Kyushu-Illinois Strategic Partnership Colloquia Series #2

Mathematics Without Borders
—Applied and Applicable

Date / Time: 18:00-20:00, Tuesday March 9 and Wednesday March 10, 2021 (USA Central)
9:00-11:00, Wednesday March 10 and Thursday March 11, 2021 (Japan Standard Time)

The workshop explores the expanding connections between mathematicians from Kyushu University and the University of Illinois Urbana-Champaign. This partnership is built upon the universal appeal of mathematics across borders and disciplines. The workshop will highlight the potential mathematical abstractions have to distill ideas and connect people. Kyushu's Graduate Program of Mathematics for Innovation (GPMI) has been selected as one of the venues for the WISE Program (Doctoral Program for World-leading Innovative and Smart Education) funded by the Japanese government and will enroll students for the first time starting April 2021. We are pleased to offer this opportunity where scholars, students, and prospective students can explore ideas together. Register today via the link below.

Day 1

JST	USA Central	Program	Speaker
9:00-9:20	18:00-18:20	Opening Remarks	Susan Martinis, Vice Chancellor for Research and Innovation, Stephen G. Sligar Professor of Molecular and Cellular Biology, Illinois
			Reitumetse Mabokela, Vice Provost for International Affairs and Global Strategies, Professor of Higher Education, Illinois
			Yoshio Hisaeda, Executive Vice President for Research, Professor of Applied Chemistry, Kyushu
			Toshiyuki Kono, Executive Vice President for International Affairs, Professor of Law, Kyushu
9:20-10:00	18:20-19:00	Lecture #1	Vera Mikyoung Hur, Professor and Philippe Tondeur ScholarBrad and Karen Smith Professorial Scholar, Department of Mathematics, Illinois
10:00-10:10	19:00-19:10	Q/A	
10:10-10:50	19:10-19:50	Lecture #2	Seiichi Uchida, Professor, Faculty of Information Science and Electrical Engineering, Kyushu
10:50-11:00	19:50-20:00	Q/A	

Day 2

JST	USA Central	Program	Speaker
9:00-9:40	18:00-18:40	Lecture #3	Anil Hirani, Associate Professor, Department of Mathematics, Illinois
9:40-9:55	18:40-18:55	Q/A	
9:55-10:35	18:55-19:35	Lecture #4	Shizuo Kaji, Professor, Institute of Mathematics for Industry, Kyushu
10:35-10:50	19:35-10:50	Q/A	
10:50-11:00	10:50-11:00	Closing Remarks	Yuliy Baryshnikov, Professor, Department of Mathematics, Illinois Osamu Saeki, Director / Professor, Institute of Mathematics for Industry, Kyushu University

Registration https://zoom.us/webinar/register/WN_tddbR8ciTHKKji-QCvbjkA

KYUSHU UNIVERSITY

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

GPMI Graduate Program of Mathematics for Innovation

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Abstract

Lecture #1

"Water Waves: breaking, peaking and disintegration"

Vera Mikyoung Hur, Professor and Philippe Tondeur ScholarBrad and Karen Smith Professorial Scholar, Department of Mathematics, Illinois

Water waves describe the situation where water lies below a body of air and are acted upon by gravity. Describing what we may see or feel at the beach or in a boat, they are a perfect specimen of applied mathematics. They encompass wide-ranging wave phenomena, from whitecapping to tsunamis and to rogue waves. The interface between the water and the air is free, and poses profound and subtle difficulties for rigorous analysis, numerical computation and modeling. I will discuss some recent developments and future research directions, particularly, a rich variety of wave phenomena in rotational flows, and their instability, and also statistical and machine learning approaches to rogue waves.

Lecture #2

"Visual Design Analysis with Machine Learning"

Seiichi Uchida, Professor, Faculty of Information Science and Electrical Engineering, Kyushu University

Visual designs are image data, such as fonts, logos, and typographies, and often carefully created for showing specific impressions. In this talk, several on-going attempts of visual design analysis at my lab will be introduced. For the trials, we employ various machine learning techniques to deal with the complex relationships between image appearance and impression.

Lecture #3

"Structure-preserving discretization of differential calculus and geometry"

Anil Hirani, Associate Professor, Department of Mathematics, Illinois

Two important aspects of the structure of differential calculus are the chain and product rules. On manifolds, chain rule generalizes to the exterior derivative commuting with pullback by smooth maps. The product rule generalizes to a rule for the exterior derivative of wedge product of differential forms. These properties, especially the product rule, may be used as one of the defining properties for a covariant derivative in differential geometry. What if one is developing calculus and geometry for non-smooth spaces. One such application is the development of a discrete exterior calculus and discrete differential geometry for simplicial complexes (e.g. triangle meshes and tetrahedral meshes). What should play the role of the smooth maps, the exterior derivative, the wedge product and the covariant derivative so that we can speak of the above structural properties of calculus and geometry in this discrete setting? I will use examples to describe such a discrete calculus and geometry we have been developing. This will be a survey of some old ideas and some new developments. The newer developments are joint work with Mark Schubel (Apple Inc.) and Daniel Berwick-Evans (UIUC).

Lecture #4

"Geometry of Kaleidocycles"

Shizuo Kaji, Professor, Institute of Mathematics for Industry, Kyushu University

Kaleidocycles are Origami models of flexible polyhedra which exhibit an intriguing turning-around motion (have a look at the pictures at https://github.com/shizuo-kaji/Kaleidocycle). The study of Kaleidocycles involves kaleidoscopic aspects and lies at the intersection of geometry, topology, and integrable systems (and mechanics). In this talk, we discuss two "incarnations" of them.
(1) The states of a Kaleidocyce form a real-algebraic variety defined by a system of quadratic equations. In particular, the degree-of-freedom of its motion corresponds to the dimension of the variety. Using this formulation, we introduce a special family of Kaleidocycles, which we call the Mobius Kaleidocycles, having a single-degree-of-freedom (joint work with J. Schoenke at OIST).
(2) A Kaleidocycle can be viewed as a discrete space curve with a constant torsion. Its motion corresponds to a deformation of the curve. Through this correspondence, we describe particular motions of Kaleidocycles using semi-discrete integrable systems (joint work with K. Kajiwara and H. Park at Kyushu University).

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