An innovative tool for conducting remote inspections throught the digital twin of a bridge obtained by photogrammetry

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BRIDGES AND VIADUCTS: MAIN CHALLENGES

Autostrade per l'Italia Group

The largest highway operator in Europe

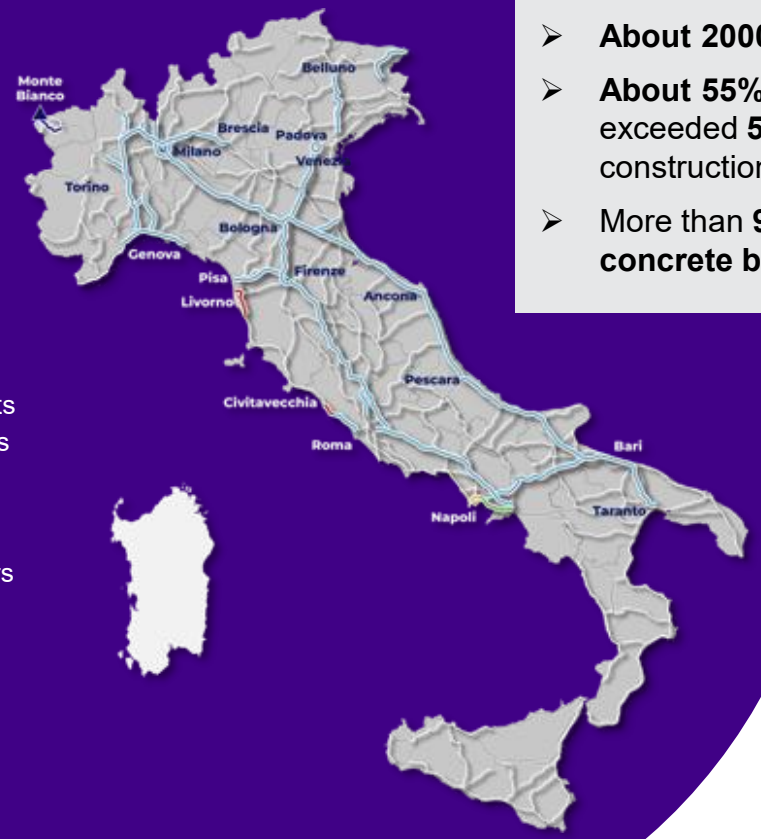
~ 3.000 km motorway network

~ 320 km tunnels

~ 4400 bridges /viaducts and overpasses

4,6 M daily customers

2,7 M daily vehicle transit



- **About 2000** bridges (> 10m)
- **About 55%** of bridges has exceeded **50 years** since construction
- More than **90%** of bridges are **concrete bridges**

Trends

Vulnerability of bridges to environmental actions - degradation of concrete and reinforcement corrosion

Current **traffic loads** higher than those foreseen in the design phase (dimensions, typologies and design speed of vehicles, etc.)

Average age of bridges increases: the heritage of national structures consists of bridges and viaducts built mainly between 1960-1980; more than 50% of the bridges have therefore exceeded their useful project life and a further 30% are about to exceed it

Exceptional actions can compromise the safety of bridges - earthquake, hydrogeological risk, landslide risk

For existing bridges, it is necessary to carry out **an accurate phase of assessment of the degraded conditions**

