天元数学国际交流中心 2026 年
智能交通中的数学理论与方法研讨会

会
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会议时间：2026 年 1 月 11 日-1 月 17 日

会议地点：天元数学国际交流中心，云南昆明

召集人：

韩德仁（北京航空航天大学）

陈彩华（南京大学）

胡耀华（深圳大学）

联系人：

蔡邢菊（南京师范大学）

联系方式：13338617884；caixingju@njnu.edu.cn

研讨内容及科学意义：本研讨会旨在推动应用数学理论的创新与边界拓展。智能交通面临的高维、动态与不确定性挑战，将催生对新型数学工具、算法和模型的需求，进而反哺数学学科的发展，形成正向反馈。研讨会将搭建数学家、交通工程师、计算机科学家与城市规划者的共创平台，围绕多源异构数据融合、时空预测、网络优化与控制、博弈与机制设计、随机与鲁棒优化、因果推断与评估等方向，开展联合攻关与案例验证。研究内容包括：1）开展多源异构数据的时空建模与融合，形成可解释的需求预测与拥堵演化模型；2）面向调度、信控与路径优化，设计随机/鲁棒/分布式算法，并给出可计算的收敛与误差界；3）开展复杂系统的博弈与机制设计，刻画出行主体行为与激励；4）构建标准数据集、评测指标与开源工具，支撑复现与对标。科学意义在于：以数学化、可验证的模型连接机理与应用，推动数学、计算与交通工程的深度交叉；加深对复杂交通系统底层规律的

定量刻画，促进数学理论与工程实践的深度耦合，加快科研成果从“实验室”走向“马路”；为未来智能、绿色与安全的交通基础设施提供可验证的理论支撑与决策依据；通过对不确定性与风险的系统建模，提升系统韧性与应急能力；培养跨学科人才，增强产业与公共治理的创新能力，最终提升城市运行效率、降低碳排放并保障公共安全，具有长期而深远的战略价值。

预期成果：

1. 形成理论框架共识： 明确关键数学技术在智能交通核心问题中的应用路径与瓶颈，凝练未来重点研究方向，为领域发展提供理论指引。

2. 促进交叉学科合作： 搭建数学、计算机、交通工程等多学科深度交流的平台，促成若干跨学科合作项目与团队的建立。

3. 产出决策支持建议： 汇总形成关于智能交通系统优化、政策制定与标准建设的专家建议白皮书，为相关部门的科学决策提供理论依据。

4. 发掘与培育人才： 激发青年学者与研究生的创新思维，为领域培养亟需的复合型后备人才。

会议日程

2026 年 1 月 12 日 (星期一)			
09:00-09:30	开幕式及合影		
时间	报告人	报告题目	主持人
09:30-10:20	戴彧虹 中国科学院数学与系统科学研究院	A Surrogate Value Function Formulation for Bilevel Optimization	刘新为
10:20-10:50	茶歇		
10:50-11:40	杨海 香港科技大学	Some Emerging Research Issues in Ride-sourcing Markets	刘新为
11:40-14:30	自由活动：午餐		
14:30-15:20	陈彩华 南京大学	Identifying spatiotemporal positions of network-wide traffic incidents with floating car data: A shockwave-informed optimization model	张进
15:20-15:50	茶歇		
15:50-16:40	胡耀华 深圳大学	非凸稀疏优化与矩阵低秩优化	张进
16:40-17:30	自由讨论		崔春风
17:30-19:30	自由活动：晚餐		

2026 年 1 月 13 日 (星期二)			
时间	报告人	报告题目	主持人
09:00-09:50	黄海军 北京航空航天大学	连续走廊问题的研究进展	徐薇
09:50-10:20	茶歇		
10:20-11:10	罗志兴 南京大学	Approximation for Pure Integer Two-stage Distributionally Robust Service Network Design Problem with Demand Uncertainty	徐薇
11:10-12:00	自由讨论		王正礼
12:00-14:30	自由活动：午餐		
14:30-15:20	邵虎 中国矿业大学	Modeling and Algorithms for Traffic Demand Flow: Observation, Estimation, and Prediction	徐红利
15:20-15:50	茶歇		
15:50-16:40	龙梦 重庆国家应用数学中心	车路协同下的动态公交信号优先：深度强化学习方法与优化	徐红利
16:40-17:30	自由讨论		龙梦
17:30-19:30	自由活动：晚餐		

