A determination of scatterers using topology optimization with time domain BIEM for scalar wave problems

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We consider an identification of the number, shape and location of scatterers in a target object using scalar waves in anticipation of application to ultrasonic quantitative non-destructive estimate(QNDE). We calculate the scattering wave field numerically and introduce a objective functional which consists of the difference between the numerical and observational scattering field. The scatterers are determined as the minimizer of the objective functional. We also consider the topology change of the target object in order to execute the identification considering the generation and extinction of scatterers. We define a topology derivative as the sensitivity of the objective functional with respect to the topology change and execute the identification of the scatterers using the topology derivative via the level set method. We solved some numerical examples of a scalar wave problem in 3D and determined the number, shape, and location of scatterers at the same time. We also show the numerical results of determination of the number, location, and direction of cracks in a scalar wave problem in 2D.

References

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