Geophysical Research Abstracts
Vol. 18, EGU2016-12968-1, 2016
EGU General Assembly 2016

A S.M.A.R.T. system for the seismic vulnerability mitigation of Cultural Heritages

Antonio Montuori (1), Antonio Costanzo (1), Iolanda Gaudiosi (2), Antonio Vecchio (3), Mario Minasi (1), Sergio Falcone (1), Carmelo La Piana (1), Salvatore Stramondo (1), Giuseppe Casula (4), Maria Giovanna Bianchi (4), Maria Fabrizia Buongiorno (1), Massimo Musacchio (1), Fawzi Doumaz (1), and Maria Ilaria Pannaccione Apa (1)

(1) Istituto Nazionale di Geofisica e Vulcanologia (INGV), Centro Nazionale Terremoti (CNT), Italy (antonio.montuori@ingv.it), (2) Centro Nazionale delle Ricerche (CNR), Istituto di Geologia Ambientale e Geoingegneria (IGAG), Italy, (3) Observatoire de Paris, Laboratory for Space Studies and Instrumentation in Astrophysics, Paris, France, (4) Istituto Nazionale di Geofisica e Vulcanologia (INGV), Sezione di Bologna, Italy

Both assessment and mitigation of seismic vulnerability connected to cultural heritages monitoring are non-trivial issues, based on the knowledge of structural and environmental factors potential impacting the cultural heritage. A holistic approach could be suitable to provide an effective monitoring of cultural heritages within their surroundings at different spatial and temporal scales. On the one hand, the analysis about geometrical and structural properties of monuments is important to assess their state of conservation, their response to external stresses as well as anomalies related to natural and/or anthropogenic phenomena (e.g. the aging of materials, seismic stresses, vibrational modes). On the other hand, the investigation of the surrounding area is relevant to assess environmental properties and natural phenomena (e.g. landslides, earthquakes, subsidence, seismic response) as well as their related impacts on the monuments. Within such a framework, a multi-disciplinary system has been developed and here presented for the monitoring of cultural heritages for seismic vulnerability assessment and mitigation purposes*. It merges geophysical investigations and modeling, in situ measurements and multi-platforms remote sensing sensors for the non-destructive and non-invasive multi-scales monitoring of historic buildings in a seismic-prone area. In detail, the system provides: a) the long-term and the regional-scale analysis of buildings' environment through the integration of seismogenic analysis, airborne magnetic surveys, space-borne Synthetic Aperture Radar (SAR) and multi-spectral sensors. They allow describing the sub-surface fault systems, the surface deformation processes and the land use mapping of the regional-scale area on an annual temporal span; b) the short-term and the basin-scale analysis of building's neighborhood through geological setting and geotechnical surveys, airborne Light Detection And Radar (LiDAR) and ground-based SAR sensors. They enable assessing the site seismic effects, the built-up structural features and the surface deformation processes of the local-scale area on a monthly temporal span; c) the real- to near-real-time and building scale analysis of the heritage through proximal remotely sensing tools (e.g. terrestrial laser scanning, infrared thermal cameras and real aperture radar), combined with ambient vibration tests. They allow analyzing geometric, structural and material properties / anomalies of buildings as well as the state of conservation of structures on a real-time temporal span. The proposed approach is: Specific (it targets the cultural heritages monitoring for seismic mitigation purposes); Measurable (it provides synthetic descriptors or maps able to quantify structural and the environmental properties / anomalies / trends); Action-oriented (it provides information to plan consolidation and restoration actions for prevention activity); Relevant (it allows achieving consolidated results for cultural heritage monitoring); Time-related (it specifies when the results can be achieved). Meaningful results, obtained for the Saint Augustine Complex (XVI century) located in the historic center of the Calabrian chief town of Cosenza, are presented in terms of a web-based Geographic Information System (GIS) platform and a 3-dimensional (3D) visual software for the monitoring of environmental/urban landscapes and buildings. These tools represent the added-value products of the proposed SMART system, which allow integrating and combining multi-sensors analyses in order to support end-users involved into a cultural heritage monitoring.

* The present work is supported and funded by Ministero dell'Istruzione, dell'Università e della Ricerca (MIUR) under the research project PON01-02710 "MASSIMO" - "Monitoraggio in Area Sismica di Sistemi Monumentali".