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Abstract

A differential evolution optimization scheme is used to choose shape parameter and node distribution when applying the radial basis function meshless numerical method. Rectangular composite plates and an isotropic L-shaped plate are considered. Results show that differential evolution optimization is a good option to choose parameters for the numerical method requiring minimal intervention by the user, even for complex geometries.

1 Introduction

The use of radial basis functions for interpolation was proposed by Hardy and later considered as one of the best methods in terms of accuracy for scatter data interpolation [1, 2]. The excellent behavior of radial basis functions for interpolation motivated their use for solving parabolic, hyperbolic or elliptical partial differential equations [3, 4]. The method develloped by Kansa in [3, 4] for solving PDEs is also known as Kansa's collocation or unsymmetric collocation since the collocation procedure produces asymmetric matrices.

The meshless method uses radial basis functions g to approximate a function f. It is assumed that any function, f may be written as an expression of N continuously differentiable basis functions, g:

$$\tilde{f}(\mathbf{x}) = \sum_{j=1}^{N} \beta_j g_j (\mathbf{x} - \mathbf{x}_j, \epsilon) \tag{1}$$

where g_j depends on a distance d between N center points (or nodes)$\mathbf{x_j}$ and interpolation points $\mathbf{x}$, and may depend on a user defined shape parameter ϵ. The quality of the solutions is greatly influenced by the choice of this shape parameter, since it can improve the conditioning of the problem if correctly chosen. Usually this parameter is chosen by trial and error and depends on the user's experience, which is not a desirable feature of the method. On the other hand, if the shape parameter is well chosen, the method presents a fast convergence and excellent accuracy.

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