure.

Related Project: Recharged
Abstract Submission Deadline: 30 November 2025
More information: here

featured topic - publication in Communications engineering (Nature Portfolio)

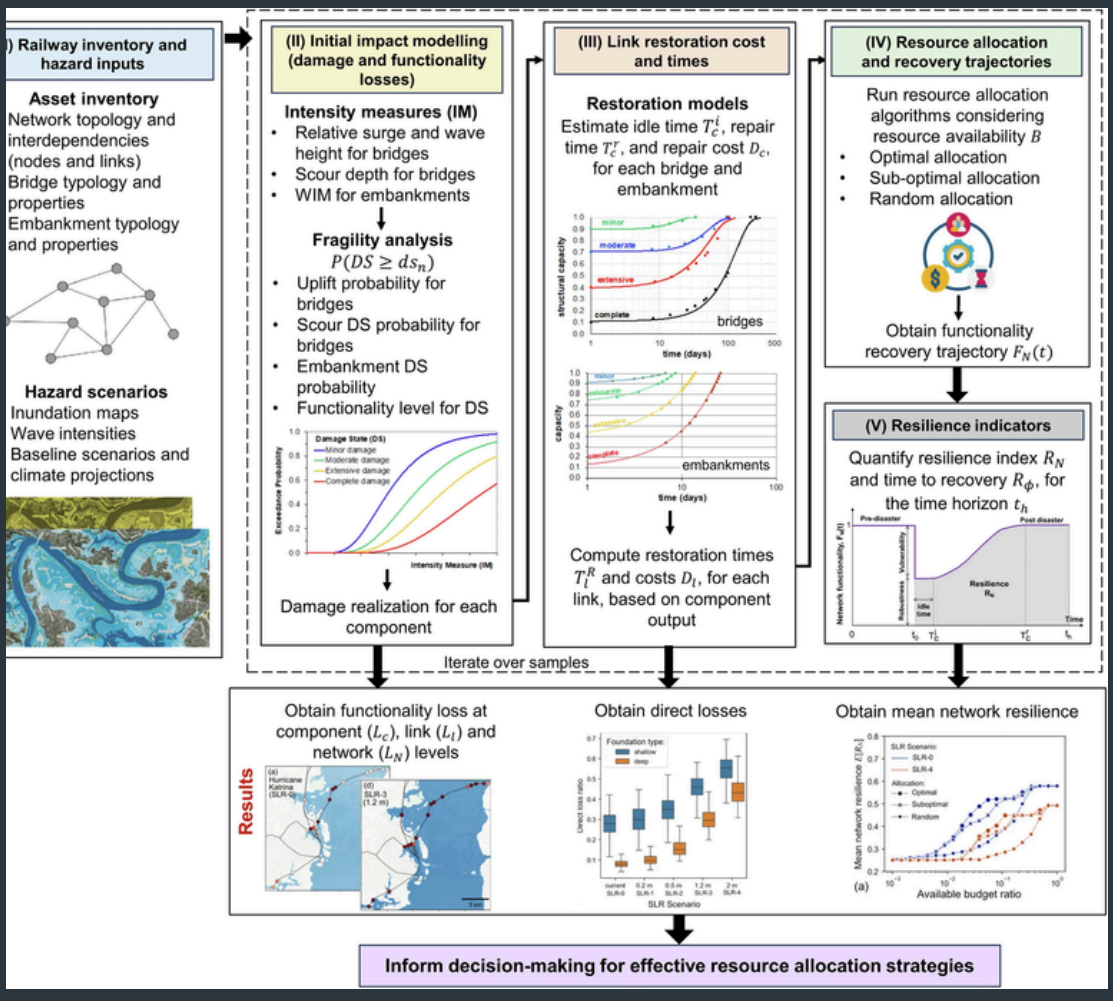
Climate-resilient railway networks: a resource-aware framework

Anibal Tafur, Sotirios A. Argyroudis, Stergios A. Mitoulis & Jamie E. Padgett

Stergios Mitoulis and Sotirios Argyroudis have co-authored a landmark international study, published in Communications Engineering (Nature Portfolio), that introduces a probabilistic, resource-aware framework to boost the resilience of railway freight networks against climate-driven disruptions. The research tackles escalating risks from compound hazards such as hurricanes and sea-level rise, offering a new way to assess vulnerabilities and strengthen critical transport systems.

