山东大学 SHANDONG UNIVERSITY

THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大學

DEPARTMENT OF APPLIED MATHEMATICS 應用數學系

Workshop on Collaboration and Exchange Project between Shandong University and The Hong Kong Polytechnic University

(山东大学与香港理工大学合作交流项目研讨会)

主办单位：The PolyU-SDU Joint Research Center on Financial Mathematics

(山东大学、香港理工大学)

组织委员会：吴臻（山东大学）

孙德锋（香港理工大学）

王光臣（山东大学）

姚嘉晖（香港理工大学）

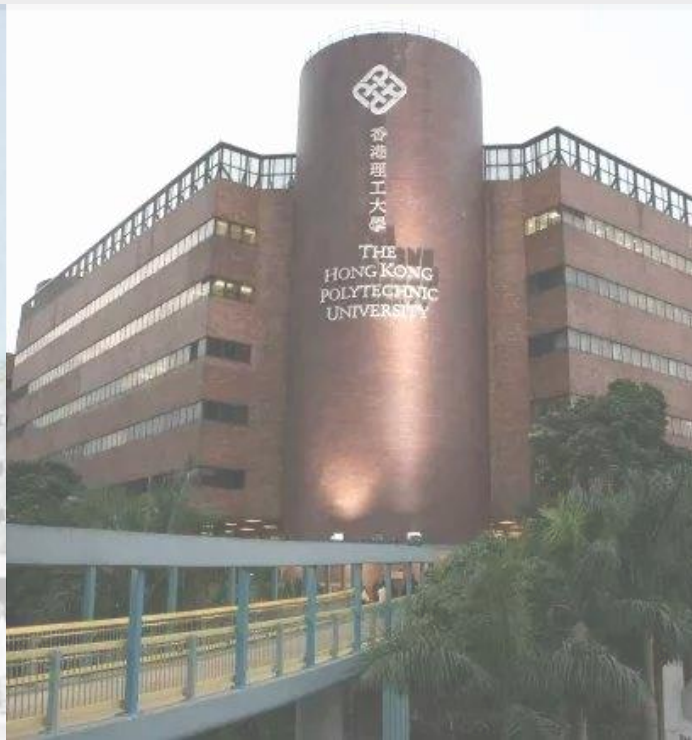
会务组：黄建辉（香港理工大学）、聂天洋（山东大学）

举办日期：2020 年 8 月 22 日

举办形式：线上活动

腾讯会议 ID: 969 106 476

密码：123456



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腾讯会议 ID: 969 106 476，密码：123456

