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Rapid assessment of earthquake-induced building damage using remote sensing LiDAR data

Fatemeh Foroughnia¹, Valentina Macchiarulo¹, Luis Berg², Matthew DeJong², Pietro Milillo^{3,4}, Kenneth W. Hudnut⁵, Kenneth Gavin¹, and Giorgia Giardina¹

¹Department of Geoscience and Engineering, Delft University of Technology, Delft, Netherlands (f.foroughnia@tudelft.nl)

²Department of Civil and Environmental Engineering, University of California, Berkeley, Berkeley, California, United States

³Department of Civil and Environmental Engineering, University of Houston, Houston, Texas, United States

⁴Microwaves and Radar Institute, German Aerospace Center (DLR), Weßling, Germany

⁵Southen California Edison, Rosemead, California, United States

Earthquakes are natural hazards leading to the greatest human and economic losses, which are mostly due to structural collapses. Rapid identification and assessment of earthquake-induced damage to structures is therefore an essential component of the emergency response, and instrumental to effective reconstruction plans. Typically, structural damage assessment is conducted through building-by-building inspections during post-earthquake field reconnaissance missions. These missions are expensive and time-consuming, especially if large areas need to be investigated. Remote sensing techniques provide a relatively low-cost, wide-area alternative to in-situ monitoring. Classification and change detection based on pre- and post-event optical and synthetic aperture radar (SAR) satellite images are the most used approaches to detect damaged structures after earthquakes. However, these techniques only provide qualitative observations of collapsed or severely damaged structures. In this work, we present a new approach for the quantitative assessment of earthquake-induced structural damage based on displacement measurements acquired by Airborne Light Detection And Ranging (LiDAR). The approach is based on the integration between LiDAR-based observations and structural indicators of damage. The application to the analysis of 684 buildings affected by the 2014 Napa earthquake, in California, demonstrates a good agreement between the LiDAR-based results and independent in-situ observations. This work sets the basis for the innovative exploitation of remote sensing data in disaster management.

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