Canada-China Workshop on Industrial Mathematics
August 5 – 10, 2007

MEALS

*Breakfast (Buffet): 7:00 – 9:00 am, Donald Cameron Hall, Monday – Friday
***Lunch (Buffet): 11:30 am – 1:30 pm, Donald Cameron Hall, Monday – Friday
***Dinner (Buffet): 5:30 – 7:30 pm, Donald Cameron Hall, Sunday – Thursday
Coffee Breaks: As per daily schedule, 2nd floor lounge, Corbett Hall
***Please remember to scan your meal card at the host/hostess station in the dining room for each meal.**

MEETING ROOMS

All lectures will be held in Max Bell 159 (Max Bell Building accessible by bridge on 2nd floor of Corbett Hall). Hours: 6 am – 12 midnight. LCD projector, overhead projectors and blackboards are available for presentations. *Please note that the meeting space designated for BIRS is the lower level of Max Bell, Rooms 155-159. Please respect that all other space has been contracted to other Banff Centre guests, including any Food and Beverage in those areas.*

SCHEDULE

Sunday August 5

16:00	Check-in begins (Front Desk – Professional Development Centre - open 24 hours) Lecture rooms available after 16:00 (if desired)
17:30-19:30	Buffet Dinner, Donald Cameron Hall
20:00	Informal gathering in 2nd floor lounge, Corbett Hall (if desired) Beverages and small assortment of snacks available on a cash honour-system.

Monday August 6

7:00-9:00	Breakfast
9:15-9:30	Introduction and Welcome to BIRS by BIRS Station Manager, MCME and MITACS Directors, Max Bell 159
9:30-10:15	*Dynamic Risk Measures in Finance, Robust Central Limit Theorem and G-Brownian Motion* Shige Peng
10:15–10:30	Coffee Break, 2nd floor lounge, Corbett Hall
10:30-11:15	*Local Computation and Global Communication in Ad Hoc Networks* Evangelos Kranakis
11:15-11:45	*Light Tailed Behaviour and Decay Rate for a General Type of Two-Dimensional Random Walk with Complex Boundary* Yiqiang Zhao
11:45-13:00	Lunch
13:00-14:00	Guided Tour of The Banff Centre; meet in the 2nd floor lounge, Corbett Hall
14:00	Group Photo; meet on the front steps of Corbett Hall
14:30-15:15	*The Thermodynamic Closure Approximation of Kinetic Theories for Complex Fluids*, Pingwen Zhang
15:15-15:45	*Rapid computation of thermal stress in crystals with facets and allowing for material anisotropy* Sean Bohun
15:45-16:00	Coffee Break, 2nd floor lounge, Corbett Hall
17:30-19:30	Dinner

Tuesday August 7

7:00-9:00 Breakfast
9:00-9:45 *Industrial Collaboration at the intersection of applied stochastics and operational research*
Matt Davison
9:45-10:15 *Nonlinear Expectations and Nonlinear Pricing*
Zengjing Chen
10:15–10:30 Coffee Break, 2nd floor lounge, Corbett Hall
10:30-11:15 *Novel concepts for RNA pseudoknot structures*
Christian Reidys
11:15-11:45 *Modelling Cortical Spreading Depression*
Robert Miura
11:45-13:30 Lunch
13:30- 14:15 *Designing a "virtual liver" for the prediction of drug transport and metabolism*
Rebeccah Marsh
14:15-14:45 *Spatio-temporal modeling for bone remodeling processes*
Nilima Nigam
14:45-15:15 *Are Foresight and Mathematics Ready for Each Other?*
David Crabtree
15:30-16:00 Coffee Break, 2nd floor lounge, Corbett Hall
17:30-19:30 Dinner