09:00-09:10 会议开幕式（吴臻，孙德锋）

09:10-09:40 王光臣（山东大学）

09:40-10:10 许左权 （香港理工大学）

10:10-10:40 余翔 （香港理工大学）

10:50-11:20 赵卫东（山东大学）

11:20-11:50 李步扬（香港理工大学）

11:50-12:20 杜宁 （山东大学）

14:00-14:30 黄建辉（香港理工大学）

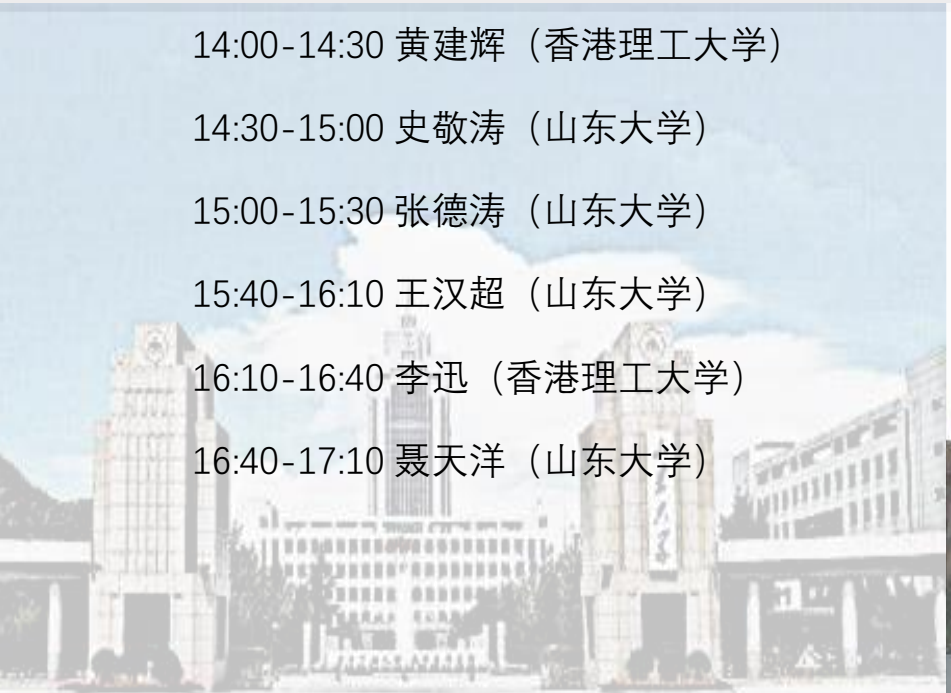
14:30-15:00 史敬涛（山东大学）

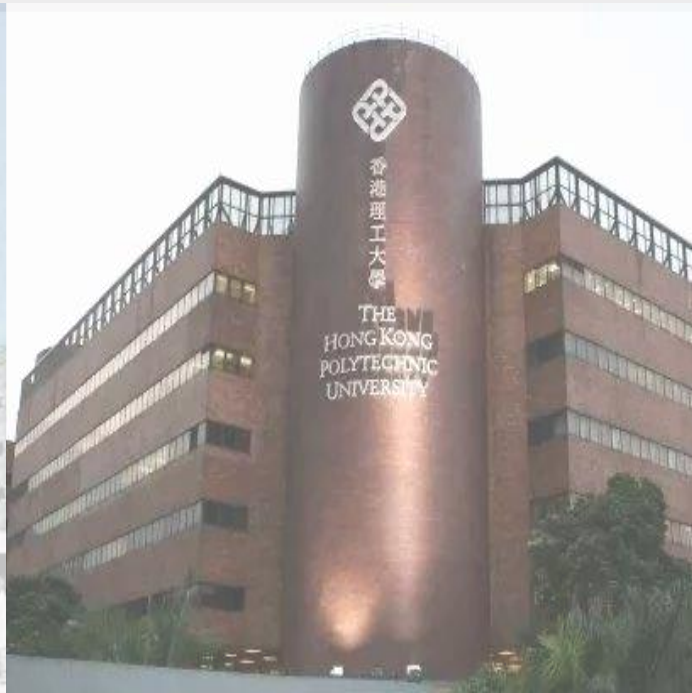
15:00-15:30 张德涛（山东大学）

15:40-16:10 王汉超（山东大学）

16:10-16:40 李迅（香港理工大学）

16:40-17:10 聂天洋（山东大学）





“山东大学-香港理工大学合作交流项目”

研讨会

程序册

在线会议

2020 年 8 月 22 日

“山东大学-香港理工大学合作交流项目”研讨会
通知

各位老师：

为促进优化控制、科学计算、金融数学、概率论与数理统计及相关领域的学术交流，以及国家自然科学基金委与香港研究资助局合作研究项目“模型不确定性下的随机控制理论及其在金融风险管理中的应用”的开展，拟定于 2020 年 8 月 22 日在线举办“山东大学-香港理工大学合作交流项目”研讨会。会议邀请相关领域的专家学者做学术报告，介绍相关领域的最新进展和学术前沿动态，促进学术交流。

一、会议名称：“山东大学-香港理工大学合作交流项目”研讨会

主办单位：The PolyU-SDU Joint Research Center on Financial Mathematics (山东大学、香港理工大学)

组织委员会：吴臻教授、孙德锋教授、王光臣教授, 姚嘉晖教授

会务组：黄建辉、聂天洋

二、会议时间：2020 年 8 月 22 日

三、会议平台：腾讯会议

会议 ID: 969 106 476

密码：123456

会议直播： https://meeting.tencent.com/l/6Nhtrb9NsG8A

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山东大学、香港理工大学

2020 年 8 月 12 日

会议程序

2020年8月22日　学术报告			
时间	主持人	报告人	报告题目
09:00-09:10		吴臻 孙德锋	致开幕词
09:10-09:40	赵卫东	王光臣	An asymmetric information mean-field type LQ stochastic Stackelberg differential game
09:40-10:10		许左权	Dual Utilities on Risk Aggregation under Dependence Uncertainty
10:10-10:40		余翔	Optimal Consumption with Reference to Past Spending Maximum
10:40-10:50	休息		
10:50-11:20	林延平	赵卫东	High-order methods for FBSDEs with applications
11:20-11:50		李步扬	Convergence of Zziuk's Linearly Implicit Parametric Finite Element Method for Curve Shortening Flow
11:50-12:20		杜宁	Fast finite element method for space-fractional dispersion equations
12:20-14:00	午餐		
14:00-14:30	王光臣	黄建辉	Social Optima in Robust Mean Field LQG Control: From Finite to Infinite Horizon
14:30-15:00		史敬涛	A Global Maximum Principle for Stochastic Optimal Control Problems with Delay and Applications
15:00-15:30		张德涛	Optimal portfolio selection and consumption problem with assets under partial informations
15:30-15:40	休息		
15:40-16:10	李迅	王汉超	Exponential Concentration Inequalities for Purely Discontinuous Martingales
16:10-16:40		李迅	Optimal Stopping Investment with Non-smooth Utility and Portfolio Constraints
16:40-17:10		聂天洋	Game options in nonlinear markets
17:10	会议结束		

