Improved method of fundamental solutions in conjunction with kernel-independent fast multipole method for solving potential problems

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Abstract

This paper presents a novel boundary-type meshless method, improved method of fundamental solutions (IMFS) in conjunction with kernel-independent fast multipole method, for solving potential problems. The proposed IMFS method requires two sets of source points, which are placed on the physical boundary and fictitious boundary outside the physical domain, and then combines the fundamental solutions generated by these two sets of source points as the kernel functions. Numerical results show that the proposed IMFS method inherits high accuracy in the standard method of fundamental solutions (MFS), and yet avoids to produce the ill-conditioning resultant matrix in the MFS. The subsequent numerical experiments show that the proposed IMFS scheme works well with up to 250,000 source points situation, and can be accelerated by the kernel-independent fast multipole method, which can reduce the asymptotic complexity of the proposed method to $O(mN)$, where N is the number of source points, m means the iterations.

Keywords: Computation