Wednesday August 8

7:00-9:00 Breakfast
9:00-9:45 *Industrial Mathematics in the Cementing of Oil and Gas Wells*
Ian Frigaard
9:45-10:30 *Case study: Spontaneous well-logging*
Yongji Tan
10:30-10:45 Coffee Break, 2nd floor lounge, Corbett Hall
10:45-11:30 *An application of numerical bifurcation analysis*
Greg Lewis
11:30-13:30 Lunch
13:30-15:30 Roundtable discussion on opportunities for bilateral collaborations on industrial mathematics
15:30-16:00 Coffee Break, 2nd floor lounge, Corbett Hall
17:30-19:30 Dinner

Thursday August 9

7:00-9:00 Breakfast
9:00-9:45 *Nonlinear models of pharmacokinetic processes*
Jack Tuszynski
9:45-10:30 *Processing of physiological signals by biochemical systems: emergence of high frequency waves from low frequency inputs in brain receptors*
Sanjive Qazi
10:30-10:45 Coffee Break, 2nd floor lounge, Corbett Hall – to START no earlier than 10 am
10:45-11:30 *Distribution theory, stochastic processes and infectious disease modeling*
Ping Yan
11:30-13:00 Lunch
13:00-17:30 Bus trip to Lake Louise (optional)
Bus transportation will pick up in front of Donald Cameron Hall
18:00-19:30 Dinner

Friday August 10

7:00-9:00	Breakfast
9:00-9:45	*The Interstitial Fluid Flow in human connective Tissue: A mathematical model for experiment phenomena in Traditional Chinese Medicine* Guanghong Ding
9:45-10:30	*Roles of Mathematical Modeling for Disease Management--opportunity and progress for Canada-China Collaboration* Jianhong Wu
10:30-10:45	Closing Remarks, MCME and MITACS Directors
10:45-11:15	Coffee Break, 2nd floor lounge, Corbett Hall
11:30-13:30	Lunch

Checkout by 12 noon.

** 5-day workshops are welcome to use the BIRS facilities (2nd Floor Lounge, Max Bell Meeting Rooms, Reading Room) until 3 pm on Friday, although participants are still required to checkout of the guest rooms by 12 noon. **

Banff International Research Station

for Mathematical Innovation and Discovery

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ABSTRACTS

Speaker: Sean Bohun, University of Ontario Institute of Technology
Title: Rapid computation of thermal stress in crystals with facets and allowing for material anisotropy
Abstract: A model is presented for the computation of stress inside a crystal produced with a directional growth technique such as the Czochralski method. The method uses perturbation analysis based on a small lateral heat flux to generate a semi-analytical solution. Due to the semi-analytical nature of the solutions, the thermal stress in crystals with facets and with weak anisotropy can be computed very efficiently, compared to a full 3D simulation. Examples are given for a variety of seed orientations and show that with respect to the stress,
the geometric effect due to any facets is dominant while the effect of material anisotropy is secondary.

Speaker: Zengjing Chen, Shandong University
Title: Nonlinear Expectations and Nonlinear Pricing
Abstract: As the generalizations of mathematical expectations, coherent and convex risk measures, Choquet expectation and Peng's g-expectations all have been widely used to study the question of hedging contingent claims in incomplete markets. Obviously, the different risk measures or expectations will typically yield different pricing. In this paper we investigate differences amongst these risk measures and expectations in the framework of the continuous-time asset pricing. We show that the coherent pricing is always less than the corresponding Choquet pricing. This property and inequality fails in general when one uses pricing by convex risk measures. Finally, we show that g-expectations are the better way for the pricing options for the claims with higher interest rate for borrowing and with short-sales constraints.

Speaker: David Crabtree, Precision Metrology Institute
Title: Are Foresight and Mathematics Ready for Each Other?
Abstract: Foresight methods are widely believed to deliver substantial benefits over the long term to the organizations that practice them. They have two main uses: - firstly, they serve to better prepare executive for decision-making through exposure to a broader range of unfamiliar but relevant issues in their thinking about the future, and, secondly, they facilitate strategic planning. It is probable that Foresight has been practiced for just about as long as human beings have existed. And although different methods have emerged with the passage of time, there are some characteristics that have remained constant. Most notoriously, Foresight continues to be practiced largely as an art. The practitioners come mostly from the social sciences and seem not to have brought mathematical rigor with them.