2026 年 1 月 14 日 (星期三)			
时间	报告人	报告题目	主持人
09:00-09:50	韩德仁 北京航空航天大学	交通管理的效率、公平与机制设计	蔡邢菊
09:50-10:20	茶歇		
10:20-11:10	张立卫 东北大学智能工业与系统优化国家级前沿科学研究中心	Halpern Acceleration of the Inexact Proximal Point Method of Rockafellar	蔡邢菊
11:10-12:00	自由讨论		吴育洽
12:00-14:30	自由活动：午餐		
14:30-17:30	自由讨论		
17:30-19:30	自由活动：晚餐		

2026 年 1 月 15 日 (星期四)			
时间	报告人	报告题目	主持人
09:00-09:50	王晓蕾 同济大学	Service Network Design of Modular Vehicles on General Road Networks Considering Passengers' Turning Choices	徐梦薇
09:50-10:20	茶歇		
10:20-11: 10	杨俊锋 南京大学	A Single-Loop Algorithm for Decentralized Bilevel Optimization	徐梦薇
11:10-12:00	自由讨论		曾尚志
12:00-14:30	自由活动：午餐		
14:30-15:20	蒋建林 南京航空航天大学	Sparse-dense flight copy-based interactive mechanism to airline integrated recovery with cruise speed control	徐玲玲
15:20-15:50	茶歇		
15:50-16:40	曾尚志 南方科技大学	Extended SQP Methods in Nonsmooth Difference Programming Applied to Problems with Variational Inequality Constraints	徐玲玲
16:40-17:30	自由讨论		
17:30-19:30	自由活动：晚餐		

2026 年 1 月 16 日 (星期五)			
时间	报告人	报告题目	主持人
09:00-09:50	谢家新 北京航空航天大学	Enhanced randomized Douglas-Rachford method: Improved probabilities and adaptive momentum	彭再云
09:50-10:20	茶歇		
10:20-11: 10	王祥丰 华东师范大学	Verifiably Improving Optimization Algorithms via LLMs	彭再云
11:10-12:00	自由讨论		
12:00-14:30	自由活动：午餐		
14:30-17:30	自由讨论		
17:30-19:30	自由活动：晚餐		

A Surrogate Value Function Formulation for Bilevel Optimization

戴彧虹

中国科学院数学与系统科学研究院

摘要：The value function formulation captures the hierarchical structure of bilevel optimization through the optimal value of the lower level problem, but its implicit and nonsmooth nature poses significant analytical and computational challenges. We propose a surrogate value function formulation that replaces the implicit value function with an explicit surrogate based on lower level stationarity. Unlike Karush-Kuhn-Tucker formulations, our proposed formulation avoids incorporating the entire stationary set of the lower level problem into the upper level feasible region. The surrogate value function formulation is shown to be equivalent to the original bilevel program when the lower level Lagrangian is pseudoconvex. In addition, the relationships between the stationarity conditions of the surrogate value function formulation and those of existing single-level models are characterized. To handle the complementarity constraints, we develop a smoothing barrier augmented Lagrangian method and show that accumulation points of the generated iterates are Clarke stationary. Extensive numerical experiments, including nonconvex and degenerate cases, demonstrate the effectiveness of the surrogate value function formulation. This is a joint work with Mengwei Xu, Xin-Wei Liu and Meiqi Ma.

报告人简介：戴彧虹，中国科学院院士，中国科学院数学与系统科学研究院副院长、研究员、博士生导师。现任中国运筹学会理事长、中国数学会副理事长、国际运筹学会联合会（IFORS）副主席。戴彧虹研究员长期从事优化方法的理论及应用研究，在连续优化、整数规划和应用优化等方面作出了系统的创造性工作。曾或正主持国家杰出青年科学基金、国家基金委创新研究群体项目、“十四五”国家重点研发计划项目等多项基金项目。应邀在 2022 年国际数学家大会做 45 分钟邀请报告，在 2022 年第 24 届国际数学规划大会做一小时邀请报告。 曾获国家自然科学二等奖（2006，排名第二）、冯康科学计算奖（2015）、中国数学会陈省身数学奖（2017）、中国工业与应用数学学会首届萧树铁应用数学奖（2018）、中国运筹学会运筹应用奖（2018）。2021 年当选中国工业与应用数学学会会士，

2022 年当选首届中国运筹学会会士，2023 年当选国际运筹学会联合会会士，2025 年当选为中国科学院院士。

Some Emerging Research Issues in Ride-sourcing Markets

杨海

香港科技大学

摘 要： Urban mobility has undergone drastic changes in recent years with the introduction of application-based taxi and car service e-hailing systems. These systems provide timely and convenient on-demand ride services to anyone, anywhere and anytime. E-hailing is now prevalent in the traditional taxi industry by effectively mitigating information asymmetry and uncertainty between customers and taxi drivers; E-hailing in the form of ride-sourcing can efficiently match a requesting customer with an affiliated private car driver nearby for on-demand ride services. This talk highlights some emerging research issues and latest developments in ride-sourcing markets, including demand forecasting, surge-pricing, matching and ridesharing, as well as analysis of human mobility and network property with big car trajectory data.

