University of Brasília
Mechanical Science Graduate Program

Unit information

Program	Mechanical Science (53001010053P0)
Course unit	INTRODUCTION TO THE BOUNDARY ELEMENT METHOD
Unit code	PPGINT
Unit number	2014
Credit points	4
Period	01/01/2012 -
Professor	Éder Lima de Albuquerque
Prerequisites	No

Unit outline

Objective:

This unit aims to introduce students to the boundary element method, compare it with other numerical methods, and show its strengths and weaknesses. At the end of this course, the student will be able to understand the fundamentals of the boundary element method, know the boundary element software available, whether open source or commercial, be able to apply the method in the most diverse problems of mechanical sciences.

Purpose:

Due to its specific feature of discretization only of the boundary, the boundary element method is the most suitable numerical method to treat nonlinear problems due to boundary conditions in areas such as contact mechanics and linear problems of an infinite domain in areas such as acoustics, electromagnetism (magnetic fields), electrostatics, soil mechanics and crack propagation. Thus, the application of the boundary element method in the mechanical sciences is vast and often with advantages over other methods, such as the finite element method or the finite difference method.

Contents:

1. Mathematical review: Gauss-Green theorem; integration by parts, Dirac delta, numerical integration. **2. Calculation of properties of plane figures:** Calculation of perimeter, area and centroids of plane figures using line integrals – the method of 2D radial integration. **3. Calculation of properties of solids:** Calculation of surface area, volume and centroids of solids using surface integrals – the 3D radial integration method. **4. Surface meshing in solids:** Triangular and quadrilateral meshing in the plane. Mesh generation on surfaces. **5. Boundary element method for potential problems:** Laplace equation; Fundamental solution; Weighted residuals method; Contour integral equation; Method of two-dimensional boundary elements; Treatment of domain integrals. Three-dimensional contour element method

Assessment

A final exam (50% of the grade); Exercise lists (50% of the grade).

Obs:

Reference:

1. E. L. Albuquerque, **Introdução ao Método dos Elementos de Contorno**, Apostila, Universidade de Brasília, 2023.
2. Jon T. Katsikadelis. **The Boundary Element Method for Engineering and Sciences: Theory and Applications**. Elsevier, Academic Press, 2016.
3. C. A. Brebbia, J. Dominguez. **Boundary Elements: An Introductory Course**. McGraw Hill, 2nd Edition, 1989.
4. M. H. Aliabadi. **The Boundary Element Method: Applications in Solids and Structures**, Wiley, 2002.