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Abstract

UAVs for Disaster Response: Rapid Damage Assessment and Monitoring of Bridge Recovery after a Major Flood †

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While the planet is experiencing the roughest ecological disruption in our history, it is of utmost importance to try to mitigate the impact of intensifying natural disasters. Bridges are the priority for enabling climate resilience in transport infrastructure. They are inarguably the most valuable assets of transportation networks. Capital investment in bridge construction and maintenance in Europe is enormous, representing 30% of the total cost of transport networks. Nonetheless, bridges are too vulnerable. They are disproportionately exposed to natural hazards, especially floods, while becoming increasingly deficient due to ageing and urbanization trends.

Emerging Technologies are enablers of bridge resilience. Advocating for the use of UAVs in disaster response, this study provides solid and well-documented case studies discussing lessons learnt from the systematic analysis of field evidence after a recent (September 2020) Mediterranean Hurricane that struck central Greece. The use of UAVs proved essential for the rapid site reconnaissance and mapping of complex and severely damaged structures, including sinking piers, and collapsed abutments, with increased safety. UAVs effectively bypassed access blockages, resulting from failures in the road network, while, most importantly, allowing the execution of works with the minimum of human exposure to health risks during the peak of the COVID-19 pandemic.

The produced 3D models are powerful visualization tools that were found to fully compensate for the inability to physically visit the site, inspect and make decisions for severely damaged bridges. The value of this capability is also acknowledged by the researchers and engineers who performed the virtual inspections and who could not be present because of COVID-induced travel restrictions.

These models significantly facilitated the identification and analysis of the various bridge failure mechanisms, providing a uniquely comprehensive database of bridge response patterns under extreme flow velocities [1]. Furthermore, they proved useful as benchmarks for comparisons and informed decisions concerning the progress of restoration activities [2]. As such, they enabled accurate monitoring of bridge recovery and, incidentally, rapid assessment of the impact of an earthquake sequence that shook the region shortly after the flood, while mitigation works were underway. Thanks to this coincidence, we were given the opportunity to document a unique case study of the long-term performance of bridges in a multi-hazard environment, which should be of interest to all engineers and researchers in the field of civil infrastructure.

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