According to one supposedly successful rubric, Foresight breaks down into two phases, with Exploratory Foresight preceding Normative Foresight.

Exploratory Foresight facilitates how visionary planners may think about far futures (i.e. beyond 30 years). The outcome of the exploratory exercise is a set of far-future scenarios that assist in the next phase, and a training experience for executives.

Normative Foresight takes over at this point. The objective is to interpolate events between the exploratory scenarios developed in the previous phase and the present day landscape, passing through the time horizon for strategic planning. The output is a kind of schedule that helps identify some critical stepping-stones to a desired future with a clear description of a multitude of pathways between then and now. Of focal interest is the plethora of important events along those pathways just beyond the strategic planning horizon. Rooted in the present and dealing with issues and technologies that are expected to mature during the lifetime of the organization, normative foresight elaborates a broad range of factors, and then selects from these a set of foundations upon which a future that is either desired or preferred can start to be constructed.

Foresight methodology requires the opinions of generalists as well as specialists. It provides practitioners and decision-makers with the ability to understand both technical and social risks, and to explain how they formed their conclusions. Put into practice, the method creates common purpose among disparate players that would otherwise have pursued divergent or conflicting goals.

A compelling reason why this approach is valuable within the broader context of Foresight is the deficiency of other methods for providing future references to augment the forecasts that strategic planners traditionally use. I shall describe the two phases of the methodology in greater detail and based on that framework shall identify critical areas wherein benefits from greater rigor might result. The presentation is intended to be interactive with workshop participants providing feedback on the criticalities.

Speaker: Matt Davison, University of Western Ontario
Title: Industrial Collaboration at the intersection of applied stochastics and operational research
Abstract: For the past 8 years the speaker has led an active and industrially focused research group at the University of Western Ontario. We have applied mathematical tools and techniques from stochastic analysis and operational research ranging from problems arising in the energy industry and the insurance industry, to problems coming from federal government departments of Environment and Defence, to medical research, to problems involved in managing large software projects.

This talk will give a brief overview of all of the research projects described above, followed by a more in depth discussion of several problems. The talk will close with some remarks on what we at Western have found to make a mutually successful industry-academic collaboration.

Speaker: Guanghong Ding, Fudan University
Title: The Interstitial Fluid Flow in human connective Tissue: A mathematical model for experiment phenomena in Traditional Chinese Medicine
Abstract: On the base of deep part dissection of acupoints on the upper limbs of human body and the micro and macro observation and measurement, we constructed a mathematical model on the flow of the tissue fluid in interosseous membrane. By this model, we get to know the characteristics of the tissue-fluid flow and the influence of tissue-fluid flow on superficial shearing stress of mast cell. The results of this study preliminarily explain the feeling-along-meridian phenomenon and the acupuncture mechanism. When being acupunctured, the related mast cells will be activated to discharge particles. The histamine in the particles will increase the transmission capacity of capillary and the velocity of the tissue-fluid flow and the superficial shearing stress of related mast cell will be increased, which will once again activate mast cells to discharge active substance. Part of the active substance will be absorbed by capillary and the other part will be passed by tissue fluid to a remote place and it will activate the mast cells and the capillaries there. The directional path of the tissue fluid is approximately the same as the meridian, which forms the phenomenon of feeling-along-meridian on macroscale.
Speaker: Ian Frigaard, University of British Columbia
Title: Industrial Mathematics in the Cementing of Oil and Gas Wells

Abstract: About 13,000 oil and gas wells are constructed in Canada annually. Prior to production, at least one casing is cemented into every well, in an operation called primary cementing. This involves pumping a sequence of non-Newtonian fluids down the inside of the casing and up around the outside of the casing, along the annulus formed via with the drilled hole. In this talk we outline some of the interesting fluid mechanical questions that must be answered in order to design primary cementing jobs effectively. Current mathematical and computational modelling methods are discussed and a selection of results, both analytical and computational, are presented.