会议ID： 969 106 476

An asymmetric information mean-field type LQ stochastic Stackelberg differential game

Guangchen Wang, Shandong University

Abstract: This talk is concerned with an asymmetric information LQ stochastic Stackelberg differential game with one leader and two followers, where the game system is governed by mean-field type stochastic differential equation. With the help of some systems of Riccati equations, the followers solve an MF-type stochastic LQ game problem with partial information first, and then, the leader turns to address an optimal control problem driven by linear mean-field type forward-backward stochastic differential filtering equation. By maximum principle, direct construction method and optimal filtering, the open-loop Stackelberg solution is expressed as a feedback form of state, state estimation, and state mean.

These results provided here are taken from Guangchen Wang, Yu Wang and Susu Zhang (Optim. Control Appl. Meth., 2020).

Optimal Stopping Investment with Non-smooth Utility and Portfolio Constraints

Xun Li (PolyU)

Abstract: This study addresses an investment problem facing a venture fund manager who has a non-smooth utility function. The theoretical model characterizes an absolute performance-based compensation package. Technically, the research methodology features stochastic control and optimal stopping by formulating a free-boundary problem with a nonlinear equation, which is transferred to a new one with a linear equation. Numerical results based on simulations are presented to better illustrate this practical investment decision mechanism.

Optimal consumption with reference to past spending maximum

Xiang Yu (PolyU)

Abstract: This paper studies an infinite horizon optimal consumption problem under exponential utility, together with non-negativity constraint on consumption rate and a reference point to the past consumption peak. The performance is measured by the distance between the consumption rate and a fraction 0<=lambda<=1 of the historical consumption maximum. To overcome its path-dependent nature, the consumption running maximum process is chosen as an auxiliary state process that renders the value function two dimensional depending on the wealth variable x and the reference variable h.

The associated Hamilton-Jacobi-Bellman (HJB) equation is expressed in the piecewise manner across different regions to take into account constraints. By employing the dual transform and smooth-fit principle, the classical solution of the HJB equation is obtained in a closed form, which in turn provides some thresholds of the wealth level and the associated piecewise feedback optimal investment and consumption strategies. Numerical examples are also presented to illustrate some theoretical results and financial implications.

High-order methods for FBSDEs with applications

Weidong Zhao, Shandong University

Abstract: In this talk, we will present high-order numerical methods for solving nonlinear forward backward stochastic differential equations with applications in solving fully nonlinear second-order parabolic partial differential equations and stochastic optimal control problems.

Convergence of Zziuk's linearly implicit parametric finite element method for curve shortening flow

Buyang Li (PolyU)

Abstract: Convergence of Dziuk's fully discrete linearly implicit parametric finite element method for curve shortening flow on the plane remains still open since it was proposed in 1990, though the corresponding semidiscrete method with piecewise linear finite elements has been proved to be convergent in 1994, while the error analysis for the semidiscrete method cannot be directly extended to higher-order finite elements or full discretization. In this paper, we present an error estimate of Dziuk's fully discrete linearly implicit parametric finite element method for curve shortening flow on the plane for finite elements of polynomial degree $r \geqslant 3$. Numerical experiments are provided to support and complement the theoretical convergence result.

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Fast finite element method for space-fractional dispersion equations

Ning Du, Shandong University

Abstract: We develop a fast and accurate finite element method space-fractional dispersion equations, which are expressed in terms of fractional directional derivatives in all the directions that are integrated with respect to a probability measure on the unit circle. The fast method significantly reduces the computational work of solving the discrete linear algebraic systems from $O(N^3)$ by a direct solver to $O(N \log N)$ per iteration and a memory requirement from $O(N^2)$ to $O(N)$. The developed preconditioned fast Krylov subspace iterative solver significantly reduces the number of iterations in a Krylov subspace iterative method and may improve the convergence behavior of the solver. Numerical results show the utility of the method.

Social Optima in Robust Mean Field LQG Control: From Finite to Infinite Horizon

Jianhui Huang (PolyU)

Abstract： In this work, we study social optimal control of Mean-field linear-quadratic-Gaussian models with uncertainty. Specially, the uncertainty is represented by an uncertain drift, which is common for all agents. A robust optimization approach is applied by assuming all agents treat the uncertain drift as an adversarial player. In our model, both dynamics and costs of agents are coupled by mean-field-terms, and both finite- and infinite-time horizon cases are considered. By examining social functional variation and exploiting person-by-person optimality principle, we construct an auxiliary control problem for the generic agent via a class of forward-backward stochastic differential equation system. By solving the auxiliary problem and constructing consistent mean field approximation, a set of decentralized control strategies is designed and shown to be asymptotically optimal.

