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Thesis/Dissertation Sheet

Surname/Family Name	:	**Wang**
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Abbreviation for degree as give in the University calendar	:	**Ph. D**
Faculty	:	**Faculty of Engineering**
School	:	**School of Civil & Environmental Engineering**
Thesis Title	:	**Integrating CAD geometry and scaled boundary finite element analysis**

Abstract 350 words maximum

The Finite element method (FEM) constitutes a general tool for the numerical solution in. Although it is a principle method in the engineering field, deficiency in geometric representation has been detected. Besides, it could be expensive in terms of time and human resource to create the mesh required by the FEM. The research towards integrating geometry and analysis has led to the 'Isogeometric Analysis' (IGA) (Hughes et al., 2005). However, as the CAD model provides information only of the boundary, a 2D/3D stress analysis is still one major step away.

This thesis presents a simple and efficient technique based on the combination of the scales boundary finite element method (SBFEM), automatic mesh generation and adaptive refinement algorithms to reduce the human efforts in the structural analysis. This framework will also be further extended to problems with singularities and to dynamic analysis. To mode problems with complex geometries, the problems domains are divided into a mesh of scaled boundary finite elements. A quad-tree based mesh generation algorithm is developed to provide high quality mesh. Furthermore, no human efforts are required for the pre-processing as the output of the CAD will be used to determine the geometric information automatically.

To ensure a controllable accuracy and minimal computational cost, an adaptive mesh refinement algorithm is also developed. The expressions related to the eigenvalues of the SBFEM formulation representing the quantity of the error in the interpolation are adopted together with the area and other geometric properties of the Scaled Boundary Finite Element. A machine learning model using the Multilayer Perceptron (MLP) is trained to determine whether a Scaled Boundary Finite Element needs refinement or not based on all these information.

The proposed method is further extended to 3D with an initial mesh generated based on the STL file and octree algorithm. The octree mesh provides a high quality mesh in 3D for SBFEM and the IGES file from the CAD software will be adopted in order to map intersection points back to NURBS surfaces to preserve an exact geometry. The convex hull properties of the NURBS are utilized to accelerate the algorithm.

王俊超 .... Signature

.... Witness Signature

31/08/18 .... Date

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