Organisation: The Swiss Applied Mathematical Society, Switzerland

Horizon Europe call HORIZON-CL2-2026-01-HERITAGE-03: AI integration in CCSI work practice: catalysing innovation and competitiveness

Research interest

Our research focuses on applied mathematics, artificial intelligence, and stochastic modelling for complex systems. We develop mathematical and AI-enabled digital twins for risk intelligence, with applications in cultural and digital heritage preservation, including the study of heritage sites such as Petra. By integrating stochastic differential equations, data science, and physics-informed modelling, we support predictive analysis, conservation planning, and sustainable management of complex cultural systems.

Potential contribution to the consortium

We contribute interdisciplinary expertise in applied mathematics, artificial intelligence, and stochastic modelling for complex systems, with a focus on developing AI-enabled digital twins for cultural and digital heritage preservation. Our team works at the intersection of mathematical modelling, data science, and heritage science to support predictive risk intelligence for complex heritage environments.

Within the consortium, we will contribute to the conceptual and methodological development of mathematical and AI-driven models that enable monitoring, analysis, and prediction of heritage risks, including erosion, structural degradation, and environmental impacts. Building on experience with international collaborations and open science initiatives, we will support the integration of data-driven approaches with cultural heritage practice.

We will also contribute to case studies involving heritage sites such as Petra, helping to develop digital twin frameworks that combine mathematical modelling, AI analytics, and heritage documentation. In addition, we will support interdisciplinary coordination, scientific dissemination, and the development of open knowledge resources that enhance innovation, collaboration, and long-term sustainability in digital heritage preservation.

Foreseen costs

The foreseen costs mainly cover personnel time for research and technical development, including applied mathematics, artificial intelligence modelling, and data analysis related to digital heritage preservation. Additional costs include travel and subsistence for consortium meetings, workshops, and coordination activities, particularly for collaboration with international partners and case study sites such as Petra.

Budget is also allocated for data processing, digital modelling, and development of AI-enabled digital twin prototypes, including software tools and computational resources. Further costs relate to dissemination and communication activities, including workshops, publications, and outreach to cultural heritage stakeholders and creative industry partners.

Where relevant, limited resources may also support heritage documentation activities, stakeholder engagement, and the development of open-access materials to ensure the accessibility, sustainability, and long-term impact of the project outcomes.

Additional partners and their role

- **Cardiff University, UK**. Role: Contribute expertise in applied mathematics and stochastic modelling. Support the development of mathematical frameworks for uncertainty quantification, risk modelling, and predictive analysis relevant to cultural heritage preservation and AI-enabled digital twin systems.

- **Cyprus University of Technology**, Cyprus. Role: Provide expertise in archaeology and digital heritage documentation. Contribute archaeological knowledge, heritage data integration, and support the interpretation and documentation of cultural heritage assets using digital and analytical methods.
- **Petra National Trust**, Jordan. Role: Act as a key cultural heritage stakeholder and local partner for engagement and dissemination. Provide expertise in heritage conservation and community engagement related to Petra, facilitate access to local heritage networks, and support outreach and public dialogue activities.
- **Hashemite University**, Jordan. Role: Contribute expertise in architecture and heritage conservation. Support architectural analysis of heritage structures, heritage documentation, and the integration of architectural knowledge into digital heritage preservation and conservation strategies related to Petra.

Previous/ongoing projects

AI for Heritage Preservation in Petra

This initiative explores the application of artificial intelligence and advanced mathematical modelling to support the preservation and sustainable management of cultural heritage sites, with Petra as a primary case study. The project brings together expertise in applied mathematics, AI, architecture, archaeology, and heritage science to investigate digital documentation, risk assessment, and predictive modelling for heritage conservation.

The initiative promotes interdisciplinary collaboration between European and Jordanian partners and contributes to developing AI-enabled digital approaches for monitoring heritage degradation, supporting conservation planning, and strengthening international knowledge exchange on digital heritage preservation.

Relevant publications

Mu, Gang, and Vishal Varma. 2025. “AI Enabled Digital Twins.” *Harvard Business Review*, May 29, 2025.

Lau, Zechariah, Ian M. Griffiths, Aaron English, and Katerina Kaouri. "Predicting the spatio-temporal infection risk in indoor spaces using an efficient airborne transmission model." Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences 478, no. 2259 (2022).

El Faouri, Bayan. "Pursuing World Heritage status for cities in the MENA region: Local implications for urban regeneration and contemporary architecture, the case study of As-Salt in Jordan." Cardiff University, 2024.

El Faouri, Bayan F., and Magda Sibley. "Mapping the Role of Jordan’s Governmental Institutions and NGOs in the Inscription of As-Salt City on the UNESCO World Heritage." In International Conference on Conservation of Architectural Heritage, pp. 431-448. Cham: Springer International Publishing, 2022.

Agapiou, Athos, Vasiliki Lysandrou, Dimitrios D. Alexakis, Kyriakos Themistocleous, Branka Cuca, A. Argyriou, Apostolos Sarris, and Diofantos G. Hadjimitsis. "Cultural heritage management and monitoring using remote sensing data and GIS: The case study of Paphos area, Cyprus." Computers, Environment and Urban Systems 54 (2015): 230-239.

Agapiou, Athos. "Remote sensing heritage in a petabyte-scale: satellite data and heritage Earth Engine© applications." International journal of digital earth 10, no. 1 (2017): 85-102.

Contact

Dr. Gang Mu, President of the Swiss Applied Mathematical Society, mug@swissmath.org