THE MESHLESS INTEGRAL METHOD: THE EFFECTS OF SUPPORT DOMAIN, SUBDOMAIN, NODAL DENSITY AND MONOMIAL BASIS

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The support domain radii, subdomain radii, nodal density and order of monomial basis used in the moving least squares approximation (MLSA) affect strongly the accuracy of a meshless method, and the effects of these parameters are the focus of this study. The meshless integral method used here is an improved version from an earlier model based on the local boundary integral equation (LBIE) developed by Atluri *et al.* [1]. Through the use of the subtraction technique, the strong singularity in the governing integral equation is removed which improves significantly the accuracy and robustness of the method. Two algorithms are proposed which allow the program to determine the support domain radii during execution based on the geometric information of nodal distribution. A similar scheme to automatically set up the subdomain radii is also proposed. The effects of the support domain and subdomain radii, nodal density and the order of monomial basis up to cubic are explored using several 2D examples including patch tests, bending, and stress concentration at a hole. Several conclusions are drawn from this study. The support domain radius for a node has to be larger than some critical value so that the domain of influence of every node contains sufficient number of nodes required by MLSA. If the displacement field is an n-th order polynomial in x and y and the order of the monomial basis used in MLSA is also n, the meshless solution is exact (within machine accuracy) for all support domain radii above the critical values. If the order of the monomial basis is linear, whether or not the displacement field is a polynomial, the meshless solution converges to the displacement field as the nodal distribution is refined and the support domain radii are above the critical values but not too large. If the displacement field is not a polynomial, the support domain radii should not be too large in order to maintain localness of MLSA to achieve good accuracy. For such cases, the linear monomial basis performs the best, while the cubic performs the worst.

References

[1] S.N. Atluri, J. Sladek, V. Sladek, T. Zhu, "The Local Boundary Integral Equation (LBIE) and Its Meshless Implementation for Linear Elasticity," *Comp. Mech.* 25, p.180-198, 2000