2022 年偏微分方程控制理论学术研讨会

会议手册

2022 年 11 月 12 日

中国地质大学(武汉)数学与物理学院

湖北 武汉

2022 年偏微分方程控制理论学术研讨会

为迎接中国地质大学（武汉）70 周年校庆，促进我院研究生和教员在微分方程及其控制理论方面的研究，加强与国内微分方程及其控制理论的最新成果交流，以及扩大国内偏微分方程控制的数学理论相关领域的学术交流，受新冠肺炎疫情的影响，我们拟于 2022 年 11 月 12 日通过腾讯会议召开“2022 年偏微分方程控制理论”网络在线学术会议。会议以加强偏微分方程控制理论及相关领域的学术交流为主旨，展示和介绍理论及应用方面的最新研究成果和进展。

会议时间　2022 年 11 月 12 日

会议方式　腾讯会议 ID：773-147-868

特邀报告人

郭宝珠　教授　（华北电力大学数理学院）

胡　龙　教授　（山东大学数学学院）

金　龙　副教授　(清华大学丘成桐数学科学中心)

吕　琦　教授　（四川大学数学学院）

汪更生　教授　(天津大学应用数学中心)

尤　波　教授　(西安交通大学数学与统计学院)

张　琼　教授　（北京理工大学数学与统计学院）

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会议日程安排

2022 年 11 月 12 日（星期六） **腾讯会议 ID：773-147-868**				
时间		报告题目	报告专家	主持人
上午	8:20-8:30	开幕式	郭上江 院长	刘汉兵
	8:30-9:30	Weak observability inequality and stabilization	汪更生（天津大学）	王 明
	9:30-10:30	Output regulation of 1-d wave PDE with unknown exosystem	郭宝珠（华北电力大学）	
	10:30-11:30	Relationship between the maximum principle and dynamic programming for infinite dimensional stochastic control systems	吕琦（四川大学）	
	11:30-12:30	Control of eigenfunctions on surfaces of negative curvature	金龙（清华大学）	
	午间休会			
下午	14:30-15:30	Stability of Elastic Systems with Local Damping	张琼（北京理工大学）	刘汉兵
	15:30-16:30	Minimal time for the null-controllability of linear hyperbolic balance laws	胡龙（山东大学）	
	16:30-17:30	Boundary stabilization and disturbance rejection for a stochastic heat equation subject to unknown disturbance	周华成（中南大学）	
	17:30-18:30	Insensitizing controls for a fourth order semi-linear parabolic equations	尤波（西安交通大学）	

报告题目和摘要

注：按姓氏拼音字母为序

Output regulation of 1-d wave PDE with unknown exosystem

郭宝珠（华北电力大学数理学院）

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Abstract. The internal model principle is one of the main approaches to solve output regulation problem. In the past a few years, we have developed observer-based approach for output regulation of PDEs. However, by the internal model principle approach, the exosystem that produces the disturbance and reference signals is supposed to be known. For completely unknown exosystem, the adaptive internal model has been developed for lumped parameter systems for years. In this talk, I will present some new results on application of the adaptive internal model approach to output regulation of 1-d wave PDE with completely unknown exosystem.

Minimal time for the null-controllability of linear hyperbolic balance laws

胡龙（山东大学数学学院）

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Abstract. This talk is devoted to the minimal time for the null-controllability of linear hyperbolic balance laws by means of one-sided boundary controls. It is known in some previous works that such a critical time can be sensitive to both internal and boundary coupling terms, especially when null and exact controllability are not equivalent. The necessary and sufficient conditions will be shown when the minimal time is invariant with respect to the internal couplings, no matter what the boundary coupling terms are. Some interesting counterexamples will also be discussed.

Control of eigenfunctions on surfaces of negative curvature

金龙 （清华大学丘成桐数学科学中心）

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Abstract. In this talk, we present a uniform lower bound for the mass in any fixed nonempty open set of normalized Laplacian eigenfunctions on negatively curved surfaces, independent of eigenvalues. The result extends previous joint work with Semyon Dyatlov on surfaces with constant negative curvature. The proof relies on microlocal analysis, chaotic behavior of the geodesic flow and a new ingredient from harmonic analysis called Fractal Uncertainty Principle by Jean Bourgain and Semyon Dyatlov. Further applications include control for Schrodinger equation and exponential decay of energy for damped waves. This is based on joint work with Semyon Dyatlov and Stephane Nonnenmacher.

Relationships Between the Maximum Principle and Dynamic Progr amming for Infinite Dimensional Stochastic Control Systems

吕琦 （四川大学数学学院）

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Abstract. Pontryagin type maximum principle and Bellman's dynamic programmin g principle serve as two of the most important tools in solving optimal control proble ms. There is a huge literature on the study of relationship between them. In this tal k, we present some results for the relationships between Pontryagin type maximum pr inciple and dynamic programming principle for control systems governed by stochasti c evolution equations in infinite dimensional space, with the control variables appeari ng into both the drift and the diffusion terms.

Weak observability inequality and stabilization

汪更生 （天津大学应用数学中心）

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Abstract. We present a sufficient and necessary condition ensuring the stabilization for a linear control system $[A,B]$, where A generates a semigroup on a Hilbert space X, and B is a linear and bounded operator from another Hilbert space U to

X. This condition is characterized by some weak observability inequalities. The result is extended to the case where B is unbounded. Some applications are given.

Insensitizing controls for a fourth order semi-linear parabolic equations

尤波 （西安交通大学数学与统计学院）

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Abstract. In this talk, we will consider the existence of insensitizing controls for a fourth order semilinear parabolic equation. Here, the initial data is partially unknown, we would like to find controls such that a specific functional is insensitive for small perturbations of the initial data. In general, this kind of problems can be recast as a null controllability problem for a nonlinear cascade system. We first establish the corresponding global Carleman estimates, and then we prove a null controllability result for a linear problem by global Carleman estimates and dual arguments. Finally, by virtue of Leray-Schauder's fixed points theorem, we conclude the null controllability for the cascade system in the semi-linear case.

Stability of Elastic Systems with Local Damping

张琼 （北京理工大学数学与统计学院）

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Abstract. We consider the polynomial stability for an abstract system of the type $u_{tt}+Lu+Bu_t=0$, where L is a self-adjoint operator on a Hilbert space and operator B represents the local damping. By establishing precise estimates on the resolvent, we prove polynomial decay of the corresponding semigroup. The results reveal that the rate of decay depends strongly on the concentration of eigenvalues of operator L and non-degeneration of operator B. Finally, several examples are given as an application of our abstract results.

Boundary stabilization and disturbance rejection for a stochastic heat equation subject to unknown disturbance

周华成 （中南大学数学与统计学院）

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Abstract. In this talk, we discuss the stabilization and disturbance rejection for an anti-stable stochastic heat equation with unknown boundary external disturbance generated by an exogenous system. When there is no disturbance, the boundary controller can be designed by backstepping method. When there is disturbance, we propose disturbance observer-based boundary control by combining the backstepping approach and estimation/cancellation strategy, where the unknown disturbance is estimated in real time by a disturbance observer and rejected in the closed-loop, while the in-domain multiplicative noise whose intensity is within a known finite interval is attenuated. We prove that the resulting closed-loop system is exponentially stable in the sense of both mean square and almost surely.