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Numerical modeling of GPR to simulate the underground cavities in the urban area

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Recently, the damage caused by the sinking of the ground in the urban area due to the cavities beneath the road is increasingly reported, and related researches to prevent such kinds of damages by finding cavities through 3D GPR (ground penetrating radar) exploration in advance. Our research group built the full scale experiment site which has similar underground structures, such as pipe lines, sewer channels, etc. and installed the simulated cavities made of polystyrene near or under the underground structure. GPR measurements were conducted on the surface of the experiments site. Those experiment intended to accumulate the basic knowledge required to interpret the response of various kinds of cavities and finally raise the accuracy of cavity interpretation. Although the real scale experiment gives the interpretation result which are very similar to the real situation, it only use the simple shape of cavities due to its expensive construction cost and cannot change the shape of cavities easily. However, numerical simulation of 3D GPR can change the shape of cavity and background model easily, but the size of modeling area is limited by the computation capability and sometimes costs are even higher if we use very big numerical model. In this study, we used the latest computation technology like GPGPU, Xeon phi acceleration to reduce the computation time and the maximum size of model available in out computation facility to simulate the real situation. When we compared the result of numerical simulation with that of the real scale experiments, these two results showed very similar behaviors. Another responses are acquired by changing the shape and location of cavities in the numerical simulation and compared. We could identify the slight differences due to the shape of cavity models and it might be helpful to interpret the repose of real underground cavities.