Analysis of laminated plates and shells by collocation with radial basis functions

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1 Introduction

Recently, radial basis functions (RBFs) have enjoyed considerable success and research as a technique for interpolating data and functions. A radial basis function, $\phi(\|x - x_j\|)$ is a spline that depends on the Euclidian distance between distinct data centers $x_j, j = 1, 2, ..., N \in \mathbb{R}^n$, also called nodal or collocation points.

Although most work to date on RBFs relates to scattered data approximation and in general to interpolation theory, there has recently been an increased interest in their use for solving partial differential equations (PDEs). This approach, which approximates the whole solution of the PDE directly using RBFs, is very attractive due to the fact that this is truly a mesh-free technique. Kansa [1] introduced the concept of solving PDEs using RBFs.

Structures composed of laminated materials are among the most important structures used in modern engineering and, especially, in the aerospace industry. Such lightweight structures are also being increasingly used in civil, mechanical and transportation engineering applications. The rapid increase of the industrial use of these structures has necessitated the development of new analytical and numerical tools that are suitable for the analysis and study of the mechanical behavior of such structures. The behavior of structures composed of advanced composite materials is considerably more complicated than for isotropic ones. The strong influences of anisotropy, the transverse stresses through the thickness of a laminate and the stress distributions at interfaces are among the most important factors that affect the general performance of such structures. The use of shear deformation theories has been the topic of intensive research, as in [2–14], among many others.

The analysis of laminated plates by finite element methods is now considerably established. The use of alternative methods such as the meshless methods based on radial basis functions is atractive due to the absence of a mesh and the ease of collocation methods. More recently the author and colleagues have applied RBFs to the static deformations of composite beams, plates and shells [15–22].

This paper presents a review of current methods for the analysis of laminated plates and shells by strong-form-based meshless methods.

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