A Global Maximum Principle for Stochastic Optimal Control Problems with Delay and Applications

Jingtao Shi, Shandong University

Abstract: In this talk, an open problem is solved, for the stochastic optimal control problem with delay where the control domain is nonconvex and the diffusion term contains both control and its delayed term. Inspired by previous results by Øksendal and Sulem [A maximum principle for optimal control of stochastic systems with delay, with applications to finance. In J. M. Menaldi, E. Rofman, A. Sulem (Eds.), Optimal control and partial differential equations, ISO Press, Amsterdam, 64-79, 2000] and Chen and Wu [Maximum principle for the stochastic optimal control problem with delay and application, Automatica, 46, 1074-1080, 2010], Peng's general stochastic maximum principle [A general stochastic maximum principle for optimal control problems, SIAM J. Control Optim., 28, 966-979, 1990] is generalized to the time delayed case, which is called the global maximum principle. A new backward random differential equation is introduced to deal with the cross terms, when applying the duality technique. Comparing with the classical result, the maximum condition contains an indicator function, in fact it is the characteristic of the stochastic optimal control problem with delay. Furthermore, to illustrate the applications of our theoretical results, two dynamic optimization problems are addressed.

Joint work with Dr. Weijun Meng.

Optimal portfolio selection and consumption problem with assets under partial informations

Detao Zhang, Shandong University

Abstract: We consider a finite-time optimal consumption problem in a continuous-time mean-variance portfolio selection problem in a market with multiple stocks and a bonds. The investor cannot observe the factor process and uses only past information of risky assets. Only series of past price movements are considered as historical information available to the investors. The problem is to maximize the expected utility of consumption and terminal wealth. We consider a model where the mean returns of risky assets depend linearly on underlying factors formulated as the solutions of stochastic equations. We derive the Hamilton–Jacobi–Bellman equation. Efficient strategies based on partial information are derived. We obtain an explicit form of the value function and the optimal strategy for this problem. Solutions involve the optimal filter of the stock appreciation rate processes. Moreover, we run simulations.

The main methodological contribution of the paper is to employ the Kalyan-Bucy filter to develop analytical and numerical approaches in obtaining the filter. The main contribution is also to solve the related backward stochastic differential equations.

Exponential Concentration Inequalities for Purely Discontinuous Martingales

Hanchao Wang, Shandong University

Abstract: A novel exponential concentration inequality is obtained for purely discontinuous local martingales. The proof is largely based on a new exponential martingale and the optional time rule. As direct applications, we can derive the classical Bernstein type inequality, de la Pe\~na's inequality and exponential concentration inequality for purely discontinuous local martingales under the exponential moments or bounded jumps assumption. Besides, we consider the continuous time matrix-valued local martingales and obtain a refined concentration inequality for norms of matrix operators through a new exponential supermartingale for traces. This is a joint work with Zhonggen Su.

Dual utilities on risk aggregation under dependence uncertainty

Zuoquan Xu (PolyU)

Abstract: Finding the worst-case value of a preference over a set of plausible models is a well-established approach to address the issue of model uncertainty or ambiguity. We study the worst-case evaluation of Yaari’s dual utility functionals of an aggregate risk under dependence uncertainty along with its decision-theoretic implications. To arrive at our main findings, we introduce a technical notion of conditional joint mixability. Lower and upper bounds on dual utilities with dependence uncertainty are established and, in the presence of conditional joint mixability, they are shown to be exact bounds. Moreover, conditional joint mixability is in- deed necessary for attaining these exact bounds when the distortion functions are strictly inverse-S-shaped. This is a joint work with Ruodu Wang, Waterloo University and Xun Yu Zhou, Columbia University.

Game options in nonlinear markets

Tianyang Nie, Shandong University

Dumitrescu et al. 2017 studied game options in a model with a single jump using the nonlinear arbitrage-free pricing approach developed by El Karoui and Quene 1997. We extend their findings by providing a comprehensive theoretical study of unilateral pricing, hedging and exercising problems for the counterparties within a general nonlinear setup with discontinuous assets prices. We also present a BSDE approach, which allows us to obtain more explicit results. To this end, we employ results on BSDEs and doubly reflected BSDEs driven by RCLL martingales established in our recent paper. This is a joint work with Marek Rutkowski and Edward Kim, University of Sydney.