Graduate

Mechanics Seminar

The boundary element method applied to solid and fluid mechanics

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Microsoft Teams - https://tinyurl.com/semmec0121

Abstract.

The Boundary Element Method (BEM) is a computational method for solving systems of differential equations formulated in integral form. It is applied in several areas of engineering and sciences, such as fluid mechanics, acoustics, electromagnetism, and fracture mechanics. The main difference between the boundary element method and the finite element method is that in the first one only the boundary of the problem is discretized (divided into elements). This, in many cases, drastically reduces the size of the problem and simplifies mesh generation.

The method performs better than the finite element method under certain circumstances, when the domain is infinite or semi-infinite as in acoustic and soil mechanics, or when the contour is constantly changing, as is the case of crack propagation. The major disadvantage of the BEM is the fact that matrices of the method are fully populated. This kind of matrix makes difficult the analysis of problems with many millions of unknown variables (large scale problems). However, currently, with the development of fast boundary element methods, the BEM has presented advantages over the finite element method (FEM) in a large range of large scale problems.

This seminar shows some applications of the BEM in different areas of the Engineering (crack propagation, plates, shells, fluid flow, contact mechanics, etc). A comparison with the FEM is carried out emphasizing the advantages and disadvantages of each method. The fast multipole boundary element method (FMBEM) is presented as a good alternative to circumvent the fully populated matrix problem. Some commercial and academic applications of the FMBEM are cited.