THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

DEPARTMENT OF APPLIED MATHEMATICS
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The Hong Kong Polytechnic University
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Colloquium

Recent developments in fractional calculus theory and fractional calculus of variations as well as their numerical methods

By

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Abstract

In this talk, I shall first briefly review a newly developed theory of weak fractional (differential) calculus and fractional Sobolev spaces. The crux of this new theory is the introduction of a weak fractional derivative concept which is a natural generalization of integer order weak derivatives, it also helps to unify multiple existing fractional derivative concepts. Various calculus rules including a fundamental theorem of calculus will be reviewed and connections to existing fractional derivatives will also be explained. Based on the weak fractional derivative concept, new fractional order Sobolev spaces can be naturally defined and many important properties, such as density theorem, extension theorem, and trace theorem, of those Sobolev spaces can be established. I shall then introduce a class of fractional calculus of variations problems and their associated Euler-Lagrange (fractional differential) equations. Unlike the existing fractional calculus of variations, the new framework and theory are based on the newly developed theory of weak fractional derivatives and their associated fractional order Sobolev spaces. Since fractional derivatives are direction-dependent, using one-sided fractional derivatives and their combinations leads to new types of fractional differential equations; including new one-side fractional Laplace operators and future value problems. Finally, I shall discuss some new finite element (and DG) methods for approximating the weak fractional derivatives and the solutions of fractional calculus of variations problems and their associated fractional differential equations.

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Date: 23 November 2021 (Tuesday)
Time: 10:00-11:00 (Hong Kong Standard Time GMT +8)
Venue: Online Talk via Zoom (Meeting ID: 958 6917 0931)
Speaker: Prof. Xiaobing Feng, The University of Tennessee
Host: Dr. Buyang Li, The Hong Kong Polytechnic University
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https://polyu.zoom.us/j/95869170931?pwd=VGtsdXErTi83R08yeVE1TVBtU1RZQT09

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