NSF/CBMS Regional Conference in the Mathematical Sciences

Department of Applied Mathematics

Illinois Institute of Technology

Nonlocal Dynamics: Theory, Computation and Applications

June 4 - 9 · 2017 · Chicago · USA

Organizers: Jinqiao Duan, Xiaofan Li

Principal Lecturer:

Qiang Du.

Columbia University, United States

National Science Foundation

ILLINOIS INSTITUTE OF TECHNOLOGY

Information

All events will take place in John T. Rettaliata Engineering Center （see blue arrow on map）

Conference Center: Room 104 (Crawford Auditorium)

All lectures/talks: Room 104 (Crawford Auditorium)

Lodging: CLUB QUARTERS HOTEL CENTRAL LOOP

111 West Adams Street
Chicago, IL 60603
+1.312.214.6400

From Club Quarters Hotel Central Loop to IIT:

Head east on W Adams St to Green Line Station(Adams&Wabash), take Green Line toward Ashland&63st direction, get off at station (35th-Bronzeville-IIT , see yellow arrow on campus map). And head north on State St to John T. Rettaliata Engineering Center.

Parking: A4 visitor park lot (（see red arrow on map）

Contact person:

Mr. Zhuan Cheng, zcheng9@hawk.iit.edu, +1(312)-799-1937
Ms. Gladys Collins, collinsg@iit.edu, +1(312)-567-8980

Nearby Restaurants

MTCC Cafeteria
3201 S State St Chicago, IL 60616 (on campus)
Campus cafeteria

Jimmy Johns
3506 South State Street, Chicago, IL 60616 (on campus)
Subway sandwiches – freaky fast delivery.

Starbucks
3506 S. State Street, Chicago, IL 60616 (on campus)
Coffee and pastries – yum.

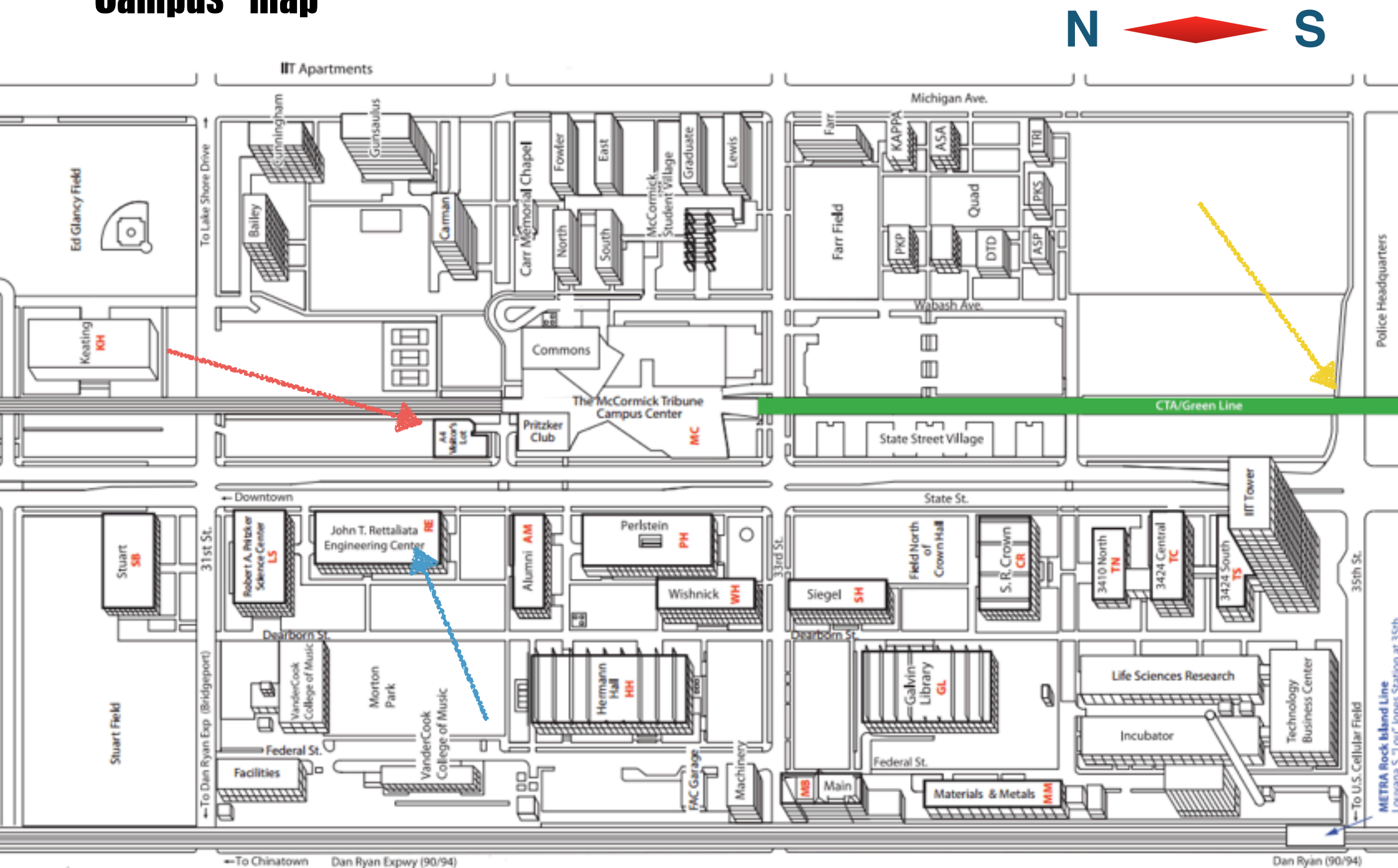
New Furama Restaurant
2828 S Wentworth Ave, Chicago, IL 60616 (off campus)
Chinese food and Dim Sum

