



The Hong Kong University of Science and Technology

Department of Mathematics

PhD THESIS EXAMINATION

***Numerical Methods for Partial Differential Equations on
Meshless Domains and the Dirichlet k -Partition Problem***

By

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ABSTRACT

This thesis consists of two parts. In the first part, we developed a new meshless method, called the regularized least squares radial basis function (RLS-RBF) method, for solving PDEs on irregular domains with a set of randomly generated points. Unlike typical RBF methods, our RBF is centered at a set of nicely chosen ghost sample points, with a regularization of the RBF is added. This effectively avoids the ill-conditioning in the interpolation matrix and ensure the reconstruction exactly passes through the center. An analytical proof is presented to show that the Laplace operator estimated by our method is consistent with the exact Laplacian. Various numerical examples are demonstrated to show its consistent property. In the second part, we proposed a simple level set method for the Dirichlet k -partition problem. We first formulate the problem as a nested minimization problem of a functional of the level set function and the corresponding eigenfunction. As an approximation, we propose to replace the eigenfunction by the level set function so that the nested minimization can be converted into a single minimization problem. Standard gradient descent method is applied, and a Hamilton-Jacobi type equation is obtained. Various numerical examples are provided to demonstrate its effectiveness under different domains.

Date: 6 July 2020, Monday

Time: 2:30 p.m.

Zoom Meeting: <https://hkust.zoom.us/j/92130903209>

Thesis Examination Committee:

Chairman	: Prof. Simon M.H. WONG, HUMA/HKUST
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