报告人简介：Prof. Hai Yang is a highly regarded Chair Professor at The Hong Kong University of Science and Technology, with a global reputation as an active scholar in the transportation field. He has published over 350 papers in leading international journals, including Transportation Research, Transportation Science, and Operations Research, and has an impressive SCI H-index citation rate of 73. Prof. Yang has received numerous national and international awards, including the 2020 Frank M. Masters Transportation Engineering Award and the 2021 Francis C. Turner Award of the American Society of Civil Engineers. He was also appointed as Chang Jiang Chair Professor of the Ministry of Education of PR China and served as the Editor-in-Chief of Transportation Research (TR) Part B: Methodological from 2013 to 2018. Currently, Prof. Yang serves on the Distinguished Editorial Board of Transportation Research Part B: Methodological, Scientific Council of Transportation Research Part C: Emerging Technologies, and serves as an Advisory Editor of Transportation Science.

Identifying spatiotemporal positions of network-wide traffic incidents with floating car data: A shockwave-informed optimization model

陈彩华

南京大学

摘要：Accurate spatiotemporal positions of traffic incidents, namely their occurrence times and links, are crucial for extensive incident-related analyses and traffic management systems. Such information is difficult to obtain directly from incident reports due to ambiguous text descriptions and unreported incidents. To address this issue, some existing studies have utilized various data sources, like social media data, and develop data-driven methods for incident identification. However, the limited data availability and potential low data quality across the road networks, including data missing and errors, may prevent these methods from accurately identifying the spatiotemporal positions of network-wide incidents. In this research, we attempt to address these challenges by developing a shockwave-informed optimization model using floating car data (FCD). The input to our model includes network-wide traffic speeds during the analysis period, which may contain measurement errors and missing data but are generally available across the entire network. Our model then outputs the most likely spatiotemporal positions of network-wide incidents. Specifically, the identification is achieved by analyzing the origins associated with spatiotemporal progression of incident impact. To address missing and erroneous speed data, we formulate shockwave propagation as constraints to characterize the incident impact on speed evolution across adjacent links and time intervals, which compensates for the limited information in the corrupted data. Moreover, the complex road network structure influencing shockwave propagation is incorporated within the constraints. Under suitable assumptions, we prove that solving the model is equivalent to performing maximum likelihood estimation. Numerical experiments are conducted to validate our model and results show that satisfactory results can be achieved under different missing rates and noise magnitudes, which demonstrates the accuracy and robustness of our proposed model.

报告人简介：陈彩华，国家优秀青年基金获得者、国家自然科学基金重大项目课题负责人，现任南京大学教授、博士生导师、工程管理学院副院长。南京大学理学博士，新加坡国立大学联合培养博士。从事数据驱动的决策、不确定决策的理论与算法、优化算法设计与应用等研究，代表作发表于Management Science, Mathematical Programming, Informs Journal on Computing, SIAM系列, IEEE系列杂志及NeurIPS, CVPR等人工智能顶级会议。获华人数学家联盟最佳论文奖(2017、2018)，中国运筹学会青年科技奖(2018)，江苏省工业与应用数学学会青年奖(2020), 南京大学青年五四奖章(个人 2019，团队 2024)，入选首批南京大学仲英青年学者(2017)、南京大学青年名师名课培养计划(2020)及江苏省社科优青(2019)。主讲及参与的课程包括：数据分析与决策导论（线下）、应用统计（线下）、随机优化理论及应用（线下）、应用统计与R语言(MOOC, 2021 春上线, 国家一流课程）、最优化理论与方法(MOOC, 2022 春上线)、研究生学术规范与学术诚信(MOOC, 2021 秋上线，江苏省精品教学资源)，指导的本科生多次获得美国大学生数学建模竞赛Finalist等奖励、工业工程与精益管理创新赛全国一等奖，研究生获中国大学生国际创新大赛金奖。