Speaker: Evangelos Kranakis, Carleton University
Title: Local Computation and Global Communication in Ad Hoc Networks
Abstract: The nature of ad hoc networking imposes an additional requirement that algorithms should be {\em local} in the sense that messages propagate only a constant number of hops and each host makes decisions based solely on information obtained from hosts located a constant (independent of the size of the network) number of steps away from it. We will discuss the interaction between local computation and global communication in such systems and give
an overview of methods that are more robust for dynamically changing ad hoc networks, including routing, simplifying the network infrastructure (spanners), channel alocation (coloring), and clustering (dominating sets).

Speaker: Greg Lewis, University of Ontario Institute of Technology
Title: An application of numerical bifurcation analysis
Abstract: In this talk, I will discuss the application of numerical bifurcation techniques to problems in fluid dynamics. Specifically, I will discuss how these techniques can be used to compute flows for a wide range of the problem parameters, and how they can be used to trace out the transition curves between various flow types.

As examples, I will present the analysis of two models from geophysical fluids: (1) a model of the differentially heated rotating annulus experiment, which is a laboratory experiment that consists of observing the fluid in a rotating cylindrical annulus while the rotation rate and the temperature difference between the inner and outer walls of the annulus are varied, and (2) a model of a fluid in a differentially heated rotating spherical shell with radial gravity.

In both, the Navier-Stokes equations in the Boussinesq approximation are used to model the fluid flow, and therefore, discretization leads to large sparse systems. Numerical continuation is used to follow steady solutions as the differential heating, rotation rate and other parameters are varied. Specific eigenvalues of the linearization about a numerically computed steady solution are computed to locate bifurcations, which we expect will correspond to flow transitions. Numerical centre manifold reduction and approximation of the coefficients of the normal form equations at the bifurcation points can provide detail of the nature of the transitions.

Speaker: Rebeccah Marsh, MITACS
Title: Designing a "virtual liver" for the prediction of drug transport and metabolism
Abstract: Significant progress has been made in the development of a multi-scale virtual liver that can become a patient-specific simulation platform. As the main organ responsible for the transformation and metabolism of drugs, the liver plays a significant role in determining the amount of beneficial and harmful substances that enter the bloodstream. However, it can be difficult to predict how an individual patient will process a given drug. Therefore, virtual models can be a powerful tool that can offer an "in silico" testing environment as an alternative or complement to in vitro and in vivo experiments. By taking into account as many anatomical and physiological characteristics of a real patient as possible, these computational models can be used to simulate patient responses under different conditions, especially the heterogeneity associated with disease and cancerous transformation. However, because the structure and functions of the liver are highly complex, this type of realistic model quickly becomes computation-intensive. As a result, a collaboration was formed with the Computer Modelling Group Ltd., and the simulations are being carried out using their

STARS simulator developed for the petroleum industry. STARS is an advanced processes simulator for modeling the flow of multi-phase, multi-component fluids using finite difference methods and efficient numerical solution algorithms. Preliminary results of dynamic simulations of real-time drug transport and enzymatic reactions in the liver building block, the lobule, will be presented, and aspects of the virtual organ will be introduced. Ultimately, these simulations can help improve the accuracy, specificity, and cost-effectiveness of pre-clinical tests as well as the clinical outcomes of patient therapies.

Speaker: Robert M. Miura, New Jersey Institute of Technology
Title: Modelling Cortical Spreading Depression
Abstract: The brain is a complex organ composed largely of neurons, glial cells, and blood vessels. In spite of an enormous experimental and theoretical literature on the brain, we do not have a good understanding of how it functions on a gross mechanistic level. In general, the brain maintains a homeostatic state with relatively small ion concentration changes. A lot can be learned about the brain by studying extreme phenomena, and one such phenomenon is called cortical spreading depression (CSD for short). CSD was discovered over 60 years ago by A.A.P. Leao, a Brazilian physiologist doing his PhD research on epilepsy at Harvard University. It is characterized by nonlinear chemical waves that propagate at very slow speeds, on the order of mm/min, in the cortex of different brain structures in various animals, including humans where it is associated with migraine with aura, and results in massive changes in ion concentrations. To date, we do not have a good explanation of how CSD occurs, although a number of mechanisms have been hypothesized to be important for CSD wave propagation. In this talk, I will review some of the characteristics of CSD wave propagation, and describe two new mechanisms that are believed to be important, namely osmotic effects and the spatial buffer mechanism. Continuum models of CSD, consisting of coupled nonlinear diffusion equations for the ion concentrations, will be described.

