A fundamental study of a numerical analysis based on the point source method for the Helmholtz equation in 2D

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The singular source method is one of numerical methods for an inverse scattering problem, which finds unknown boundaries of scatterers from given scattering fields. This method constructs a indicator function, which goes to infinity near the unknown boundaries, based on a scattered field with a point souce wave incident. The indicator function diverges as fast as the singularity of the fundamental solution. Hence, in particular for the Helmholtz equation in 2D, finding the unknown boundaries by numerically calculating the indicator function is very difficult since the singularity of the fundamental solution is logarithmic. In order to alleviate this problem, we propose a numerical technique to use a derivative of the indicator function instead of the standard indicator function itself. We show that the derivative of the indicator function can be calculated easily and diverges near the unknown surfaces relatively faster than the conventional indicator function. We also mention that the normal vectors of the unknown boundaries are also computed from the differentiated indicator function.

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