

CAMERA: Causal Adaptive Multimodal Environment for Real-time Analysis

This project will develop and validate CAMERA (Causal Adaptive Multimodal Environment for Real-time Analysis), a novel AI model designed to understand how public sentiment and socio-economic risk evolve in complex real-world environments.

Large infrastructure and Net Zero projects, including Small Modular Reactors (SMRs), carbon capture systems, offshore wind developments, hydrogen infrastructure, and major energy networks, increasingly **face delays caused by public opposition, regulatory escalation, and socio-economic concerns**. Existing approaches to understanding public response typically rely on static surveys, retrospective analysis, or manual consultation processes that struggle to identify emerging risks early enough to support effective decision-making.

The project investigates whether a continuously updating AI system combining online learning with causal reasoning can improve prediction, adaptability, and explainability in changing environments.

To achieve this, the project will develop CAMERA as a multimodal causal world model capable of continuously learning from evolving data streams including text, images, audio, and structured information. Unlike conventional AI systems trained offline on static datasets, CAMERA is designed to adapt in real time as conditions change and to model the underlying drivers behind behavioural shifts rather than relying only on surface-level correlations.

The model combines four core technical innovations:

- intelligent filtering of high-volume streaming data to identify important emerging signals while reducing computational load
- multimodal learning across text, images, audio, and structured metadata
- causal modelling of evolving socio-technical drivers such as trust, safety concerns, economic disruption, and public response
- dual-timescale adaptation mechanisms enabling rapid reaction to emerging events while maintaining long-term model stability

The project will validate CAMERA against existing state-of-the-art AI approaches using both public datasets and infrastructure-related datasets provided through project collaborators. Validation will include testing prediction accuracy, early-warning capability, causal reasoning performance, and real-time adaptation under changing conditions.

The initial application area is socio-economic risk and public acceptance analysis for nationally significant infrastructure projects. Beyond infrastructure, the underlying AI capability could support wider applications in areas such as public policy modelling, national resilience analysis, financial risk intelligence, and other sectors requiring real-time understanding of evolving human behaviour under uncertainty.

The project aims to strengthen UK capability in advanced AI systems, particularly in online learning, explainable AI, and adaptive AI architectures for dynamic real-world environments.