The Hong Kong University of Science and Technology

Department of Mathematics

MPhil THESIS EXAMINATION

Embedding Methods for Hyperbolic Conservation Laws on Implicit Surfaces

By

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ABSTRACT

We develop simple numerical methods for solving hyperbolic conservation laws defined on curves or surfaces. Following an embedding approach originally developed for eikonal equations on manifolds, we will replace the hyperbolic conservation law on surfaces with a related partial differential equation (PDE) defined in a tubular neighborhood of the implicit surface. Then we can apply the typical finite difference method on the underlying Cartesian mesh. We first discuss a simple extension idea, which orthogonally extends the flux function from the implicit surface. This approach gives a simple first-order scheme for the surface hyperbolic conservation laws. To improve the order of the numerical method, we apply the standard TVD-RK3 WENO3 scheme and introduce a modification factor to the PDE based on the local curvature of the surface in the second part of this work. This extra factor aims to correct the speed of the flux on each level surface, so the numerical solution in the tubular neighborhood at the later time will be orthogonal to the implicit surface. We will give two- and three-dimension examples on linear and nonlinear equations to demonstrate the accuracy of the proposed schemes.

Date: **27 July 2021, Tuesday**

Time: **2:00 p.m.**

Venue: **Online via Zoom**
https://hkust.zoom.us/j/92341741642
(Passcode: 921755)

Thesis Examination Committee

Chairman	:	**Prof. Yang XIANG, MATH /HKUST**
Thesis Supervisor	:	**Prof. Shing Yu LEUNG, MATH/HKUST**
Member	:	**Prof. Kun XU, MATH/HKUST**

(Open to all faculty and students)
The student's thesis is now being displayed on the reception counter in the General Administration Office (Room 3461).