Construction of the image using the method of fundamental solutions

Chen J T

Distinguished Chair Professor

Department of Harbor and River Engineering, National Taiwan Ocean University, Keelung, Taiwan

Department of Mechanical and Mechatronic Engineering, National Taiwan Ocean University, Keelung, Taiwan

Bachelor Degree Program in Ocean Engineering Technology, Taiwan

Department of Civil Engineering, National Cheng-Kung University, Tainan, Taiwan

In potential theory, the image method plays an important role in solving boundary value problems. First, we will review some popular images of special geometry. Based on the degenerate kernel, an alternative way to construct the image across a circular boundary was found by Chen and Wu in 2006. Not only mathematicians but also engineers show their interest to this paper as reported 1751 highly reading in the Research Gate. We may wonder whether this idea can be applied to the elliptical boundary or not. Besides, the image across the impedance boundary in the half plane is also our concern as well as a quarter and a hole in the half plane. By using the method of fundamental solution, the most efficient distribution source is the image that we need. For example, the two foci in the bipolar coordinates are found to be the simplest sources in the MFS for the BVP of an infinite plane with two circular holes. In this proposal, we will try to find the simplest source distribution in the MFS and correlate to the image method.

Prerequisite

Integral equations, potential theory, method of fundamental solutions, image method, and some experiences in programming.

References

1. J. T. Chen and C. S. Wu, 2006, Alternative derivations for the Poisson integral formula, International Journal Mathematical Education Science and Technology, Vol.37, No.2, pp.165-185.
2. J. T. Chen, H. C. Shieh, Y. T. Lee and J. W. Lee, 2011, Bipolar coordinates, image method and the method of fundamental solutions for Green’s functions of Laplace problems with circular boundaries, Engineering Analysis with Boundary Elements, Vol.35, pp.236-143.
3. J. T. Chen, H. G. Shieh, J. J. Tsai and J. W. Lee, 2010, A study on the method of fundamental solutions using the image concept, Applied Mathematical Modelling, Vol.34, pp.4253-4266.
4. J. T. Chen, Y. T. Lee, S. R. Yu and S. C. Shieh, 2009, Equivalence between Trefftz method and method of fundamental solution for the annular Green’s function using the addition theorem and image concept, Engineering Analysis with Boundary Elements, Vol.33, pp.678-688.
5. J. T. Chen, H. C. Hsieh, Y. T. Lee and J. W. Lee, 2010, Image solutions for boundary value problems without sources, Applied Mathematics and Computation, Vol.216, pp.1453-1468, 2010.

Ncts2021-abs by Chen J T due date April 22, 2021