By combining hazard modelling, structural fragility analysis, and resource optimisation, the study simulates post-disruption recovery and shows how targeted allocation of resources can accelerate network restoration. Results indicate resilience gains of up to 75%, providing infrastructure managers and policymakers with practical tools to prioritise investments and design faster, more cost-effective recovery strategies.

This work reflects a strong global collaboration between MetaInfrastructure and Rice University (Anibal Tafur, Prof Jamie E. Padgett) uniting expertise in climate science, structural engineering, and network recovery planning to deliver actionable solutions for climate adaptation.



DOI: https://doi.org/10.1038/s44172-025-00493-4

our news Jul-Sep 2025

September 23, 2025: Stergios-Aristoteles Mitoulis delivered a keynote at ARTISTE 2025, the inaugural International Conference & Summer School on Artificial Intelligence in Structural Engineering, held at the Valentino Castle of Politecnico di Torino. His lecture, "From Asset Damage to Systemic Breakdown: Rethinking Infrastructure Resilience with AI", explored how artificial intelligence can transform the anticipation and response to complex infrastructure failures.

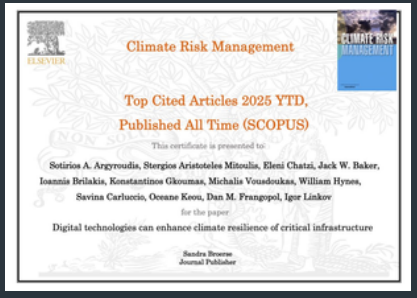
September 14, 2025: Dr Stergios-Aristoteles Mitoulis concludes visit to Tongji University with resilience workshop in Shanghai. The workshop explored key aspects of resilience planning — from systemic and asset-specific resilience to renovation costs, import dependencies, and resource constraints — underscoring the need to embed economic and material factors into resilience frameworks.

September 13, 2025: The article, titled "Bridge damage characterisation using machine learning: methods and advances", by Stergios-Aristoteles Mitoulis, Francesco Pentassuglia, and Ivan Izonin, was published in Results in Engineering. The paper reviews global approaches to bridge damage detection and demonstrates how machine learning can transform structural health monitoring.

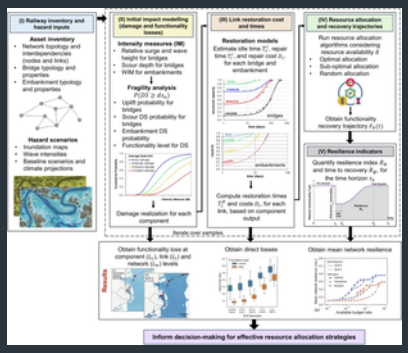
September 11, 2025: Stergios-Aristoteles Mitoulis visited Tongji University's College of Architecture and Urban Planning (CAUP) to exchange ideas on resilient and sustainable urban environments. Meeting with Professors Xing Shi, Ariel Peixian Li, and colleagues, he explored innovative approaches to transforming built environments while expressing his interest in future collaborations.

September 9, 2025: Stergios-Aristoteles Mitoulis delivered a distinguished lecture at the Chinese Academy of Sciences in Beijing. His talk, "Wildland Urban Interface and Critical Infrastructure: A Missing Link in Wildfires Resilience", examined vulnerabilities in the WUI and outlined a framework for strengthening infrastructure resilience before, during, and after wildfires, highlighting the role of fragility curves and digital tools in shaping future-ready standards.

September 8, 2025: Our paper "Digital technologies can enhance climate resilience of critical infrastructure" has been recognised by Elsevier as the #1 most cited paper in Climate Risk Management since January 2022, one of the most downloaded articles, and the #9 most cited paper of all time in the journal. With over 300 citations on Google Scholar, this achievement highlights both the urgent need for digital innovation in climate resilience.

