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Comparison of various numerical discretisation approaches for the scaled boundary method

Yiqian He[1], Haitian Yang[1], and *Andrew J. Deeks[2]

[1]Department of Engineering Mechanics, Dalian University of Technology,
Dalian 116024, P.R. China
[2] School of Engineering and Computing Sciences, Durham University,
South Road, Durham, DH1 3LE, UK

*Corresponding author: a.j.deeks@durham.ac.uk

The scaled boundary method is a semi-analytical method for solving linear partial differential equations. It combines the advantages of the finite element and boundary element methods, and adds appealing features of its own, such as the ability to handle the problems involving unbounded domains and the problems involving stress singularities or discontinuities. In the scaled boundary method, the discretisation approach used in the circumferential direction has significant influence on the accuracy of the resulting solutions. The most commonly used method for performing this circumferential discretisation is the finite element approach, leading to the method called the scaled boundary finite element method (SBFEM), and most previous work using the SBFEM has employed linear or quadratic isoparametric elements. In this paper, various alternative numerical discretisation approaches for the scaled boundary method developed by the authors are described and compared, including scaled boundary methods using *h*-hierarchical and *p*-hierarchical finite elements, higher-order finite elements, the meshless local Petrov-Galerkin approach, the Element-free Galerkin approach and Fourier shape functions. These approaches have significant advantages in accuracy and convergence compared with conventional SBFEM. Numerical examples are provided to compare the above mentioned scaled boundary methods in terms of accuracy and convergence, and the performance of these various approaches in different cases will be discussed.

Keywords: Scaled boundary method, numerical discretisation approaches, computational accuracy, comparisons.