非凸稀疏优化与矩阵低秩优化

胡耀华

深圳大学

摘要：稀疏优化与低秩优化是运筹优化的研究热点，在信息论、图像科学、机器学习等领域有着广泛的应用；非凸正则化方法在应用中展现出强大的稀疏还原性与抗噪强健性。生物信息学是通过基因之间相互作用来解释生命与进化的现象，是新兴交叉学科方向。本报告将介绍稀疏优化/低秩优化与生物信息学的桥梁，描述多种基因调控网络结构所对应的非凸稀疏优化/低秩优化模型。我们还将重点介绍非凸稀疏优化/低秩优化模型的数学理论，包括模型的相合性理论与渐进性理论，最优解的等价刻画，一阶算法的线性收敛速度与全局收敛性理论等。

报告人简介：胡耀华，先后于浙江大学获得学士与硕士学位，香港理工大学获得博士学位。现任深圳大学数学科学学院特聘教授，副院长，博士生导师，香港理工大学兼职博导。主要从事连续优化理论、方法与应用研究，代表性成果发表在SIAM Journal on Optimization, Mathematical Programming, Inverse Problems,

Journal of Machine Learning Research, Genome Biology, Bioinformatics 等期刊，授权多项国家发明专利，开发多个生物信息学工具包与数据库。

连续走廊问题的研究进展

黄海军

北京航空航天大学

摘要：本报告围绕四个方面展开：（一）介绍走廊问题的基础重要性、基本表达和公开问题。（二）介绍连续走廊问题的最新研究进展。（三）证明：当早到/晚到时间的单位惩罚函数为连续时，非收费均衡态下，走廊上通勤者的出发时空分布是角形的（horn-shaped），且角的顶点就是走廊终点。（四）证明且观察到：通勤数量的分布密度沿着走廊起点到终点是先升后降。

报告人简介：北京航空航天大学长江学者特聘教授，教育部复杂系统分析与管理决策重点实验室主任。国家自然科学基金委员会委员和咨询委员会委员、ISTTT 国际顾问委员会委员、WCTRS Steering Committee 委员，Transport Policy 主编，TR Part E 和 TS 等刊物 AE。围绕交通网络模型、道路交通流模型、拥挤收费、智慧交通与物流等主题，主持完成国家杰出青年科学基金、创新群体科学基金、国家 973 计划和重点研发计划等项目。曾获复旦管理学杰出贡献奖、中国系统工程学会理论贡献奖、国家自然科学二等奖等。

Approximation for Pure Integer Two-stage Distributionally Robust Service Network Design Problem with Demand Uncertainty

罗志兴

南京大学

摘要：We investigate a distributionally robust service network design problem with integer recourse and addresses the computational challenge stemming from integer recourse. Based on a two-stage consolidation-based formulation, the second-stage worst-case expected cost can be evaluated in closed form by leveraging the concave envelope of the recourse function. The closed-form nature enables reformulation of the original two-stage model into an approximate model that can be solved directly by commercial solvers. Numerical experiments on the Civil Aeronautics Board dataset

show that the proposed approximation approach is capable of solving large-scale instances—with up to 3.5 million variables—within acceptable computation time. Out-of-sample simulations demonstrate that our model outperforms both deterministic and stochastic benchmarks, validating the quality of the approximation.

报告人简介：罗志兴博士于 2010 年在华南理工大学获得学士学位，于 2014 年在香港城市大学获得博士学位，现为南京大学工程管理学院教授、博士生导师，主要研究的领域是运筹优化算法设计、智慧物流、智能制造等。他主持国家自然科学基金青年项目、面上项目和优秀青年项目各一项，在国际知名期刊 Management Science、Manufacturing & Service Operations Management、INFORMS Journal on Computing、Transportation Science、Transportation Research Part-B: Methodological 以及 Naval Research Logistics 发表论文十多篇。他 2018 年参加京东物流举办的“全球运筹优化挑战赛”，在城市物流运输车辆智能调度赛题获得第一名，2019 年入选中国科协青年人才托举工程，2020 年获得华为诺亚方舟实验室优秀高校合作项目奖。

Modeling and Algorithms for Traffic Demand Flow: Observation, Estimation, and Prediction

