Contents

Chapter 1

Introduction

1.1 Computational mechanics in civil engineering

1.1.1 Mathematical model in mechanics

1.1.2 Numerical method

1.1.3 Computational mechanics in modern age

1.2 Current difficulties in numerical analysis

1.2.1 Human effort on meshing

1.2.2 Imperfection in geometric representation

1.2.3 Lack of re-meshing scheme

1.3 Proposed approach

1.4 Research contribution

1.4.1 Meshing based on CAD output in 2D and 3D

1.4.2 High quality elements by Quad-tree

1.4.3 Auto re-meshing based on error

1.5 Objectives and scope

1.6 Organization of the thesis

1.7 List of publications

Chapter 2

Literature review

2.1 Overview of numerical methods

2.1.1 Finite element method

2.1.2 Boundary element method

2.1.3 Isogeometric analysis

2.2 Scaled boundary finite element method

2.3 Approaches for meshing automation

2.3.1 Initial Graphics Exchange Specification (IGES) file

2.3.2 Non-Uniform Rational B-Spline (NURBS)

2.4 Conclusions

Chapter 3

Isogeometric enhanced scaled boundary finite element method in 2D

Chapter 4

Quad-tree mesh and auto refinement in 2D analysis based on error

4.1 Introduction

4.2 CAD output in 2D

4.3 NURBS utilization

4.3.1 Distance function

4.3.2 Finding intersections

4.3.3 Optimization

4.4 Quad-tree structure

4.5 Conclusions

Chapter 5

Adaptivity

Chapter 6