

分布式人工智能实验室

年度报告(2022)





睽违两年，我们重启了年度报告。

在本年度，我们重新梳理了团队研究方向并进行了深入地讨论与思考，确定以人工智能驱动的学习型算法设计与分析为未来的主要研究方向。

在本年度，我们进一步扩大了团队规模，有新的成员加入进来，也有两位同学顺利获得学位毕业。团队的运转逻辑和规则得到了进一步优化和明晰。

在本年度，我们取得了一些小小的成绩。学术交流成效方面较之前有了明显提升，科研产出方面在整体平稳的态势上也有部分亮点工作，团队建设方面也有一定的进步。当然，还有广阔的星辰大海需要我们不断努力。

在本年度，我们启动了专属于实验室的微信公众号，请大家多多关注指导。

在新的一年里，我们希望能够进一步转型升级，在团队建设、科研成果、个人成长方面有更精彩的表现。

继续向前。



沈栋

分布式人工智能实验室
中国人民大学

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2022.4.11

田天海教授，澳大利亚莫纳什大学(Monash University) 数学学院
Inference of pseudo-time trajectory using single-cell gene expression data

2022.4.20

张世华教授，中国科学院数学与系统科学研究院
Deciphering spatial domains from spatially resolved transcriptomics

2022.4.22

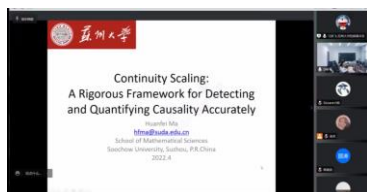
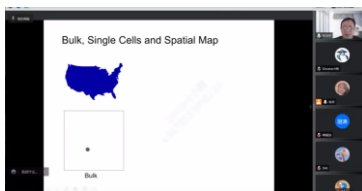
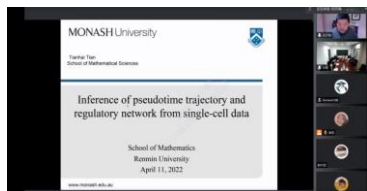
马欢飞教授，苏州大学数学科学学院
Continuity scaling: A rigorous framework for detecting and quantifying causality accurately

2022.4.25

张治华研究员，中科院北京基因组研究所
A dynamic kissing model for enhancer-promoter communication on the surface of transcriptional condensate

2022.5.16

张家军教授，中山大学数学学院
三维基因组结构调控基因表达的理论建模与统计推断



2022.9.13

张晓飞教授，华中师范大学数学与统计学学院

Imputing dropouts for single-cell RNA sequencing based on multi-objective optimization

2022.10.20

孟澄助理教授，中国人民大学统计与大数据研究院

Efficient Algorithms for Large-scale Optimal Transport Problems

2022.11.3

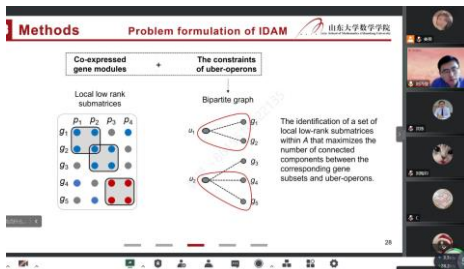
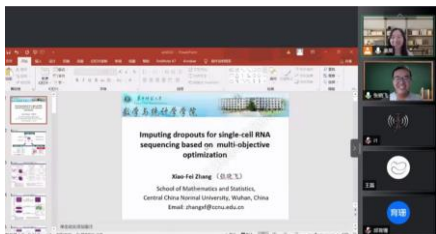
陈秀琼讲师，中国人民大学数学学院

Nonlinear Filtering Problems

2022.12.1

刘丙强教授，山东大学数学学院

Inference of disease-associated microbial gene modules based on meta-genomic and meta-transcriptomic data