邵虎

中国矿业大学

摘要：Traffic demand flow estimation (TDFE) is a critical task in urban transportation planning and management, as it provides a scientific foundation for decision-making in infrastructure construction, public transit optimization, and congestion mitigation. To address this problem, this study comprises three systematic and interconnected research components: (1) the establishment of an observability theory based on graph isomorphism to guide cost-effective data acquisition, (2) the development of a deep learning-based model for accurate and interpretable dynamic TDFE, and (3) the construction of a bilevel origin-destination (OD) demand model along with the design of a corresponding efficient solution algorithm. To overcome the economic constraints of limited sensing resources, this research first establishes a graph theory-based analytical framework for traffic network flow observability. It derives the analytical

relationship for the minimum number of observable links and subsequently proposes a resource-constrained sensor deployment optimization model. By quantifying the information loss imposed by budget limitations, the model aims to maximize network flow observability at minimal cost, thereby laying a high-quality data foundation for subsequent analysis. For accurate and interpretable estimation of dynamic traffic demand, a Multi-feature Recurrent Learning Network (MRLN) that integrates physical traffic mechanisms is developed. This model structures key system processes such as trip distribution, route choice, and traffic assignment into interpretable computational units. Through a temporal-recursive and feature-fusion architecture, it achieves high-fidelity inversion of dynamic origin-destination (OD) demand, significantly enhancing both model interpretability and estimation accuracy. Addressing the practical challenge of solving complex models with real-world, multi-source heterogeneous data, a bilevel OD estimation model is constructed. A tailored, efficient heuristic solving algorithm based on the proximal linearized Alternating Direction Method of Multipliers (ADMM) is designed for this model. This algorithm substantially improves computational efficiency and numerical stability in data-sparse and heterogeneous scenarios, ensuring the practical utility of advanced estimation models. The three research components follow a progressive logic: the economical deployment establishes the essential data foundation for precise modeling, which in turn drives the development of robust solving algorithms. This complete technical chain ensures the practical applicability of advanced models, ultimately delivering an implementable framework for TDFE that provides tangible support for decision-making in intelligent transportation systems.

报告人简介：邵虎，中国矿业大学数学学院，教授，博士，博士生导师，中国矿业大学校学术委员会常委、江苏省应用数学(中国矿业大学)中心副主任、中国矿业大学数学学科建设与指导委员会主任、数学学院教授委员会主任。全国煤炭行业教学名师、全国大学生数学建模竞赛优秀指导教师江苏省高校优秀共产党员，江苏省“青蓝工程”优秀教学团队带头人，江苏省运筹学会副理事长。作为主持人，连续主持 5 项国家自然科学基金项目(面上 4 项，青年 1 项)，主持省教改项目 3

项（含重点项目 2 项），发表科研论文 70 余篇，出版第一作者专著 1 部，参编教材 2 部，获得江苏省教学成果一等奖、教育部自然科学奖二等奖、中国矿业大学教学贡献奖、教学模范等 100 余项奖励。主要从事问题驱动型“应用数学”研究，研究方向涉及最优化理论应用、交通网络建模与算法设计、数据驱动下的网络建模与算法、机器学习的应用等。

车路协同下的动态公交信号优先：深度强化学习方法与优化

龙梦

重庆国家应用数学中心

摘要：交通信号优先是缓解大都市交通拥堵、提升公交效率的有效措施。针对现有公交信号优先方法在模型依赖和响应滞后等方面的不足，本工作提出车路协同环境下基于深度强化学习的公交信号优先方法，将工程约束融入学习算法以保证决策合理性，并有效处理多冲突公交优先请求、优先与非优先车辆的权衡以及多交叉口协同控制问题。单交叉口与多交叉口仿真结果表明，该方法能够显著提升公交运行可靠性和道路通行效率，具有良好的工程应用前景。

报告人简介：龙梦，重庆师范大学重庆国家应用数学中心讲师，数学与智能交通团队骨干成员。2020 年于大连理工大学取得交通信息工程及控制硕士学位，2024 年于香港理工大学取得智能交通系统博士学位，曾赴日本东京大学智能交通研究所访问交流半年，2025 年入选新重庆引才计划优秀青年专项。主要研究方向为人工智能赋能道路交通管控，包括基于强化学习的公交信号优先、高速路交织区合流控制等，成果发表在 Transportation Research Part C、IEEE Transactions on Intelligent Transportation Systems 等期刊。