WI-FI:

Connection: IIT-Connect
Login: iit-event
Password: Event772016!

Website: http://math.iit.edu/nonlocaldynamics.html

Campus map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Quad
PKS
PKP
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ASP
Police Headquarters
Keating
KH
Wabash Ave.
Commons
The McCormick Tribune Campus Center
MC
Pritzker Club
CTA/Green Line
State Street Village
← Downtown
State St.
IIT Tower
Stuart
SB
31st St.
Robert A. Pritzker Science Center
LS
John T. Rettaliata Engineering Center
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3424 Central
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3424 South
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35th St.
Dearborn St.
Dearborn St.
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VanderCook College of Music
Morton Park
VanderCook College of Music
Hermann Hall
HH
Galvin Library
GL
Life Sciences Research
Technology Business Center
Incubator
Federal St.
Federal St.
Facilities
FAC Garage
Machinery
MB
Main
Materials & Metals
MM
To U.S. Cellular Field
METRA Rock Island Line
←To Chinatown
Dan Ryan Expwy (90/94)
Dan Ryan (90/94)

Program

	Monday, June 5	Tuesday, June 6	Wednesday, June 7	Thursday, June 8	Friday, June 9
8:00 - 9:00	Registration, Lobby Opening, Room 104	Registration, Lobby Opening, Room 104	Coffee	Coffee	Coffee
9:00 - 10:00	Opening Remark Qiang Du, Lec 1, Overview of nonlocal models	Tadele Mengesha, Lec 3, Variational analysis of nonlocal systems related to peridynamics	Qiang Du, Lec 5, Numerical approximations of nonlocal models-II	Xiaochuan Tian, Lec 7, Local and nonlocal coupling II (Xiaochuan)	Qiang Du, Lec 9, Nonlocal phase field and nonlocal conservation laws
10:00 - 11:00	Qiang Du, Lec 2, Examples of nonlocal mocels	Qiang Du, Lec 4, Numerical approximations of nonlocal models-I	Xiaochuan Tian, Lec 6, Local and nonlocal coupling I	Qiang Du, Lec 8, Nonlocal gradient and nonlocal in time dynamics	Qiang Du, Lec 10, Peridynamics for brittle fracture, open questions
11:00 - 11:30	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
11:30 - 12:30	Hong Wang, Title:TBA	Luis Silvestre, Title:TBA	Pablo Seleson Title:Anisotropic bond-based peridynamic models	Toniazzi, Lorenzo Title: Probabilistic solutions of fractional differential equations for generalized Caputo-type operators	Coffee and Discussion
12:30 - 2:00	Lunch	Lunch	Lunch	Lunch	Lunch
2:00 - 3:00	Coffee and Discussion	Pablo Raúl Stinga, Title: Heat semigroups, fractional Laplacians and applications	Tadele Mengesha Title: Mulitiscale analysis of linearized nonlocal models	Coffee and Discussion	Coffee and Discussion
3:00 - 4:30	Coffee and Discussion	Coffee and Discussion	Coffee and Discussion	Coffee and Discussion	Coffee and Discussion