- 2022.5.4-2022.5.7, 第13届亚洲控制会议 (The 13th Asian Control Conference), 高帅参会并做报告Iterative learning control for high-speed trains with nonuniform operation lengths
- 2022.8.3-2022.8.5, IEEE第11届数据驱动控制与学习系统会议(IEEE 11th Data Driven Control and Learning Systems Conference), 沈栋、姜昊、何迅、张泽义、李子涵和高帅参会. 何迅做学术报告Iterative learning control for multi-agent systems over unknown fading networks; 张泽义做学术报告Extended iterative learning control for inconsistent tracking problems with random dropouts
- 2022.10.3-2022.10.7, IEEE 2022年度图像处理国际会议(2022 IEEE International Conference on Image Processing), 赵兴莹参会并作报告EOGFACE: Deep face recognition via extensional logits



资助 Funding

科技部国家重点研发计划“社会治理与智慧社会科技支撑”专项

沈栋 ➤ 面向资本市场审慎监管的系统性风险监测与预警技术研究(子课题)

国家高层次人才特殊支持计划青年拔尖人才项目

沈栋 ➤ 复杂批次系统的智能学习控制

国家自然科学基金面上项目

姜昊 ➤ 单细胞多组学数据融合优化建模与异质性分析

国家自然科学基金青年科学基金项目

陈秀琼 ➤ 基于深度学习的非线性滤波算法的研究

中国人民大学“拔尖创新人才培养资助计划”

霍妞 ➤ 首次入选

中国人民大学研究生科学研究基金项目

何迅 ➤ 分布式系统的增益设计与协同控制

中国人民大学交叉创新研究计划

黄顺昊 ➤ 基于康复机器人的按需辅助训练与智能评估方案



荣誉 Award

张泽义, 姜昊, 沈栋

- 第 11 届 IEEE 数据驱动控制与学习系统会议最佳论文提名奖

沈栋

- Top 2% among the most-cited scientists worldwide (斯坦福大学发布)
- 河南省自然科学二等奖
- 河南省教育厅科技成果奖一等奖
- 中国人民大学本科课程教学优秀奖

姜昊

- 中国人民大学教学标兵候选人



179195	Köker, Raşit	Sakarya University of tur
179196	Rosen, Yale	SUNY Downstate Health usa
179197	Craswell, Nick	Microsoft Corporation usa
179198	Twala, Bhikisipho	Durban University of Izaf
179199	Crook, Joan M.	McMaster University can
179200	Stein, Janice Gross	University of Toronto can
179201	Shen, Dong	Renmin University of (chn)
179202	Pethick, D. W.	Murdoch University aus
179203	Mikkonen, Tommi	Helsingin Yliopisto fin
179204	Subramani, Saravanan	Sri Venkateswara Colleind
179205	Hirsh, Haym	Cornell University usa
179206	Kelley, M.	Harvard University usa
179207	Freivalds, Rusip\$	Institute of Mathematilva
179208	Nvfors, Allan	Haukeland Universitetssnor



三好学生

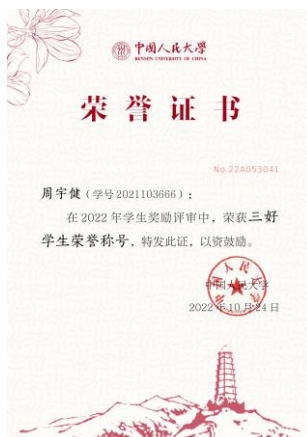
➤ 高帅、周宇健、李子涵

优秀学生干部

➤ 周宇健、黄逸翔、程翔

优秀共青团员

➤ 高帅



奖学金 Scholarship

国家奖学金

➤ 程翔、张泽义

学习优秀奖学金

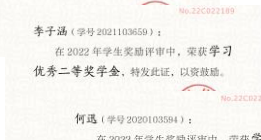
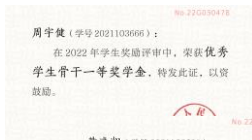
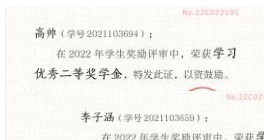
➤ 高帅、何迅、李子涵、罗莽莽、钱佳希、汪蒙洁