交通管理的效率、公平与机制设计

韩德仁

北京航空航天大学

摘要：交通管理的道路交通的规划、设计、建设、运营和维护等手段，提高道路交通的效率，减少交通拥堵，提升交通安全，改善交通环境，促进城市可持续发

展。本报告通过数学模型，重点介绍道路拥堵管理的收费策略设计和效率分析，并分析收费策略所涉及的公平性等问题。

报告人简介：韩德仁，教授，博士生导师，现任北京航空航天大学数学科学学院院长、教育部数学类专业教指委秘书长。从事大规模优化问题、变分不等式问题，以及交通规划、磁共振成像等研究工作。获教育部科学研究优秀成果奖（自然科学和工程技术）二等奖、江苏省科技进步奖、中国运筹学会青年科技奖等奖项；主持国家自然科学基金杰出青年基金项目、重点项目等多项项目。担任中国运筹学会副理事长、算法软件与应用分会理事长；《数值计算与计算机应用》、《Journal of the Operations Research Society of China》、《Journal of Global Optimization》、《Asia-Pacific Journal of Operational Research》编委。

Halpern Acceleration of the Inexact Proximal Point Method of Rockafellar

张立卫

东北大学智能工业与系统优化国家级前沿科学研究中心

摘要：This work investigates a Halpern acceleration of the inexact proximal point method of Rockafellar for solving maximal monotone inclusion problems in Hilbert spaces. The proposed Halpern inexact proximal point method (HiPPM) is shown to be globally convergent, and a unified framework is developed to analyze its worst case convergence behavior. Under mild conditions on the inexactness tolerances, HiPPM achieves an $O(k^{-2})$ convergence rate in terms of the squared fixed point residual. Moreover, under additional well-studied regularity conditions, the method attains a fast linear convergence rate. Building on this framework, we further extend the Halpern acceleration to the inexact augmented Lagrangian method for constrained convex optimization. In the spirit of Rockafellar's classical results, the resulting accelerated inexact augmented Lagrangian method inherits the convergence rate and iteration complexity guarantees of HiPPM. Numerical experiments are provided to support the theoretical findings.

报告人简介：张立卫，东北大学智能工业与系统优化国家级前沿科学研究中心教授，中国运筹学会监事。长期从事“矩阵优化”，“随机规划”和“均衡优化”的理论

与算法的研究,在稳定性分析和邻近点方法方面取得系统的研究成果。在专业期刊上发表 SCI 检索论文 130 多篇，其中包括在国际顶级期刊 Mathematical Programming, Operations Research, SIAM Journal on Optimization, Mathematics of Operations Research, Mathematics of Computation, JMLR, IEEE Transactions on Automatic Control 发表论文二十余篇。在科学出版社出版专著和教材 6 部。他目前主持一项国家重点研发计划课题，完成和主持自然科学基金面上基金多项,重点基金子课题两项。《APJOR》,《NACO》和《运筹学学报》编委，2020 年获得中国运筹学会运筹研究奖。

Service Network Design of Modular Vehicles on General Road Networks Considering Passengers' Turning Choices

王晓蕾

同济大学

摘要：The emergence of modular vehicles (MVs) opens the avenue to an entirely new urban transit system, in which a fleet of MVs circulating within the road network constitute a dynamic MV service network, and transit passengers can freely and stop-lessly choose where they go at each intersection by transferring to the appropriate pod. Provided feasible MV circulation patterns on the road network, this paper develops a novel mathematical model to depict passengers' turning choices at user equilibrium in the MV service network. We establish the equivalence of this model to a linear optimization problem, which can be further transformed into a multi-commodity network flow problem on a revised network. Taking passengers' turning choices as the lower-level problem, we then propose a bi-level problem to optimize the modular pod (MP) circulation pattern. We show that this bi-level problem can be transformed into a non-convex single-level problem with bi-convex property, and employ a multi-start alternating minimization (AM) algorithm to solve it by iteratively solving two convex subproblems. The convergence of the AM algorithm is established, and tailored algorithms are developed for solving each subproblem efficiently in large-scale networks. To mitigate the AM algorithm’s susceptibility to poor local optima in non-convex problems, an enhanced multi-start heuristic (MSAM)

is proposed. Numerical experiments on small- to large-scale networks validate the effectiveness of the proposed model and demonstrate the computational efficiency of the developed algorithms.

