报告摘要 Letter

本报告主要汇总了智能与学习系统中心（Center of Intelligent and Learning Systems）在 2019 年的研究内容。报告的主要内容包括研究组在本年度的相关数据、会议交流等学术活动、讨论组报告列表、研究生信息表、研究方向概述以及本年度发表论文集。

本研究小组的主要研究方向为迭代学习控制。围绕这一方向，研究组在本年度开展了一系列的研究，在若干个方向上取得了重要突破。主要贡献如下：

1. 针对批次变长度问题，做了一些拓展工作；
2. 考虑通信信道为衰减信号的问题，这将带来乘性的随机影响，设计了迭代学习控制算法并证明收敛性；
3. 基于均匀量化器设计了含有编解码机制的量化迭代学习控制框架，考虑了传输信道中存在随机丢包的情况，给出了设计机制及理论分析；
4. 研究了多输出系统的多目标跟踪问题，给出了一种加权优化的设计方法，并给出了性能分析。

本报告的最后一部分为本年度发表论文与在线发表论文的汇总。

Dong SHEN

2019.12.31

报告目录 Outline

1 研究组成员 Members

刘 辰

男

2017 年于长安大学获得学士学位
现于北京化工大学攻读硕士学位
2019 年研究生国家奖学金
研究方向：多智能体迭代学习控制问题
发表 SCI 论文 5 篇

瞿港归

男

2018 年于华北电力大学保定校区获得学士学位
现于北京化工大学攻读硕士学位
2019 年研究生国家奖学金
研究方向：衰减信道下的迭代学习控制
发表 SCI 论文 2 篇，在投期刊论文 2 篇

霍 妞

女

2017 年于郑州航空工业管理学院获得学士学位
现于北京化工大学攻读硕士学位
2019 年研究生国家奖学金
研究方向：量化迭代学习控制
发表 SCI 论文 2 篇

曾 堃

男

2016 年于北京航空航天大学获得学士学位
现于北京化工大学攻读硕士学位
研究方向：多智能体系统的迭代学习控制

New Alumna

曾 春

女

2019 年于北京化工大学获得硕士学位
获得 2018 年国家奖学金
研究生阶段发表 SCI 论文 2 篇
硕士学位论文《基于复合能量函数的变长度迭代学习控制》被评为校级优秀毕业论文

2 研究方向概述 Research

本研究报告以迭代学习控制为核心研究方向。本年度主要的研究课题包括如下几个方面：

1. 批次变长度下的迭代学习控制。主要研究批次运行长度并非固定不变，而是沿迭代轴方向随机变化情形的算法设计与分析问题。
2. 量化迭代学习控制。在降低通信信道数据传输量及保证系统跟踪性能的矛盾要求下，主要研究如何设计量化器以及相应的迭代学习控制算法的设计方案。
3. 衰减信道下的迭代学习控制。主要研究网络化结构中传输信道存在随机衰减效应时对传输数据的影响，以及如何进行算法设计与分析。

3 学术活动时间轴 Timeline

2019.1
在北京航空航天大学参加 IEEE IES Beijing Chapter 成立大会。
受邀在鸿绎直播课做讲座。
邀请北京工商大学魏伟教授做学术交流。

2019.2
获评 Asian Journal of Control 2018 年度杰出审稿人称号。

2019.3
邀请浙江大学于淼教授做学术报告。

2019.4
与王友清教授、Prof W. Paszke 及陈阳泉教授在 IEEE Access 组织专刊。
受邀给北京化工大学博士研究生做讲座“多种控制算法的一般数学原理”。