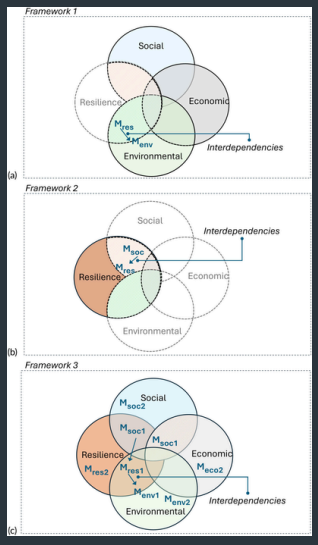


our news Jul-Sep 2025



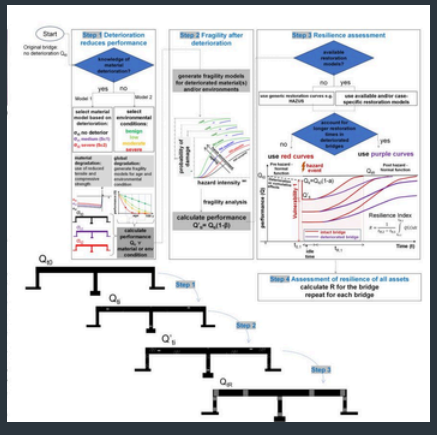
August 27, 2025: Our paper "Climate-resilient railway networks: a resource-aware framework", by Anibal Tafur, Sotirios Argyroudis, Stergios-Aristoteles Mitoulis, and Jamie Padgett (Rice University), has been published in Communications Engineering (Nature Portfolio). The study introduces a probabilistic framework to evaluate how coastal hazards and sea-level rise affect railway networks, while examining how different resource allocation strategies shape recovery and resilience.

August 18, 2025: Our paper "Enhancing Sustainability and Resilience Against Natural Hazards of the Built Environment — State of the Art and Development of a Novel Framework" by Roberta Di Bari, Raffaele Cucuzza, Marco Domaneschi, Stergios-Aristoteles Mitoulis has been published open access in Sustainable Development. The paper introduces a practical two-step framework that unifies sustainability and resilience assessment across the life cycle of buildings and infrastructure. By integrating social, environmental, and economic dimensions and accounting for performance over time, it supports proactive, risk-aware decision-making and offers a structured path to reduce risks while advancing long-term sustainability goals..



August 9, 2025: Our paper "Resilience Models for Tunnel Recovery After Earthquakes" by Zhongkai Huang, Nian-Chen Zeng, Dongmei Zhang, Sotirios Argyroudis, and Stergios-Aristoteles Mitoulis has been published in Engineering, the flagship journal of the Chinese Academy of Sciences and Chinese Academy of Engineering. The paper introduces, for the first time in the international literature, resilience models that integrate engineering, data, and recovery planning to accelerate tunnel recovery after earthquakes. These models provide a foundation for more robust post-disaster responses and have the potential to inform future infrastructure policy and practice worldwide.

August 5, 2025: Our paper "Effect of deterioration on critical infrastructure resilience—Framework and application on bridges" by Stergios-Aristoteles Mitoulis and Davide Forcellini has been published in Results in Engineering. The study introduces a resilience assessment framework that explicitly incorporates ageing and deterioration into both loss and recovery phases, with a focused application on the seismic resilience of bridges. By integrating deterioration into fragility models and recovery processes, the framework generates differentiated resilience outputs across service lifespans (20, 40, and 60 years) and develops realistic recovery curves for degraded infrastructure..



