MICROWAVE IMAGING OF SEISMIC DAMAGE
IN CONCRETE STRUCTURES

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Abstract: Nondestructive assessment of concrete structures heavily relies on visual inspections, which apparently have some limitations. Invisible damage such as voids and cracks inside concrete caused by earthquakes can be of significant concern. In this study, microwave sub-surface imaging technology using a bi-focusing operator has been developed for detecting and quantitatively assessing such internal damage. The proposed imaging system consists of several cylindrical- or planar-arrayed antennas for transmitting and receiving signals, and a numerical focusing operator is applied to the external signals both in the transmitting and in the receiving fields. An imaging algorithm using the numerical focusing operator was developed, which allows the recovery of a 2-dimensional object from its scattered field. Numerical simulation demonstrated that a sub-surface image can be successfully reconstructed by using the proposed sub-surface imaging technology. For the experimental verification, a prototype sub-surface imaging system using a planar antenna array was developed and tested on a concrete block. Internal and invisible voids in the block were successfully detected. The proposed sub-surface imaging technology can be further developed for quantitative condition assessment of general concrete structures and pavements, leading to the improvement of the current visual-inspection-based maintenance.

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