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Sound Source Localisation and Augmented Reality for On-Site Inspection of Prefabricated Building Components

Authors : Jacques Cuenca, Claudio Colangeli, Agnieszka Mroz, Karl Janssens, Gunther Riexinger, Antonio D'Antuono, Giuseppe Pandarese, Milena Martarelli, Gian Marco Revel, Carlos Barcena Martin

Abstract : This study presents an on-site acoustic inspection methodology for quality and performance evaluation of building components. The work focuses on global and detailed sound source localisation, by successively performing acoustic beamforming and sound intensity measurements. A portable experimental setup is developed, consisting of an omnidirectional broadband acoustic source and a microphone array and sound intensity probe. Three main acoustic indicators are of interest, namely the sound pressure distribution on the surface of components such as walls, windows and junctions, the three-dimensional sound intensity field in the vicinity of junctions, and the sound transmission loss of partitions. The measurement data is post-processed and converted into a three-dimensional numerical model of the acoustic indicators with the help of the simultaneously acquired geolocation information. The three-dimensional acoustic indicators are then integrated into an augmented reality platform superimposing them onto a real-time visualisation of the spatial environment. The methodology thus enables a measurement-supported inspection process of buildings and the correction of errors during construction and refurbishment. Two experimental validation cases are shown. The first consists of a laboratory measurement on a full-scale mockup of a room, featuring a prefabricated panel. The latter is installed with controlled defects such as lack of insulation and joint sealing material. It is demonstrated that the combined acoustic and augmented reality tool is capable of identifying acoustic leakages from the building defects and assist in correcting them. The second validation case is performed on a prefabricated room at a near-completion stage in the factory. With the help of the measurements and visualisation tools, the homogeneity of the partition installation is evaluated and leakages from junctions and doors are identified. Furthermore, the integration of acoustic indicators together with thermal and geometrical indicators via the augmented reality platform is shown.

Keywords : acoustic inspection, prefabricated building components, augmented reality, sound source localization
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