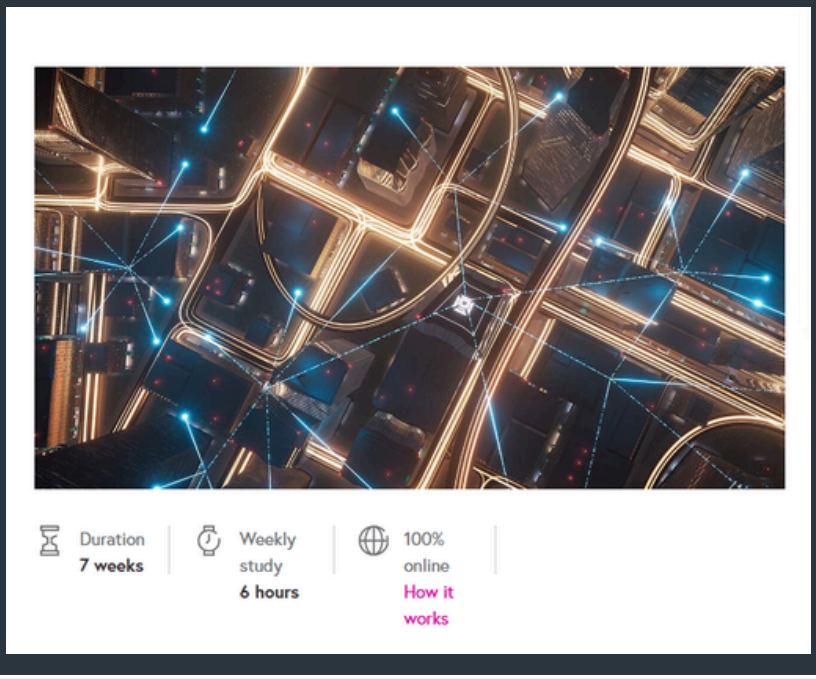
our news Jul - Sep 2025

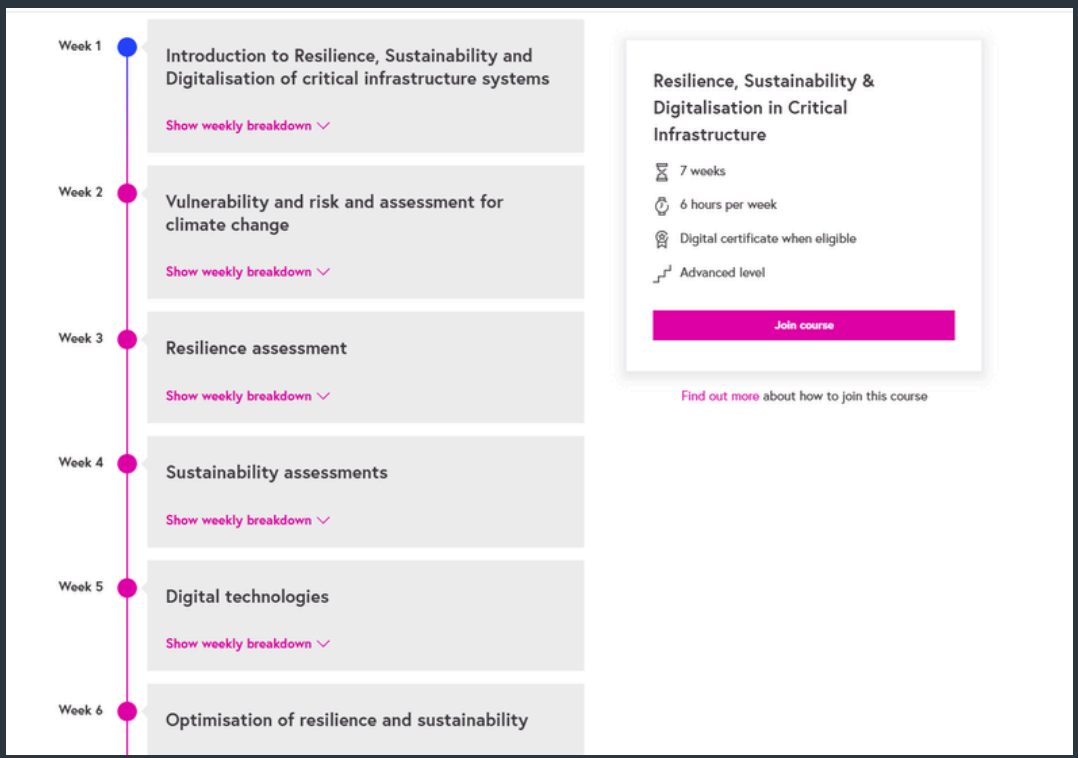
New MOOC on FutureLearn

"**Resilience, Sustainability & Digitalisation in Critical Infrastructure**" is now live on FutureLearn as a free, open-access Massive Open Online Course (MOOC).

