An improved distance transformation method for the numerical evaluation of nearly singular integrals on 3D boundary element

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Abstract

This work presents a new implementation of the conventional distance transformation method to accurately compute nearly singular integrals arising in the boundary integral equations (BIEs) on 3D boundary element. With our implementation, the drawbacks of the conventional method are avoided and reliable numerical results are still achieved when the projection point of the source point is not located at the ideal position. We first make a more general definition for locating the projection point. Then new distance functions are constructed based on two local coordinate systems. Using those functions, we have developed a distance transformation to remove or weaken the near singularities. Consequently, nearly singular integrals can be directly computed by the standard Gaussian quadrature formulae. The numerical results demonstrate that our method can provide accurate results even on a very irregular element. And the accuracy of our method is much less sensitive to the position of the projection point than the conventional method.

Keywords: nearly singular integrals; numerical integration; boundary integral equations; distance transformation method