START DATE: 1ST DECEMBER 2015
DURATION: 36 MONTHS

PROJECT COORDINATOR

AIRBUS DEFENCE & SPACE

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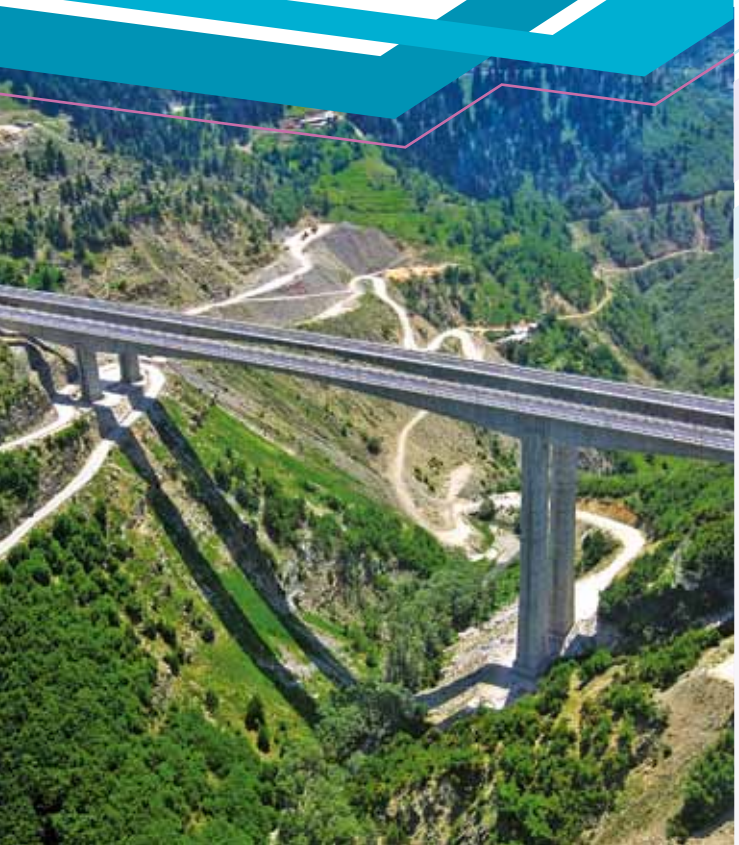
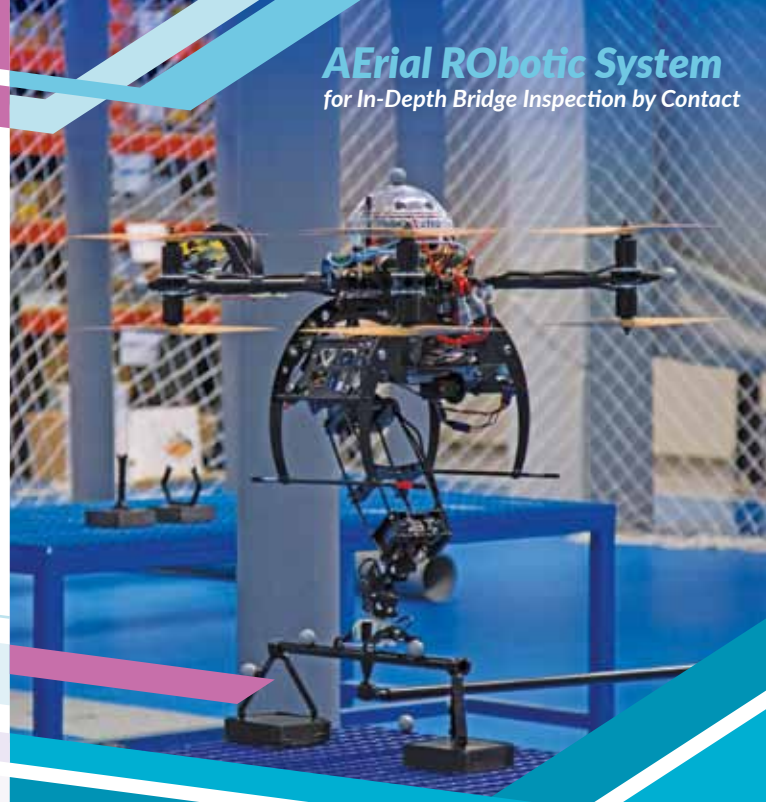
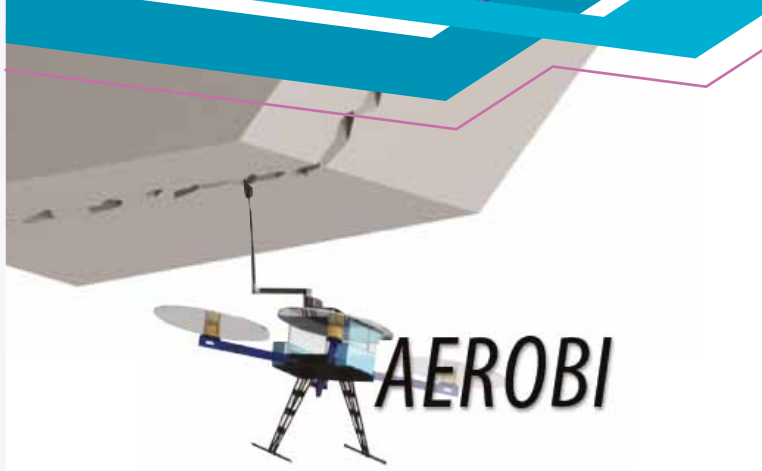