报告人简介：王晓蕾，同济大学经济与管理学院长聘教授（青百 A 岗）。2008 年本科毕业于中国科技大学（获郭沫若奖学金），2012 年博士毕业于香港科技大学（获 HKUST SENG PhD Research Excellence Award）。一直致力于城市交通系统优化领域的研究，主要研究兴趣：共享出行服务运营优化以及共享出行下的城市交通管理。在交通领域主要 SCI/SSCI 期刊发表论文 30 余篇，其中 16 篇发表于 INFORMS Journal on Computing、Transportation Research Part B、Transportation Science 等运筹、交通领域顶刊，篇均引用 80+；主持国家自然科学基金重点、优青、面上和青年项目、CCF-滴滴盖亚青年基金项目，创新群体“综合运输系统运营管理”项目骨干成员；世界交通运输大会共享与预约出行技术委员会主席，管理科学与工程学会交通运输管理分会委员，交通领域主要期刊 Transportation Research Part E 编委。

A Single-Loop Algorithm for Decentralized Bilevel Optimization

杨俊锋

南京大学

摘要：Bilevel optimization (BO) has gained significant attention in recent years due to its broad applications in machine learning. In this talk, we focus on decentralized BO and proposes a novel single-loop algorithm for solving it with a strongly convex lower-level problem. Our approach is a fully single-loop method that approximates the hypergradient using only two matrix-vector multiplications per iteration. Our algorithm does not require any gradient heterogeneity assumption and achieves the best-known convergence rate for BO algorithms. We also present experimental results on hyperparameter optimization problems using both synthetic and MNIST datasets, which demonstrate the efficiency of our proposed algorithm.（Joint with Dong Youran, Ma Shiqian, and Yin Chao)

报告人简介： Junfeng Yang, Professor, School of Mathematics, Nanjing University. His research interests are computational methods of mathematical optimization and

their applications, with a particular focus on the algorithm design and analysis for large-scale structured optimization problems arising from image/signal processing, compressed sensing, sparse/low-rank optimization, statistics/machine learning, etc. He has developed MATLAB packages FTVd, YALL1, and RecPF, which are dedicated to image restoration, compressed sensing decoding, and magnetic resonance imaging. His research works have been published in prestigious journals such as SIAM Journal on Optimization, Mathematics of Operations Research, SIAM Journal on Scientific Computing, SIAM Journal on Imaging Sciences, Mathematics of Computation, and IMA Journal of Numerical Analysis.

Sparse-dense flight copy-based interactive mechanism to airline integrated recovery with cruise speed control

蒋建林

南京航空航天大学

摘要： Aircraft rerouting and passenger reallocation are critical in airline recovery. The recovery decision of aircraft rerouting greatly affects other recovery phases, and the recovery performance of passenger reallocation influences the direct revenue of airline companies and the social reputation of the airline industry. We consider aircraft rerouting and passenger reallocation from an integration perspective to preserve their interdependence, which is neglected by the regular sequential recovery. In addition, we take the cruise speed control into consideration to improve the recovery performance. As a common way to describe the adjustments of flights in disruptions, the flight copy approach requires a lot of flight copies to obtain high-quality recovery plans, especially when considering cruise speed control. Then, the network scale of the associated problem is quite huge, and thus, solving such an integrated problem is challenging due to the real-time requirement in disruption management. This paper introduces a sparse-dense flight copy approach and proposes an interactive mechanism that alternately adjusts aircraft routes on the sparse flight copy-based network and reallocates passenger itineraries on the dense flight copy-based network. These two networks become much smaller than those from the regular flight copy

approach, and the solution difficulty decreases significantly. To realize such a mechanism, we develop a mathematical model to formulate the integrated recovery problem and propose a customized Benders decomposition (CBD) method to solve the model. The Benders decomposition strategy divides the proposed model into the aircraft rerouting subproblem and passenger reallocation subproblem, benefitting from the sparse-dense flight copy approach. By exploiting the properties and structure of the integrated recovery problem, we propose some acceleration techniques (including an effective feasibility certificate, scale management, and valid inequalities) to further promote the efficiency of the CBD method. Computational experiments on real-world data show that high-quality integrated recovery solutions (with optimality gaps within 5%) can be obtained by the proposed method within reasonable runtime. The effectiveness of acceleration techniques is also verified by the experiments.

