

Array Type Miniaturized Ultrasonic Sensors for Detecting Sinkhole in the City

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Abstract : Recently, the road depression happening in the urban area is different from the cause of the sink hole and the generation mechanism occurring in the limestone area. The main cause of sinkholes occurring in the city center is the loss of soil due to the damage of old underground buried materials and groundwater discharge due to large underground excavation works. The method of detecting the sinkhole in the urban area is mostly using the Ground Penetration Radar (GPR). However, it is challenging to implement compact system and detecting watery state since it is based on electromagnetic waves. Although many ultrasonic underground detection studies have been conducted, near-ground detection (several tens of cm to several meters) has been developed for bulk systems using geophones as a receiver. The goal of this work is to fabricate a miniaturized sinkhole detecting system based on low-cost ultrasonic transducers of 40 kHz resonant frequency with high transmission pressure and receiving sensitivity. Motivated by biomedical ultrasonic imaging methods, we detect air layers below the ground such as asphalt through the pulse-echo method. To improve image quality using multi-channel, linear array system is implemented, and image is acquired by classical synthetic aperture imaging method. We present the successful feasibility test of multi-channel sinkhole detector based on ultrasonic transducer. In this work, we presented and analyzed image results which are imaged by single channel pulse-echo imaging, synthetic aperture imaging.

Keywords : road depression, sinkhole, synthetic aperture imaging, ultrasonic transducer

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