AEROBI partners

- AIRBUS DS SAS (ADS), France
- Center for Advanced Aerospace Technologies (FADA-CATEC), Spain
- Universidad De Sevilla (USE), Spain
- Stiftung Frankfurt Institute for Advanced Studies (FIAS), Germany
- Consiglio Nazionale Delle Ricerche (CNR), Italy
- EGNATIA ODOS AE (EOAE), Greece
- Risa Sicherheitsanalysen Gmbh (RISA), Germany
- T.E.C.N.I.C. Tecniche e Consulenzenell'ingegneria Civile-consulting Engineers-SPA, Italy
- D. Mpairaktaris Kai Synergates-Grafeion Technikon Meleton Etaireia Periorismenis Efthynis (DBA), Greece
- Forum of European National Highway Research Laboratories (FEHRL), Belgium
- Netivei Israel-National Transport Infrastructure Company (NTIC), Israel
- Institut Français des Sciences et Technologies des Transports, de l'Aménagement et des Réseaux (IFSTTAR), France
- Transport Research Laboratory (TRL), UK

AErial RObotic System
for In-Depth Bridge Inspection by Contact





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Why AEROBI?

One of the greatest challenges facing engineers today is the inspection, assessment, maintenance and safe operation of existing civil infrastructure such as, bridges, tunnels, roads, retaining walls, and much more. Due to ageing, environmental factors, increased loading, change in use, damages caused by human/natural factors, inadequate or poor maintenance and deferred repairs, civil infrastructure is progressively deteriorating, urgently needing inspection, assessment and repair work. Nowhere is this need more apparent than in bridges, a large number of which have been in operation for more than half a century and there are widespread signs of deterioration, evidenced by an increase in the proportion of budgets spent on inspection and assessment.

Presently, bridge inspection is primarily done through visual observations by inspectors. It relies upon the inspector having access to bridge components via access equipment (ladders, rigging and scaffolds) and vehicular lifts (manlifts, bucket trucks and under-bridge inspection vehicles). This is uncomfortable and potentially dangerous for the inspectors, while it interferes with the traffic contributing to bottlenecks and congestion. This coupled with the fact that inspection by the human eye, that is the norm in the industry, can be subjective and unreliable suggests the need for better ways to inspect and assess the structural condition of in-service bridges.

In recent years, there is a great boost in robotic technologies, such as, unmanned aerial robotics with multiple-joint arms, intelligent control, sensing, computer vision and machine learning that can provide the required elements for aerial robotic in-depth inspection of bridges.

AEROBI, driven by the bridge inspection industry, adapts and integrates recent research results in low flying unmanned robots with arms, intelligent control in robotics, computer vision and sensing, in an innovative, integrated, low flying, robotic system with a specialised multi-joint arm that will scan concrete beams and piers in a bridge for potential cracks on the surface or concrete swelling or spalling.

AEROBI Solution

AEROBI aims at the development and validation of the prototype of an innovative, intelligent, aerial robotic system with a specialised multi-joint arm for the in-depth structural inspection of reinforced concrete bridges, speedily and reliably, without interfering with the traffic and endangering the inspectors, that has the potential to be commercialised in the short term. The final integrated AEROBI robotic system will interweave innovative computer vision and sensing techniques with intelligent control of a multi-degree-of-freedom (MDOF) robot able to provide all required parameters for structural assessment with the required accuracy. The system will also include a module that based on inspection results will automatically assess, in near real time, the structural condition of the bridge.

The proposed bridge inspection system will include:

- A flying robotic system with a specialised multi-joint arm able to place Non Destructive Testing (NDT) devices in specific places on the surface and navigation and positioning capabilities.
- An integrated intelligent control component that should define the orientation and lighting conditions for the cameras and command the robotic system so as to receive "good visual features" while simultaneously determining the speed needed to inspect the structural elements, whether there is a need to stop and contact the element for more detailed measurements and how to obtain more detailed measurements (with which measurement device).
- A computer vision system that will combine state-of-the-art machine learning tools to automatically detect and assess defective performance in the surface through visual inspection.
- Sensing capability to provide the required measurements in the identified areas of concern (e.g., structural cracks, voids in concrete or loss of reinforcing steel bar (rebar) cross section, deflections) with the required accuracy.
- And finally, a module that based on inspection results will automatically assess the structural condition of the bridge through the use of civil engineering algorithms.

Expected Impacts

AEROBI, a robotic, fast and reliable bridge inspection and assessment solution that combines both detailed inspection and structural assessment and that does not interfere with the bridge services or endanger bridge inspectors will have a tremendous impact on the bridge inspection industry and our society:

- It will provide safe working conditions for bridge inspectors that are exposed to numerous potential hazards while performing inspection tasks.
- It will reduce to zero disruption of transport flows from rail and road bridge structural inspection and assessment.
- It will make possible fewer, faster and better planned maintenance interventions in bridges and eliminate the need for emergency repairs that are inelastic in terms of timing, require a lot of time to perform and often necessitate service interruptions.

AEROBI will lead to the deployment of robotics technologies in new application domains. This is the first time that flying robots with arms will be used for the in-depth inspection of bridges or the in-depth inspection of the rest of the civil infrastructure. Since the civil infrastructure in the developed countries is ageing and in need of in-depth inspection and assessment, the market for the proposed robotic system is large for bridges, as well as for the rest of civil infrastructure.

The AEROBI project will increase industry-academia cross-fertilisation by bringing together civil engineers and bridge operators with robotics experts from academia. It is expected that this collaboration will promote the adaptation of novel robotic technologies to specific civil engineering problems (such as bridge inspection).