The Hong Kong University of Science and Technology

Department of Mathematics

PhD THESIS EXAMINATION

Decoupling Strategies for Multi-Physics Applications

By

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ABSTRACT

In this thesis, we develop a framework to decouple PDE computation involved in many multi-physics and multi-domains applications. As one of the most well-known multi-physics applications, the fluid-structure interaction is considered to study the decoupling strategies. First, some existing decoupled schemes for the fluid-structure interaction are reviewed and compared. Then, based on one of the stable decoupled schemes, β scheme, we propose to apply multirate time-step techniques to the fluid-structure interaction, where different time-step sizes are adopted for the fluid dynamic and structure mechanics respectively. The proposed multirate β scheme is stable and uses much less computational cost to retain the same order of accuracy as the original β scheme. Next, we develop a mathematical model, which consists of fluid-structure interaction equations and a biological equation, to simulate the growth of abdominal aortic aneurysms. A decoupled scheme is designed to solve the model numerically, and the simulated results are matched with the experimental data in references. At the end, inspired by the decoupled schemes in the fluid-structure interaction, we develop a framework to design various stable decoupled schemes for the interface problems with parabolic type equations.

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***Thesis Examination Committee*:**

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The student's thesis is now being displayed on the reception counter in the General Administration Office (Room 3461).