优秀学生骨干奖学金

➤ 周宇健

社会工作与志愿服务骨干奖学金

➤ 程翔、黄逸翔



Published Papers

1. Dong Shen, Niu Huo, Samer S. Saab. A Probabilistically Quantized Learning Control Framework for Networked Linear Systems. *IEEE Transactions on Neural Networks and Learning Systems*, vol. 33, no. 12, pp. 7559-7573, 2022.
2. Shihui Jiang, Dong Shen, Tianbo Zhang, Hongze Xu. Nonlinear Robust Composite Levitation Control for High-Speed EMS Trains with Input Saturation and Track Irregularities. *IEEE Transactions on Intelligent Transportation Systems*, vol. 23, no. 11, pp. 20323-20336, 2022.
3. Xianghua Jin, JinRong Wang, Dong Shen. Representation and Stability of Solutions for Impulsive Discrete Delay Systems with Linear Parts Defined by Non-Permutable Matrices. *Qualitative Theory of Dynamical Systems*, vol. 21, Article No. 152, 2022.
4. Min Zhou, JinRong Wang, Dong Shen. Iterative Learning Based Consensus Control for Distributed Parameter Type Multi-Agent Differential Inclusion Systems with Time-Delay. *Computers & Mathematics with Applications*, vol. 127, pp. 25-47, 2022.
5. Xuefang Li, Dong Shen, Beichen Ding. Iterative Learning Control for Output Tracking of Nonlinear Systems with Unavailable State Information. *IEEE Transactions on Neural Networks and Learning Systems*, vol. 33, no. 9, pp. 5085-5092, 2022.
6. Dong Shen, Samer S. Saab. Noisy Output Based Direct Learning Tracking Control with Markov Nonuniform Trial Lengths Using Adaptive Gains. *IEEE Transactions on Automatic Control*, vol. 67, no. 8, pp. 4123-4130, 2022.
7. Fazhi Song, Yang Liu, Dong Shen, Li Li, Jiubin Tan. Learning Control for Motion Coordination in Wafer Scanners: Towards Gain Adaptation. *IEEE Transactions on Industrial Electronics*, vol. 62, no. 12, pp. 13428-13438, 2022.
8. Min Zhou, JinRong Wang, Dong Shen. Iterative Learning Based Consensus Control for Distributed Parameter Type Multi-Agent Differential Inclusion Systems. *International Journal of Robust and Nonlinear Control*, vol. 32, no. 12, pp. 6785-6804, 2022.
9. Xiaokai Cao, Michal Feckan, JinRong Wang, Dong Shen. Iterative Learning Control for Impulsive Multi-Agent Systems with Varying Trial Lengths. *Nonlinear Analysis: Modelling and Control*, vol. 27, no. 3, pp. 445-465, 2022.
10. Hao Jiang, Dong Shen, Wai-Ki Ching, Yushan Qiu. A High-Order Norm-Product Regularized Multiple Kernel Learning Framework for Kernel Optimization. *Information Sciences*, vol. 606, pp. 72-91, 2022.
11. Dong Shen, Ganggui Qu, Qijiang Song. Learning Control for Networked Stochastic Systems with Random Fading Communication. *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, vol. 52, no. 6, pp. 3659-3670, 2022.
12. Dong Shen, Chao Zhang. Zero-Error Tracking Control under Unified Quantized Iterative Learning Framework via Encoding-Decoding Method. *IEEE Transactions on Cybernetics*, vol. 52, no. 4, pp. 1979-1991, 2022.
13. Yanze Liu, Dong Shen. An Efficient Algorithm for Collaborative Learning Model Predictive Control of Nonlinear Systems. *ISA Transactions*, vol. 121, pp. 1-10, 2022.
14. Samer S. Saab, Dong Shen, Mohammad Orabi, David Kors, Rayana Jaafar. Iterative Learning Control: Practical Implementation and Automation. *IEEE Transactions on Industrial Electronics*, vol. 69, no. 2, pp. 1858-1866, 2022.

