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A multi-disciplinary approach for the structural monitoring of Cultural Heritages in a seismic area

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In the recent years, the concepts of seismic risk vulnerability and structural health monitoring have become very important topics in the field of both structural and civil engineering for the identification of appropriate risk indicators and risk assessment methodologies in Cultural Heritages monitoring. The latter, which includes objects, building and sites with historical, architectural and/or engineering relevance, concerns the management, the preservation and the maintenance of the heritages within their surrounding environmental context, in response to climate changes and natural hazards (e.g. seismic, volcanic, landslides and flooding hazards). Within such a framework, the complexity and the great number of variables to be considered require a multi-disciplinary approach including strategies, methodologies and tools able to provide an effective monitoring of Cultural Heritages form both scientific and operational viewpoints. Based on this rationale, in this study, an advanced, technological and operationally-oriented approach is presented and tested, which enables measuring and monitoring Cultural Heritage conservation state and geophysical/geological setting of the area, in order to mitigate the seismic risk of the historical public goods at different spatial scales*. The integration between classical geophysical methods with new emerging sensing techniques enables a multi-depth, multi-resolution, and multi-scale monitoring in both space and time. An integrated system of methodologies, instrumentation and data-processing approaches for non-destructive Cultural Heritage investigations is proposed, which concerns, in detail, the analysis of seismogenetic sources, the geological-geotechnical setting of the area and site seismic effects evaluation, proximal remote sensing techniques (e.g. terrestrial laser scanner, ground-based radar systems, thermal cameras), high-resolution aerial and satellite-based remote sensing methodologies (e.g. aeromagnetic surveys, synthetic aperture radar, optical, multispectral and panchromatic measurements), static and dynamic structural health monitoring analysis (e.g. screening tests with georadar, sonic instruments, sclerometers and optic fibers). The final purpose of the proposed approach is the development of an investigation methodology for short- and long-term Cultural Heritages preservation in response to seismic stress, which has specific features of scalability, modularity and exportability for every possible monitoring configuration. Moreover, it allows gathering useful information to furnish guidelines for Institution and local Administration to plan consolidation actions and therefore prevention activity. Some preliminary results will be presented for the test site of Calabria Region, where some architectural heritages have been properly selected as case studies for monitoring purposes.

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