On the enforcement of Neumann boundary conditions in the mixed MLPG collocation method for 2-D linear elastic problems

B. Jalušić[1], T. Jarak[1] and J. Sorić[1]

The mixed MLPG collocation strategy, originally presented in [Atluri, Liu and Han (2006)], is studied, where the stress and displacement fields are approximated separately by using same trial functions. Compatibility between the approximated stresses and displacements is enforced at certain points, most often the discretization nodes, in order to eliminate the nodal stress variables from the discretized governing equations.

For equal number of nodes, collocation methods are faster than the methods based on the integration of weak forms, but they suffer from numerical instabilities and the lack of accuracy caused by the inaccurate imposition of Neumann boundary conditions [Liu and Gu (2005)]. In this contribution, different procedures for the enforcement of the Neumann boundary conditions (BCs) are used, including the direct collocation approach, the penalty method [Atluri, Liu and Han (2006)] and the application of the local weak forms near the boundary with prescribed Neumann BCs [Liu and Gu (2005)]. The approximation schemes used in this work include the interpolating Moving Least Squares (IMLS) [Sorić and Jarak (2010)] and polynomial Point Interpolation Method (PPIM). They possess the interpolation property at the nodes, which enables a simple enforcement of the essential BCs, like in FEM. The accuracy and numerical efficiency of the proposed approaches for the enforcement of natural BCs are demonstrated by a set of suitable numerical examples and the results are compared to a corresponding mixed meshless approach based on the integration of a local weak form.

References:

Atluri, S.N.; Liu, H.T.; Han, Z.D. (2006): Meshless Local Petrov-Galerkin (MLPG) Mixed Collocation Method for Elasticity Problems. *CMES: Computer Modeling in Engineering & Sciences*, vol. 14, pp. 141-152.

Sorić, J.; Jarak, T. (2010): Mixed meshless formulation for analysis of shell-like structures, *Comput. Methods Appl. Mech. Engrg.*,vol. 199, pp. 1153-1164.

Liu, G.R.; Gu, Y.T. (2005): *An introduction to Meshfree Methods and Their Programming*. Springer.

[1] Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Ivana Lučića 5, 10000 Zagreb, Croatia