Speaker: Nilima Nigam, McGill University
Title: Spatio-temporal modeling for bone remodeling processes
Abstract: The process of bone remodeling- destruction of bone materials by osteoclasts, regeneration of bone matrix by osteoblasts, and a slower process of remineralization - is a continually occuring process in the body. Bone remodeling is crucially used to help maintain calcium levels for the proper functioning of many biochemical regulatory systems in the body, and is the process by which bones heal microfractures.

In this talk, we present recent work on a spatio-temporal model of these processes. Our work accounts for the local dynamics described in previous work by S. Komarova et. al, and appears consistent with experimental studies. The resultant model is interesting in its own right, since it consists of a highly coupled system of 4 nonlinear PDE. This is joint work with M. Ryser and S. Komarova.

Speaker: Shige Peng, Shandong University
Title: Dynamic Risk Measures in Finance, Robust Central Limit Theorem and G-Brownian Motion
Abstract: We present some recent developments on the theory, method and technique of robust expectations in which the well-known linear relation in classical probability theory becomes the sub-linear one.

This type of sub-linear expectations is proved to be fundamentally important in the super-hedging, super-pricing of financial derivatives as well as in the theory of measures of risk, called coherent risk measures in finance. Two types of basic uncertainties of a financial position (or a random variable) are: mean-uncertainty and variance-uncertainty.

We present a new central limit theorem: a sequence of accumulated i.i.d random variables with variance-uncertainty converges in law to a sublinear distribution called G-normal distribution. This implies that the G-normal distribution plays a centrally important place. A G-normal distribution without variance-uncertainty is just a classical normal distribution. This is also a start point of a new theory of random and stochastic calculus that gives us a new insight to characterize and calculate varies kinds of financial risk. This G-normal distribution will bring us to a new framework of stochastic calculus of Ito's type through the corresponding G-Brownian motion in which the variance uncertainty coincides with the well-known volatility uncertainty. We will also present analytical and numerical calculations and some new statistical methods with application to risk analysis in finance under volatility uncertainty.

Speaker: Sanjive Qazi, Parker Hughes Cancer Center
Title: Processing of physiological signals by biochemical systems: emergence of high frequency waves from low frequency inputs in brain receptors.
Abstract: A major form of communication between nerve cells is the chemical transmission of information between regions of the brain via synaptic junctions between nerve cells. However, how widely separated regions of the cortex involving billions of neurons coordinate complex activity is less understood. Research as shown that when people perform simple tasks, slow oscillations in the brain become coupled with the fast, high frequency-gamma oscillations in the same area. Under conditions when different brain areas oscillate together at the same low frequency and phase, the regions tune into the high-gamma oscillations and transfer information between them. To better understand how large populations of neurons can generate high frequency waves we examined information processing capabilities of single channel proteins such as the transmitter-gated GABA receptors in synaptic terminals. In this approach, exact solutions for simple bimolecular interactions and receptor transitions can be used to model complex reaction schemes by expressing them in sets of difference equations. This model demonstrates that when many neurons are stimulated by low frequency, noisy impulses, the kinetic properties of the channel protein tune into higher frequency wave outputs. This suggests that kinetic properties of single channels can generate high frequency transmission of information when many cells are stimulated at low frequencies. Furthermore, the tuning properties are disrupted by action of psycho-active drugs binding to the brain receptors. These types of simulations provide a platform for investigating the effect of psycho-active drugs on complex responses of transmitter-receptor interactions in noisy cellular environments such as the synapse.

