

Safer Bridges through Drones and AI

UAV-based Crack Detection Meets Fracture Mechanics: A Research Pathway for Autonomous AI-aided Fatigue Assessment of Steel Bridges (**UCFraMe**)

Technical University of Denmark, COWI A/S and Danish Road Directorate

UCFraMe is developing a new way to spot and assess tiny fatigue cracks in steel bridges by combining drones, engineering expertise, and artificial intelligence. Instead of simply collecting images, the project aims to turn drone footage into clear, useful and actionable information about where a crack is, how serious it may be and how it might grow over time.

This is increasingly important as many steel bridges are aging and may develop cracks in welded areas that are hard to reach and even harder to inspect safely – especially in confined spaces such as inside a bridge deck's cross-section. To tackle this, drones will capture detailed close-up images in confined areas, and AI, guided by proven fracture mechanics principles, will help predict the existence, severity and future development of any detected crack.

Led by the Technical University of Denmark (DTU), researchers from two departments, DTU Construct and DTU Electro, will collaborate with specialists and engineers from COWI A/S, who will contribute practical bridge assessment experience, and the Danish Road Directorate, who will provide the perspective of a bridge owner and maintainer. Starting around mid 2026 and running for 14 months, the work will be carried out at DTU including simulations, laboratory tests and selected bridge inspections to refine the drone-based setup.

Ultimately, **UCFraMe** aims to deliver a proof of concept method that turns drone images into reliable insights on crack existence, severity and propagation helping reduce the need for inspectors to enter hazardous spaces and supporting more proactive, efficient maintenance of critical infrastructures.