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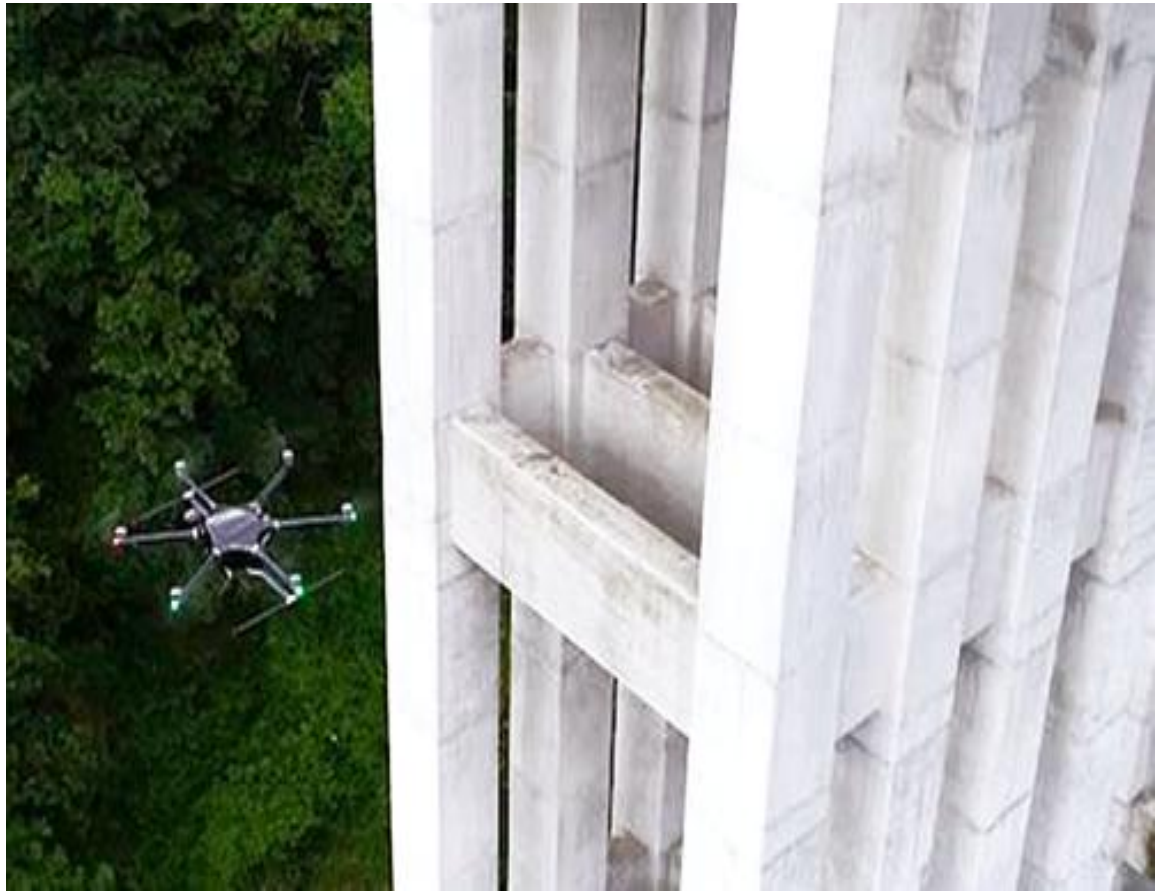

Traditional visual inspections are essential to assess the condition of highways bridges. Defect assessment is done by on field inspectors, being:

- **Laborious**
- **Time** and **cost** inefficient
- **Wide disparity in quality**

Remote inspections using **drones**

- Maximize damage identification quality
- Minimize cost
- Increase user safety

ARGO 3D is a tool to perform remote inspections using the digital twin of a bridge

- state-of-the art 3D reconstruction methods
- AI technology
- Web based application