Speaker: Christian M. Reidys, Nankai University
Title: Novel concepts for RNA pseudoknot structures
Abstract: In this talk we derive the generating function of RNA structures with pseudoknots. We enumerate all k-noncrossing RNA pseudoknot structures categorized by their maximal sets of mutually intersecting arcs. In addition we enumerate pseudoknot structures over circular RNA. For 3-noncrossing RNA structures and RNA secondary structures we present a novel 4-term recursion formula and a 2-term recursion, respectively. Furthermore we enumerate for arbitrary k all k-noncrossing, restricted RNA structures i.e.~k-noncrossing RNA structures without 2-arcs i.e.~arcs of the form $(i,i+2)$, for $1\le i\le n-2$. Finally, we present the asymptotic enumeration. We develop a general framework for the computation of exponential growth rate and the sub exponential factors for k-noncrossing RNA structures.

Speaker: J.A. Tuszynski, University of Alberta
Title: Nonlinear models of pharmacokinetic processes
Abstract: Pharmacokinetics, the study of the absorption, distribution, metabolism, and elimination of a drug from the body, is the primary quantitative tool used in drug development and administration. If a drug's behaviour is nonlinear, it becomes more difficult to determine an appropriate model and to predict optimum dosing regimes. One hallmark of nonlinearity, the power law relationship, has been identified in various aspects of pharmacokinetic data.
Many clearance curves exhibit long-time power-law tails. In addition, exposure and effect parameters frequently vary disproportionately with dose, and quantities like drug clearance, half-life, and toxicity have been found to exhibit allometric scaling. Because of their self-similar properties, power laws can indicate underlying heterogeneity. In the past couple of
decades, the concept of fractals has emerged in pharmacokinetics to describe the influence of

heterogeneous structures and physiology on drug processes occurring in the body. Fractals describe complex objects that cannot be characterized by one spatial scale (such as the bifurcating pattern of the vascular network) and processes that do not have a characteristic time scale (such as drug trapping and release). We discuss clinical applications of fractal kinetics and universal exponents. Examples that will be presented include the cardiac drug mibefradil and cancer chemotherapy drug paclitaxel.

Speaker: Jianhong Wu, York University
Title: Roles of Mathematical Modeling for Disease Management--Opportunity and Progress for Canada-China Collaboration
Abstract: Modern technologies of surveillance and data processing, in addition to increasing international collaboration and public awareness, greatly facilitate the progress of epidemiology to a predictive science, in which mathematical modeling has been playing a critical role. Great opportunities and challenges thus occur in both developed countries and growing economic powers for modellers to ensure that their epidemiological modelling studies are both relevant to the current public efforts of management of emerging and reemerging infectious diseases, and insighful for the future development of a highly interdisciplinary scientific field. These challenges require coordination and international collaboration of modellers with experts in medical sciences, health surveillance, data analysis, and public health policy makers. The recognition of the importance of this coordination and collaboration by various relevant communities and agencies in Canada and China provides excellent opportunities for the advancement of problem-driven mathematical epidemiology in both countries, and for the Canada-China collaboration in the subject area. This talk provides a short review of the current progresses and difficulties of this Canada-China collaboration, in order to stimulate discussions and to secure support for a sustainable and fruitful future.

Speaker: Ping Yan, Public Health Agency of Canada
Title: Distribution theory, stochastic processes and infectious disease modelling
Abstract: This talk addresses probability theories and stochastic processes involved in mathematical modelling of the transmission dynamics of infectious diseases. Starting from basic concepts such as susceptible, latent, infectious and removed individuals in a closed population, the talk will focus on two phases of a typical outbreak. The initial phase an outbreak is the period of time when depletion susceptible individuals is ignorable. After the initial phase, in a closed population with infected individuals being removed during their infectious period, there is always a proportion of susceptible individuals eventually escaping from infection, which defines the final size of a large outbreak.

