

# PolyU-PDE Seminar

**Prof. Cheng WANG**

University of Massachusetts Dartmouth

## Topic

**A refined convergence analysis for a fourth order finite difference numerical scheme to the Cahn-Hilliard equation**

## Date | Time

11<sup>th</sup> December 2023 (Monday) | 11am – 12noon (HK Time)

## Link:

<https://polyu.zoom.us/j/92119294780?pwd=L045VVhKaUFLK2c3ZFM4OE1hWTBLdz09>

## Meeting ID | Passcode

921 1929 4780 | 1211

## Abstract

An energy stable numerical scheme for the Cahn-Hilliard equation is analyzed in detail, with second order accuracy in time and the fourth order long-stencil finite difference approximation in space. A modified backward differentiation formula (BSF) temporal discretization is applied, and a Douglas-Dupont artificial regularization is included to ensure the energy stability. In fact, a standard application of discrete Gronwall inequality leads to a convergence constant dependent on the interface width parameter in an exponential singular form. We aim to obtain an improved estimate, with such a singular dependence only in a polynomial order. A uniform in time functional bounds of the numerical solution, including the higher order Sobolev norms, as well as the associated bounds for the first and second order temporal difference stencil, have to be carefully established. Certain recursive analysis has to be applied in the analysis for the BDF-style temporal stencil. As a result, we are able to apply a spectrum estimate for the linearized Cahn-Hilliard operator, and this technique leads to the refined error estimate.