报告人简介：蒋建林，南京航空航天大学教授，博士生导师。2000 年南京大学数学系计算数学专业获理学学士学位，2005 年南京大学数学系计算数学专业获理学博士学位。研究方向为数值最优化、航空交通运筹与优化等。在国内外正式刊物上发表学术论文 40 余篇。主持国家自然科学基金重点项目 1 项、面上项目 3 项、天元基金 2 项、专项基金 1 项。获聘湖北省“楚天学者”特聘教授，入选江苏省“333 高层次人才工程”培养对象、江苏省“青蓝工程”培养对象。

Extended SQP Methods in Nonsmooth Difference Programming Applied to Problems with Variational Inequality Constraints

曾尚志

南方科技大学深圳国家应用数学中心

摘要：This work explores a class of constrained difference programming problems, where the objective and constraints are formulated as differences of functions, without requiring their convexity. To investigate such problems, new variants of the extended sequential quadratic method are introduced. These algorithms iteratively solve strongly convex quadratic subproblems constructed via linear approximations of the given data by using their gradients and subgradients. The convergence of the proposed methods is rigorously analyzed by employing, in particular, the

Polyak-Lojasiewicz-Kurdyka property that ensures global convergence for various classes of functions in the problem formulation, e.g., semialgebraic ones. The original framework is further extended to address difference programming problems with variational inequality (VI) constraints. By reformulating VI constraints via regularized gap functions, such problems are naturally embedded into constrained difference programming that leads us to direct applications of the proposed algorithms. Numerical experiments for the class of continuous network design problems demonstrate the efficiency of the new methods.

报告人简介：曾尚志，南方科技大学深圳国家应用数学中心/数学系副教授。2015年本科毕业于武汉大学，2021年博士毕业于香港大学。2021年至2024年期间在加拿大维多利亚大学从事博士后研究工作，2024年加入南方科技大学。研究方向包括最优化理论与方法、双层规划、机器学习优化算法。研究成果发表在Math Program、SIAM J Numer Anal、J Mach Learn Res、IEEE Trans Pattern Anal Mach Intell，以及ICML、NeurIPS、ICLR等期刊和会议上。

Enhanced randomized Douglas-Rachford method: Improved probabilities and adaptive momentum

谢家新

北京航空航天大学

摘要：Randomized iterative methods have gained recent interest in machine learning and signal processing for solving large-scale linear systems. One such example is the randomized Douglas-Rachford (RDR) method, which updates the iterate by reflecting it through two randomly selected hyperplanes and taking a convex combination with the current point. In this talk, we enhance RDR by introducing improved sampling strategies and an adaptive heavy-ball momentum scheme. Specifically, we incorporate without-replacement and volume sampling into RDR, and establish stronger convergence guarantees compared to conventional i.i.d. sampling. Furthermore, we develop an adaptive momentum mechanism that dynamically adjusts step sizes and momentum parameters based on previous iterates, and prove that the resulting method achieves linear convergence in expectation with improved convergence bounds.

Numerical experiments demonstrate that the enhanced RDR method consistently outperforms the original version, providing substantial practical benefits across a range of problem settings.

报告人简介：谢家新，北京航空航天大学数学科学学院副教授，博士生导师，2017年获湖南大学计算数学博士学位。研究兴趣为随机优化算法及其加速技术，已在SIAM J. Optim., SIAM J. Matrix Anal. Appl., Math. Comp., Numer. Math.等期刊发表论文多篇。主持国家重点研发计划子课题、国家自然科学基金面上项目等项目。现为中国运筹学会算法软件及应用分会理事兼副秘书长，中国运筹学会数学规划分会青年理事。

Verifiably Improving Optimization Algorithms via LLMs

王祥丰

华东师范大学

摘要：Recent breakthroughs in LLM-driven mathematical discovery and evolutionary architectures—exemplified by frameworks such as FunSearch and AlphaEvolve—have demonstrated significant efficacy across various applications. Building on these advancements, this research extends similar methodologies to the LLM-aided design of optimization methods, with a specific focus on refining specialized techniques within optimization algorithms. We will discuss leveraging the code-generation capabilities of Large Language Models (LLMs) to enhance and accelerate the Alternating Direction Method of Multipliers (ADMM). To ensure the reliability of the newly discovered methods, we integrate formal verification languages such as Lean to provide rigorous provability. By employing formal methods as a constraint, we can establish a framework for trustworthy code generation, ensuring that the LLM-optimized algorithms are both efficient and mathematically verifiable.

报告人简介：王祥丰，华东师范大学教授，数学与工程应用教育部重点实验室副主任，目前担任上海市运筹学会副理事长、中国运筹学会算法软件与应用分会常务理事等。主要研究方向是智能体（最优化、强化学习、大语言模型驱动智能体）及应用等。曾获中国工业与应用数学学会落地应用成果、中国运筹学会青年科技奖提名奖、IEEE 信号处理学会最佳论文奖、华为云技术合作优秀合作伙伴奖等。