For the initial phase, there are two approximations: the branching process approximation and the exponential growth approximation. The branching processes may evolve in continuous time such as the Bellman-Harris process, the Cramp-Mode-Jaggers process, or a combination of them, according to assumptions on infectious and latent periods of the underlying disease. Counting processes and renewal processes are embedded within these continuous time branching processes. The exponential growth approximation and the branching process approximation are related through the Laplace transforms and Euler-Lotka equations of the distributions of the latent and infectious periods. Under the condition that infectious contacts arise from a counting process with stationary increment, both distributions of the latent and infectious periods determine the initial (exponential) growth rate but in separate ways. One of the most important parameter in infectious disease models is the reproduction number, which is an intrinsic parameter of the branching process that approximate the initial phase of the outbreak. This talk will also examine different formulations of this parameter through disease transmission parameters.

For the final size by the end of a large outbreak, there is a central limit theorem and the final size equation that links the reproduction number to the percentage of susceptible individuals eventually escaping from infection. This talk will address the generality of the final size equation and related invariant quantities by examining the underlying stochastic mechanisms. Different underlying mechanisms give different manifestations of the infectious disease outbreak over time, but may lead to the same final size as long as some of the invariant quantities are the same. This leads to definitions such as size-equivalent epidemics, size-equivalent models along with the understanding of the controlled reproduction number, as opposed to the basic reproduction number.

Important public health concerns during the initial phase of an outbreak is whether it is possible to limit the final number of infected individuals to a handful cases, and if not, how to mitigate the infection curve such as reducing the initial growth rate. After the initial phase, the public health concern is how to effectively use intervention measure to reduce the final size of the outbreak, in terms of maximizing the percentage of susceptible individuals eventually escaping from infection. Understanding the underlying probabilities and stochastic processes is crucial for the design of public health intervention strategies, such as intervention with respect to latent period distribution (e.g. quarantine exposed but not yet infectious individuals), with respect to infectious period distribution (e.g. isolation of infectious individuals), respect to the properties of the counting process (e.g. pharmaceutical interventions to reduce susceptibility of susceptible individuals, infectivity of infected individuals or social distancing to reduce contacts.)

Speaker: Tan Yongji, Fudan University
Title: Case study: Spontaneous well-logging
Abstract: Spontaneous well-logging is one kind of important well-logging technique. Since the electric field of Spontaneous well-logging is of strong discontinuity, there is some mathematical difficulty. In this talk we give mathematical model, numerical algorithm and some mathematical results for Spontaneous well-logging.

Speaker: Pingwen Zhang, Peking University
Title: The Thermodynamic Closure Approximation of Kinetic Theories for Complex Fluids
Abstract: A lot of closure approximations have been proposed in the past thirty years to obtain the tensor models from the kinetic theories of polymer dynamics, but it is very difficult to say which model is the best one. Now we present four criteria to evaluate the closure approximations, which also provides a guideline for the good closure moment models. By the detail numerical comparison among the second-order moment closure FENE models, we find that the quasi-equilibrium closure moment model with piecewise linear approximation (FENE-QE-PLA) is the right one according to our criteria. The quasi-equilibrium closure approximation is also employed to obtain tensor models from a general non-homogeneous Doi's kinetic theory of liquid crystalline polymers. Numerical results showed that the second-order closure model with the quasi-equilibrium approximation agrees qualitatively with the exact kinetic theory. Because of the complexity of the Doi's theory (nonlinear, phase transition etc), the higher-order closure approximations are more difficult than the FENE model and needed to give more accurate results.

Speaker: Yiqiang Q. Zhao, Carleton University
Title: Light Tailed Behaviour and Decay Rate for a General Type of Two-Dimensional Random Walk with Complex Boundary
Abstract: Motivated by characterizing properties of rare events in stochastic models such as telecommunications systems, insurance policies, etc, in this talk, we present some key results for a general type of two-dimensional random walk with boundaries. This type of random walk can be modeled as a quasi-birth-and-death process with countably many background (phase) states. By using the matrix-analytic method, combined with probabilistic arguments, conditions for exactly geometric decay and for light-tailed but not exactly geometric decay.