The first of its kind, this course bridges infrastructure systems, technological innovation, and climate resilience. It offers learners worldwide access to cutting-edge academic insights, real-world case studies, and practical tools to future-proof critical infrastructure. Designed for students, researchers, professionals, policymakers, and all those interested in climate adaptation, the MOOC delivers content in an engaging, interactive format.

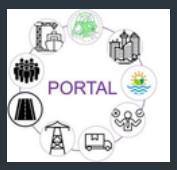
Related Project: ReCharged



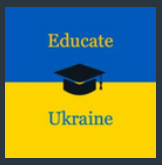


ongoing projects

PORTAL – Adaptive strategies for enhancing threat -agnostic resilience of port ecosystems
Funding: HORIZON-MSCA-SE-2025



Empower Ukraine – Capacity building for critical infrastructure restoration in Ukraine
Funding: UK Charity-2024



FIREWISE - Proactive wildfire resilience assessment and management
Funding: UKRI/HORIZON-MSCA-PF-2024

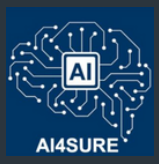
META-GRID– Climate resilience assessment and adaptation of the European power grid
Funding: HORIZON-MSCA-PF-2024

REACT – Reusing steel for emission reduction through AI-driven cutting-stock tool
Funding: HORIZON-MSCA-PF-2024

ZEBAI - Innovative methodologies to design zero-emission and cost-effective buildings based on AI
Funding: HORIZON-CL5-2023-D4-01-01

bridgeAdapt - Sustainable adaptation of bridges deteriorated to climate and human-induced damage
Funding: British Academy-2023

AI4SURE – AI-empowered data-mining techniques for sustainable and climate-resilient infrastructure peacebuilding. Funding: British Academy-2023



WINDTUNE - Efficiency of natural ventilation toward zero-energy residential buildings
Funding: British Academy-2023

ReCharged – Climate-aware resilience for sustainable critical and interdependent infrastructure systems enhanced by emerging digital technologies. Funding: HORIZON-MSCA-SE-2021

RISKADAPT – Asset-level modelling of risks in the face of climate-induced extreme events and adaptation. Funding: HORIZON-MISS-2021-CLIMA-02

completed projects

- DiRect - Digitally enhanced resilience of critical transport infrastructure
  Funding: HORIZON-TMA-MSCA-PF-EF-2021
- ReBounce - Integrated resilience assessment framework for bridges and transport networks exposed to hydraulic hazards
  Funding: H2020-MSCA-IF-2019
- BriFace - Novel assessment of bridge retrofitting measures through interface efficiency indices using a guided wave-based monitoring method
  Funding: H2020-MSCA-IF-2018
- TRANSRISK - Vulnerability and risk assessment of transportation systems of assets exposed to geo-hazards
  Funding: H2020-MSCA-IF-2016

our team

Prof Stergios Aristoteles Mitoulis, *Head*
The Bartlett School of Sustainable Construction (BSSC), University College London (UCL) and Honorary Professor, University of Birmingham
PhD, DiplEng, MSc, CEng MICE, M.ASCE, M.EAEE, FHEA
resilience of transport assets; monitoring-driven resilience of infrastructure; damage-free; zero-maintenance bridges; Eurocode expert

Dr Sotirios Argyroudis, *Global Deputy Head*
Associate Professor (Reader), Brunel University of London, PhD, DiplEng, BSc, CEng MICE, FHEA
risk and resilience assessment of critical infrastructure and networks; multiple hazards & climate change effects

Nadiia Kopiika, *BSSC, UCL Deputy Head*
Research Fellow, BSSC, UCL, British Academy/CARA
strength and reliability; strengthening; retrofitting, material properties; probabilistic approaches; non-destructive methods

Dr Ivan Izonin, *AI/ML Lead*
Associate Professor, British Academy/CARA
S.M.IEEE, M.ACM, M.INNS
AI/ML; high-speed computational intelligence; neural-like structures; non-iterative training algorithms; ensemble models; meta learning and small data analysis