15. Dong Shen, Xinghuo Yu. Learning Control over Unknown Fading Channels Based on Iterative Estimation. *IEEE Transactions on Neural Networks and Learning Systems*, vol. 33, no. 1, pp. 48-60, 2022.
16. Xiuqiong Chen, Xue Luo, Ji Shi, Stephen S.-T. Yau. General Convergence Result for Continuous-Discrete Feedback Particle Filter. *International Journal of Control*, vol. 95, no. 11, pp. 2972-2986, 2022.
17. Jiayi Kang, Xiuqiong Chen, Yangtianze Tao, Stephen S.-T. Yau. Optimal Transportation Particle Filter for Linear Filtering Systems with Correlated Noises. *IEEE Transactions on Aerospace and Electronic Systems*, vol. 58, no. 6, pp. 5190-5203, 2022.
18. Hao Jiang, Xun He, Qijiang Song, Dong Shen. Decentralized Learning Control for Large-Scale Systems with Gain Adaptation Mechanism. *Information Sciences*, vol. 623, pp. 539-558, 2023.

Accepted Papers

19. Xiaoqing Cheng, Chang Yan, Hao Jiang, Yushan Qiu. scHOIS: Determining Cell Heterogeneity Through Hierarchical Clustering Based on Optimal Imputation Strategy. *IEEE/ACM Transactions on Computational Biology and Bioinformatics*, accepted.
20. Xudong Gui, JinRong Wang, Dong Shen. Observability for Markovian Jump Boolean Network with Random Delay Effect in States. *Qualitative Theory of Dynamical Systems*, accepted.
21. Ganggui Qu, Dong Shen, Qijiang Song, Xinghuo Yu. Point-to-Point Learning and Tracking for Networked Stochastic Systems with Fading Communications. *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, accepted.
22. Shunhao Huang, Dong Shen, JinRong Wang. Point-to-Point Learning Tracking Control via Fading Communication Using Reference Update Strategy. *IEEE Transactions on Cybernetics*, accepted.
23. Xiang Cheng, Hao Jiang, Dong Shen. A Novel Accelerated Multistage Learning Control Mechanism via Virtual Performance Reduction. *IEEE Transactions on Neural Networks and Learning Systems*, accepted.
24. Wanzheng Qiu, Michal Feckan, JinRong Wang, Dong Shen. Iterative Learning Control for Conformable Stochastic Impulsive Differential Systems With Randomly Varying Trial Lengths. *International Journal of Nonlinear Sciences and Numerical Simulation*, accepted.
25. Niu Huo, Hao Jiang, Dong Shen, JinRong Wang. Finite-Level Uniformly Quantized Learning Control with Random Data Dropouts. *International Journal of Robust and Nonlinear Control*, accepted.
26. Xiang Cheng, Hao Jiang, Dong Shen, Xinghuo Yu. A Novel Adaptive Gain Strategy for Stochastic Learning Control. *IEEE Transactions on Cybernetics*, accepted.
27. Xun He, Dong Shen. Distributed Iterative Learning Temperature Control for Large-Scale Buildings. *International Journal of Robust and Nonlinear Control*, accepted.
28. Dong Shen. Practical Learning-Tracking Framework Under Unknown Nonrepetitive Channel Randomness. *IEEE Transactions on Automatic Control*, accepted.
29. Hao Jiang, Dong Shen, Shunhao Huang, Xinghuo Yu. Accelerated Learning Control for Point-to-Point Tracking Systems. *IEEE Transactions on Neural Networks and Learning Systems*, accepted.
30. Chen Liu, Xiaoe Ruan, Dong Shen, Hao Jiang. Optimal Learning Control Scheme for Discrete-Time Systems with Nonuniform Trials. *IEEE Transactions on Cybernetics*, accepted.
31. Tianbo Zhang, Dong Shen, Shihui Jiang, Hongze Xu. Adaptive Fixed-Time Antilock Control of Levitation System of High-Speed Maglev Train. *IEEE Transactions on Intelligent Vehicles*, accepted.