List of Conference Participants

Name	Institutions	Email
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Abstracts

Author: Pablo Raúl Stinga

Institution: Iowa State University

Title: Heat semigroups, fractional Laplacians and applications

Abstract: In this talk I will explain how to use the *language of heat semigroups* to analyze fractional powers of *any* linear operator, a novel idea originally introduced by J. L. Torrea and myself in 2009. By using this far-reaching point of view we can obtain pointwise integro-differential formulas, Hölder and Schauder estimates, and the Dirichlet-to-Neumann characterization via an extension problem, including formulas for the solutions in terms of semigroups and Bessel functions, for fractional powers of linear operators. We will present applications of these tools in a variety of different contexts: fractional elliptic equations (joint with L. A. Caffarelli), radial solutions to the fractional Laplacian, numerical approximations using discrete fractional Laplacians, fractional time derivative of Marchaud, and fractional powers of heat operators (master equation).

Author: Seleson, Pablo D

Institution: Oak Ridge National Laboratory

TITLE: Anisotropic bond-based peridynamic models

ABSTRACT: "The peridynamics theory of solid mechanics is a nonlocal reformulation of classical continuum mechanics, suitable for material failure and damage simulation. Originally, this nonlocal theory was presented as the bond-based peridynamic theory, for which the material response of an isotropic medium is limited by a fixed Poisson's ratio. To overcome this limitation, the state-based peridynamics theory was developed. Applications in peridynamics to date cover a wide range of scientific and engineering problems; however, the majority of those applications employ isotropic material models. Only recently, a limited number of anisotropic peridynamic models were proposed. In this talk, we will first survey the different classes of anisotropic material models in classical linear elasticity, and we will present general anisotropic bond-based peridynamic models. We will show a classification and a hierarchy of those models, and we will discuss their relation to classical elastic models as well as their modeling restrictions."

Author: Tadele Mengesha

Institution: The University of Tennessee, Knoxville

Title: Mulitiscale analysis of linearized nonlocal models

Abstract: We will apply the method of two scale convergence to study the homogenization of stationary and time-dependent nonlocal models. We first discuss the asymptotic behavior of the stationary state-based multiscale heterogeneous peridynamic model, while for time-dependent problems we study two integro-differential models: the nonlocal convection-diffusion equation and the state-based peridynamic system. These models involve nonlocal interaction terms with highly oscillatory perturbations representing the presence of heterogeneities on a finer spatial length scale. The asymptotic analysis delivers both homogenized dynamics as well as strong approximations expressed in terms of a suitable corrector theory. The two-scale convergence method provides a natural analog to that for the stationary and time- dependent local PDE models with highly oscillatory coefficients with the distinction that the driving operators considered in this talk are bounded.

Author: Lorenzo Toniazzi

Institution: University of Warwick

Title: Probabilistic solutions of fractional differential equations for generalized Caputo-type operators

Abstrac: The success of probabilistic approaches to fractional calculus suggests a new viewpoint on Caputo derivatives. We present well-posedness and stochastic representations for solutions to a large collection of fractional ordinary/partial differential equations (FODE's/FPDE's) involving generalized Caputo-type operators of order less than 1 (as introduced in [5]). Our approach unifies and clarifies many known results along with providing new results and methodologies (which lend themselves to numerical approximations). Firstly, we explain which concrete Caputo-type differential operators fall under our framework (e.g., distributed order fractional derivatives, tempered fractional derivatives). Secondly, we present well-posedness results and stochastic representation of solutions for some generalized FODE's and FPDE's (e.g., two-sided mixed FPDE's in [2] and time-fractional evolution equations in [4]). If time allows, we will present ongoing work on generalized Caputo-type operators of order between 1 and 2, multidimensional extensions of generalized Caputo derivatives, and a chronological Feynman-Kac formula for generalized evolution equations.