Dr Shchasiana Arhun, *Education & Energy Efficiency Lead*
Teaching Fellow, BSSC, UCL
sustainable transport; energy-saving and energy-efficient technologies in transport; renewable energy integration in transport; vibration diagnostics of electric machines

Dr Raffaele Cucuzza, *Circularity in Structures Lead*
Postdoctoral Research Fellow (Marie-Curie), BSSC, UCL, PhD, DiplEng
structural optimisation; data-driven design of infrastructure; LCA-driven design; eco-design; steel structures; reusing steel

Dr Stavros Sakellariou, *GIS Lead and MetaNewsletter*
Postdoctoral Research Fellow (Marie-Curie), Brunel University of London, PhD, MSC, DiplEng
wildfires simulation and management; GIS & remote sensing; spatial resilience, planning and climate change

Dr Khrystyna Myroniuk, *Building Physics Lead, Dissemination Operations*
Associate Professor, British Academy/CARA
heating, ventilation, and air conditioning; energy-saving buildings; EU standards; resource-saving technologies

Dr Roberta Di Bari, *R&D and Sustainable Buildings Lead*
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sustainable constructions; LCA; building physics

Dr Yiming Xiang, *LLMs for Research Facilitation Lead*
Research Fellow, BSSC, UCL, PhD, MSc
sustainable constructions; energy efficiency; LCA

Dariia Berestok, *Operations Lead*
Project Manager, BSSC, UCL
project management; communication; coordination; stakeholder engagement; process optimisation

John Adah Agbo, *Event Organisation Lead*
Doctoral researcher, quantity surveyor, BTech, MSc
climate-resilience and sustainability; optimisation; transport infrastructure; adaptation

Mohammed Almousa, *Communications Manager & Website Lead*
Doctoral researcher, architecture & building science, BSc, MSc
integration of micro-mobility with the public transportation

Francesco Pentassuglia
Doctoral researcher, structural engineer, MEng, MSc
FEM; risk assessment and safety; low-carbon; energy efficiency; structural engineering; remote control

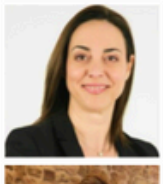
Seyyed Mohammad Hosseini, *Content & Communications Assistant*
Doctoral researcher, MSc, BSc in Civil Engineering
seismic design; infrastructure resilience; Finite Element Modelling, Building Information Modelling (BIM)

Dr Jinsheng Wang
Researcher, PhD, MSc, BEng
structural reliability; uncertainty quantification; machine learning; bridge engineering

Henrry V Rojas Asuero
Doctoral researcher (Pontificia Universidad Católica de Chile), MSc in Civil Engineering
vulnerability and fragility assessment; civil engineering systems analysis

Dr Marianna Loli
principal researcher (Marie-Curie), PhD, DiplEng, MSc, project coordinator Grid Advisors, Associate at Innovation Center on Natural Hazards & Infrastructure (ICONHIC); seismic risk assessment; geotechnical design; numerical and experimental modelling (associated member)

Prof Nataliya Shakhovska
Rector, Lviv Polytechnic National University
AI; big data; database and data warehouse integration; distributed systems; integrated systems and dataspaces; VR/AR (associated member)



María Montiel Durá Aras, *Urban Development Specialist*
Doctoral researcher, DegreeEng, MBA
civil construction and urban transports and services; urban development of cities (associated member)

Dr Eleonora Perugini
Senior Researcher, PhD, MSc, CEng
remote sensing; bridge-scour; risk assessment; field monitoring; numerical modelling; floods; nearshore morphodynamics; estuarine and river environment (associated member)

Dr Morgan Breen
Researcher, PhD, BSc in Geography
GIS and geospatial analysis; agent-based modelling; socio-economic and socio-spatial assessment; flood risk management (associated member)

Prof Jelena Ninic
Professor in Digital Engineering, Durham University, MEng, PhD, FHEA
Computational methods and tools; advanced numerical methods and novel information technologies (associated member)

MetaInfrastructure.org

For more information about our team and research project portfolio visit:
https://metainfrastructure.org