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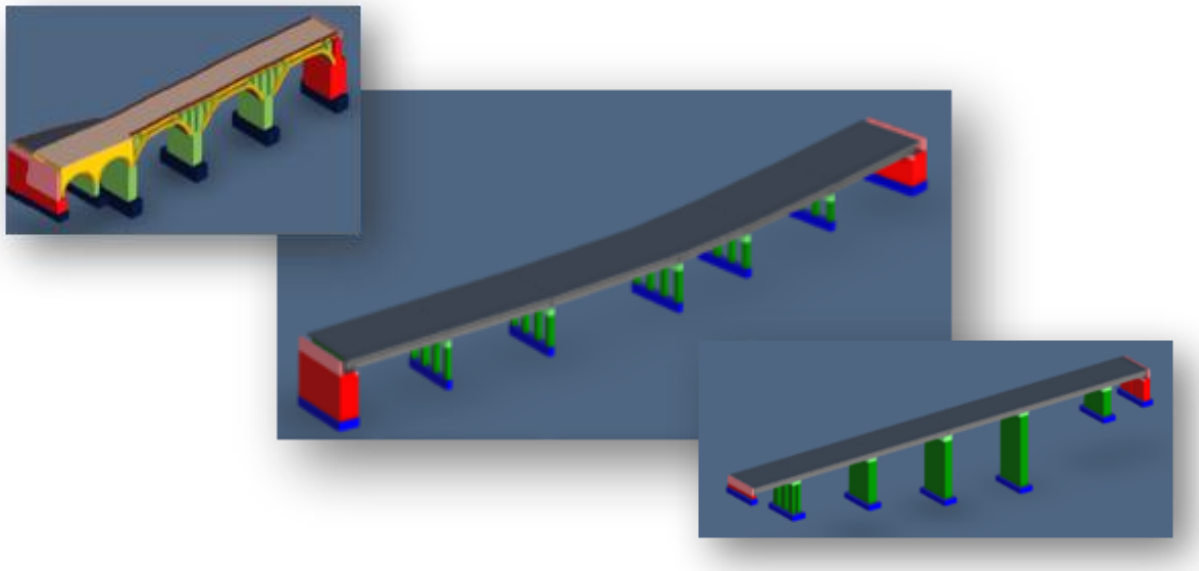
ASSET MANAGEMENT PLATFORM: ARGO



ARGO platform, the extended technological platform for managing and monitoring infrastructure life cycle.

Digital inventory of all the bridges of Autostrade per l'Italia network, which are decomposed in smaller components with a four levels hierarchy.

Automatically built simplified **3D models**, following the BIM format.

ARGO **visual inspection tool** allows to carry out on-site inspection activities:

- allows to **plan** the inspections, assign and execute them in a traceable manner.
- with a **mobile app**, helps the human to be sure to fulfill all the checks through the visualization of the simplified 3D model of the bridge
- allows comparing over time the state of a defect
- forces the user to upload images of all detected defects

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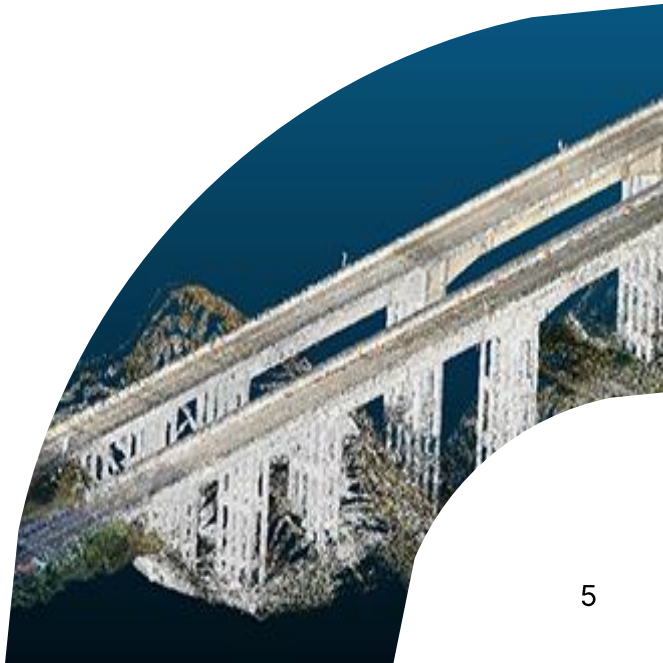
Remote inspections using ARGO 3D Tool



REMOTE INSPECTIONS USING ARGO 3D TOOL: METHODOLOGY

DATA COLLECTION

using drones around bridges. Collected data are appropriately managed, with the correct quality and completeness, and the whole data chain is signed and not repudiable.

RECONSTRUCTION OF THE DIGITAL TWIN

of the bridge obtained using photogrammetric techniques and damage identification through **AI algorithms**, analyzing drones' images, pre-identifying damages on the structure

INSPECTION PLANNING AND ASSIGNMENT

on ARGO 3D platform, so all the information related to the inspection are univocally traced inside the platform.