32. Ronghu Chi, Huaying Li, Dong Shen, Zhongsheng Hou, Biao Huang. Enhanced P-type Control: Indirect Adaptive Learning from Set-point Updates. *IEEE Transactions on Automatic Control*, accepted.
33. Ganggui Qu, Dong Shen, Xinghuo Yu. Batch-Based Learning Consensus of Multi-Agent Systems With Faded Neighborhood Information. *IEEE Transactions on Neural Networks and Learning Systems*, accepted.
34. Xiuqiong Chen, Yangtianze Tao, Wenjie Xu, Stephen S.-T. Yau. Recurrent Neural Networks Are Universal Approximators With Stochastic Inputs. *IEEE Transactions on Neural Networks and Learning Systems*, accepted.
35. Xiuqiong Chen, Stephen S.-T. Yau. On the Stability of Linear Feedback Particle Filter. *Asian Journal of Mathematics*, accepted.

Conference Papers

36. Xingying Zhao, Hao Jiang, Dong Shen. EOGFACE: Deep Face Recognition Via Extensional Logits. The 2022 IEEE International Conference on Image Processing (ICIP), Bordeaux, France, 16-19 October, 2022, pp. 311-315.
37. Tianbo Zhang, Shihui Jiang, Tiya Zhang, Dong Shen, Hongze Xu. A Kiefer-Wolfowitz Algorithm Based Adaptive PID for Magnetic Levitation Ball System With Experimental Verification. The 41st Chinese Control Conference (CCC2022), Hefei, China, July 25-27, 2022, pp. 5544-5548.
38. Xun He, Hao Jiang, Dong Shen. Iterative Learning Control for Multi-Agent Systems Over Unknown Fading Networks. The IEEE 11th Data Driven Control and Learning Systems Conference (DDCLS'22), Emeishan, China, 3-5 August, 2022, pp. 976-981.
39. Zeyi Zhang, Hao Jiang, Dong Shen. Extended Iterative Learning Control for Inconsistent Tracking Problems with Random Dropouts. The IEEE 11th Data Driven Control and Learning Systems Conference (DDCLS'22), Emeishan, China, 3-5 August, 2022, pp. 935-940.
40. Shuai Gao, Dong Shen. Iterative Learning Control for High-Speed Trains with Nonuniform Operation Lengths. The 13th Asian Control Conference, Jeju, Korea, 3-7 May, 2022, pp. 137-142.

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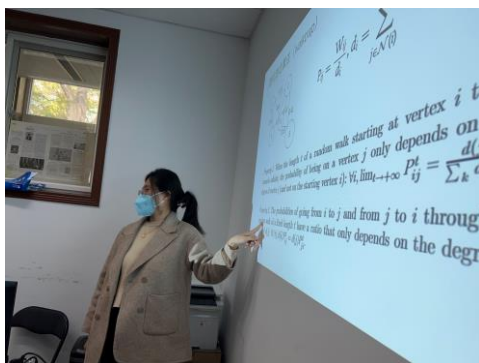
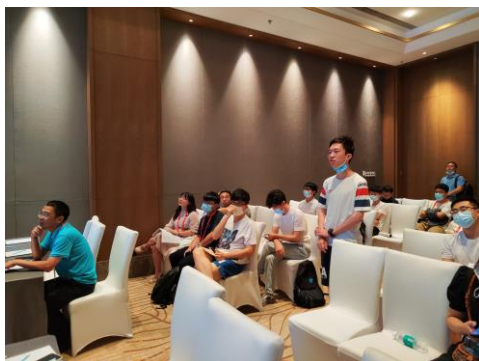
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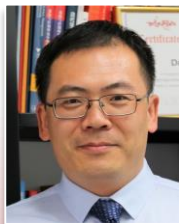
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