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FREE-VIBRATION ANALYSIS OF THIN PLATES USING THE GENERALIZED MOVING-LEAST SQUARES APPROXIMATION

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ABSTRACT

The Moving Least Squares (MLS) approximation has been used with remarkable success as the basis of various meshless methods. The generalized version of this approximation, the Generalized Moving Least Squares (GMLS), was presented by Atluri *et al* [1] in the context of the Meshless Local Petrov-Galerkin method and was applied to one-dimensional bending problems of Euler-Bernoulli beams. The term “generalized” here means that not only the primary variable (typically, the displacement) is used in the approximation but also it(s) derivative(s).

The first two-dimensional application of this approximation was made by the authors [2] using the Element–Free Galerkin (EFG) framework. The static analysis of thin plates was then successfully performed. Extension to elastic foundation analysis can be found in [3].

The results then obtained for problems whose variational basis requires the use of C^1 approximations encouraged the authors to pursuit the research and extend it to other related problems. In the present contribution the free-vibration problem of thin plates is addressed. As the approximation does not possess the Kronecker-delta property, the imposition of the essential boundary conditions is made using Lagrange multipliers and this leads to an unusual eigenvalue problem whose form is

$$\begin{bmatrix} \mathbf{S} - \omega^2 \mathbf{M} & \mathbf{G}_{S_u} \\ \mathbf{G}_{S_u} & \mathbf{O} \end{bmatrix} \begin{bmatrix} \mathbf{u} \\ \mathbf{t}_{S_u} \end{bmatrix} = \mathbf{0}.$$

The results are compared with analytical solutions and excellent agreement was found. Moreover, the results confirm that GMLS approximation has a higher performance than the conventional MLS, even taking into account that the number of degrees of freedom per node is, in the GMLS, three times that of the MLS.

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