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Urban MEMS based seismic network for post-earthquakes rapid disaster assessment

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Life losses following disastrous earthquake depends mainly by the building vulnerability, intensity of shaking and timeliness of rescue operations. In recent decades, the increase in population and industrial density has significantly increased the exposure to earthquakes of urban areas. The potential impact of a strong earthquake on a town center can be reduced by timely and correct actions of the emergency management centers. A real time urban seismic network can drastically reduce casualties immediately following a strong earthquake, by timely providing information about the distribution of the ground shaking level. Emergency management centers, with functions in the immediate post-earthquake period, could be use this information to allocate and prioritize resources to minimize loss of human life. However, due to the high charges of the seismological instrumentation, the realization of an urban seismic network, which may allow reducing the rate of fatalities, has not been achieved. Recent technological developments in MEMS (Micro Electro-Mechanical Systems) technology could allow today the realization of a high-density urban seismic network for post-earthquakes rapid disaster assessment, suitable for the earthquake effects mitigation. In the 1990s, MEMS accelerometers revolutionized the automotive-airbag system industry and are today widely used in laptops, games controllers and mobile phones. Due to their great commercial successes, the research into and development of MEMS accelerometers are actively pursued around the world. Nowadays, the sensitivity and dynamics of these sensors are such to allow accurate recording of earthquakes with moderate to strong magnitude. Due to their low cost and small size, the MEMS accelerometers may be employed for the realization of high-density seismic networks. The MEMS accelerometers could be installed inside sensitive places (high vulnerability and exposure), such as schools, hospitals, public buildings and places of worship. The waveforms recorded could be promptly used to determine ground-shaking parameters, like peak ground acceleration/velocity/displacement, Arias and Housner intensity, that could be all used to create, few seconds after a strong earthquakes, shaking maps at urban scale. These shaking maps could allow to quickly identify areas of the town center that have had the greatest earthquake resentment. When a strong seismic event occur, the beginning of the ground motion observed at the site could be used to predict the ensuing ground motion at the same site and so to realize a short term earthquake early warning system. The data acquired after a moderate magnitude earthquake, would provide valuable information for the detail seismic microzonation of the area based on direct earthquake shaking observations rather than from a model-based or indirect methods. In this work, we evaluate the feasibility and effectiveness of such seismic network taking in to account both technological, scientific and economic issues. For this purpose, we have simulated the creation of a MEMS based urban seismic network in a medium size city. For the selected town, taking into account the instrumental specifics, the array geometry and the environmental noise, we investigated the ability of the planned network to detect and measure earthquakes of different magnitude generated from realistic near seismogentic sources.