REMOTE INSPECTION EXECUTION

the inspector is able to perform the inspection using ARGO 3D tool, visualizing a high-resolution digital twin, performing linear and areal measurements and visualizing an initial set of defects suggested by an artificial intelligence

AUTOMATIC INSPECTION REPORT PRODUCTION

the system produces a report that assesses the state of the infrastructure, in a format compliant with the current Italian Guidelines, digitally signed by the inspector.

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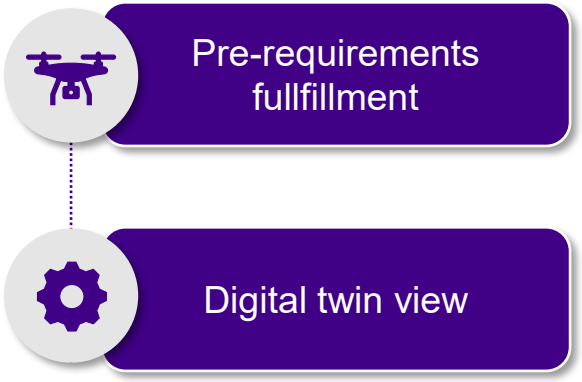
REMOTE INSPECTIONS USING ARGO 3D TOOL: PROCESS



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- Collect all images with drone
- Reconstruct the digital twin
- AI inference executed over images

- Fully usable 3D viewer from web browser
- Multiresolution

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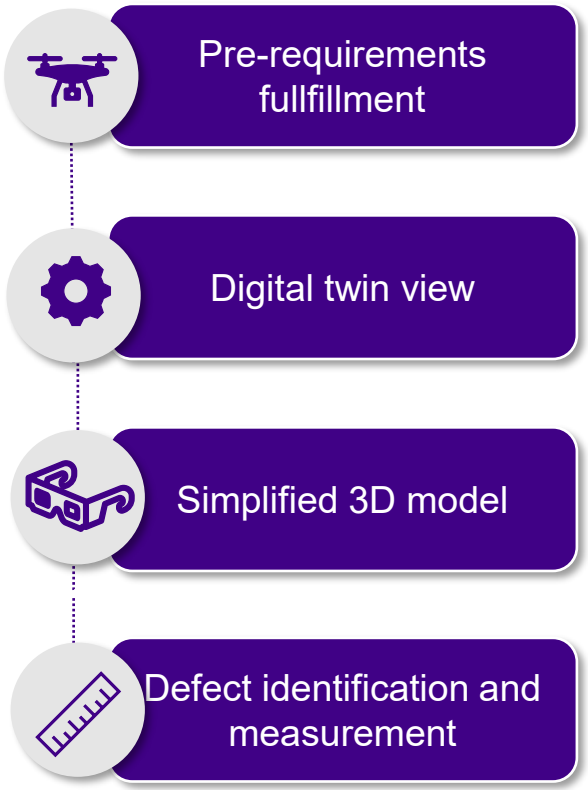
REMOTE INSPECTIONS USING ARGO 3D TOOL: PROCESS



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REMOTE INSPECTIONS USING ARGO 3D TOOL: PROCESS

- Pre-requirements fullfillment
- Digital twin view
- Simplified 3D model
- Defect identification and measurement
- Automatic damage detection with AI

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REMOTE INSPECTIONS USING ARGO 3D TOOL: PROCESS

Remote Inspections

- **Remote Inspections** done by the inspector on the ARGO3D platform
- It is possible to work directly over the digital twin, minimizing the impact on the road users

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CONCLUSION

REMOTE INSPECTIONS USING DRONES

ARGO 3D

part of the larger ARGO platform, enables remote inspections of bridges

Digitized process via mobile apps together **with** 3D models and **digital twin**

Remote inspections performed with ARGO 3D **has been tested on several bridges of Autostrade per l'Italia**

Next step

large-scale adoption of this approach and industrialization of its steps

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Thank you

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