2019.6
课题组张超、曾春获得硕士学位。
参加于浙江台州举办的人工智能与学习控制研讨会并做报告。

2019.7
前往澳大利亚 RMIT University 进行学术访问。

2019.9
受邀到北京交通大学进行学术交流。

2019.11
受邀到山东大学参加非线性控制与网络化控制研讨会并做报告。
受邀到访南开大学进行学术交流。
受邀到访贵州大学进行学术交流。

2019.12
入职中国人民大学数学学院。

4 本年度论文列表 Publications

Journal Papers

1. **Dong Shen***, Jian-Xin Xu. Robust Learning Control for Nonlinear Systems with Nonparametric Uncertainties and Non-uniform Trial Lengths. International Journal of Robust and Nonlinear Control, vol. 29, no. 5, pp. 1302-1324, 2019.
2. **Dong Shen***, Jian-Xin Xu. Adaptive Learning Control for Nonlinear Systems with Randomly Varying Iteration Lengths. IEEE Transactions on Neural Networks and Learning Systems, vol. 30, no. 4, pp. 1119-1132, 2019.
3. Shengda Liu, JinRong Wang*, **Dong Shen**, D. O'Regan. Iterative Learning Control for Differential Inclusions of Parabolic Type with Noninstantaneous Impulses. Applied Mathematics and Computation, vol. 350, pp. 48-59, 2019.
4. **Chen Liu**, **Dong Shen***, JinRong Wang. Iterative Learning Control of Multi-Agent Systems under Communication Noises and Measurement Range Limitations. International Journal of Systems Science, vol. 50, no. 7, pp. 1465-1482, 2019.
5. **Niu Huo**, **Dong Shen***. Improving Boundary Level Calculation in Quantized Iterative Learning Control with Encoding and Decoding Mechanism. IEEE Access, vol. 7, no. 1, pp. 66623-66632, 2019.
6. Dahui Luo, JinRong Wang*, **Dong Shen**. PD^\alpha-type Distributed Learning Control for Nonlinear Fractional-Order Multi-Agent Systems. Mathematical Methods in the Applied Sciences, vol. 42, no. 13, pp. 4543-4553, 2019.
7. Jing Wang*, Chenchen Yu, **Dong Shen**, Yangquan Chen. Variable Gain Feedback PDα-type Iterative Learning Control for Fractional Nonlinear Systems with Time-delay. IEEE Access, vol. 7, no. 1, pp. 90106-90114, 2019.
8. **Chun Zeng**, **Dong Shen***, JinRong Wang. Adaptive Learning Tracking for Robot Manipulators with Varying Trial Lengths. Journal of the Franklin Institute, vol. 356, no. 12, pp. 5993-6014, 2019.
9. Dahui Luo, JinRong Wang*, **Dong Shen**, Michal Feckan. Iterative Learning Control for Fractional-order Multi-agent Systems. Journal of the Franklin Institute, vol. 356, no. 12, pp. 6328-6351, 2019.
10. **Dong Shen***, **Chao Zhang**, Jian-Xin Xu. Distributed Neural Networks Based Learning Consensus Control for Heterogeneous Nonlinear Multi-Agent Systems. International Journal of Robust and Nonlinear Control, vol. 29, no. 13, pp. 4328-4347, 2019.
11. Tianbo Zhang, **Dong Shen**, Chen Liu, Hongze Xu*. A Novel Iterative Learning Control Approach Based on Steady-state Kalman Filtering. IEEE Access, vol. 7, pp. 99371-99380, 2019.
12. **Ganggui Qu**, **Dong Shen***. Stochastic Iterative Learning Control With Faded Signals. IEEE/CAA Journal of Automatica Sinica, vol. 6, no. 5, pp. 1196-1208,

2019.

13. **Chen Liu**, **Dong Shen***, Jinrong Wang. Adaptive Learning Control for General Nonlinear Systems With Nonuniform Trial Lengths, Initial State Deviation, and Unknown Control Direction. International Journal of Robust and Nonlinear Control, vol. 29, no. 17, pp. 6227-6243, 2019.
14. Xuefang Li*, **Dong Shen**, Jian-Xin Xu. Adaptive Iterative Learning Control for MIMO Nonlinear Systems Performing Iteration-varying Tasks. Journal of the Franklin Institute, vol. 356, no. 16, pp. 9206-9231, 2019.
15. Wei Wei, Xiaofang Wei, Pengfei Xia, Min Zuo, and **Dong Shen***. Seizure Control by A Learning Type Active Disturbance Rejection Approach. IEEE Access, vol. 7, pp. 164792-164802, 2019.
16. **Dong Shen***, Xuefang Li. A Survey on Iterative Learning Control with Randomly Varying Trial Lengths: Model, Synthesis, and Convergence Analysis. Annual Reviews in Control, vol. 48, pp. 89-102, 2019.

Online Journal Papers

17. **Chen Liu**, **Dong Shen***, JinRong Wang. A Two-Dimensional Approach to Iterative Learning Control with Randomly Varying Trial Lengths. Journal of Systems Science and Complexity.
18. **Dong Shen***, **Ganggui Qu**. Performance Enhancement of Learning Tracking Systems Over Fading Channels with Multiplicative and Additive Randomness. IEEE Transactions on Neural Networks and Learning Systems.
19. Samer S. Saab, **Dong Shen**. Multidimensional Gains for Stochastic Approximation. IEEE Transactions on Neural Networks and Learning Systems.
20. **Dong Shen***, Jian-Xin Xu. A New Iterative Learning Control Algorithm with Gain Adaptation for Stochastic Systems. IEEE Transactions on Automatic Control.
21. **Dong Shen***, **Chen Liu**, **Lanjing Wang**, Xinghuo Yu. Iterative Learning Tracking for Multi-Sensor Systems: A Weighted Optimization Approach. IEEE Transactions on Cybernetics.
22. **Niu Huo**, **Dong Shen***. Encoding-decoding Mechanism-based Finite-level Quantized Iterative Learning Control with Random Data Dropouts. IEEE Transactions on Automation Science and Engineering.
23. Dahui Luo, JinRong Wang, **Dong Shen**. Consensus Tracking Problem for Linear Fractional Multi-Agent Systems with Initial State Error. Nonlinear Analysis: Modelling and Control.

Conference Papers

24. **Dong Shen***, **Ganggui Qu**, **Chen Liu**. Iterative Learning Control for Linear Systems with Fading Channels. The 31st Chinese Control and Decision Conference, Nanchang, China, June 3-5, 2019.
25. **Niu Huo**, **Chao Zhang**, **Dong Shen***. Uniformly Quantized ILC with Encoding

and Decoding Mechanism under Random Data Dropouts. The 31st Chinese Control and Decision Conference, Nanchang, China, June 3-5, 2019

26. **Chen Liu**, **Dong Shen***. Learning Consensus for Nonlinear Multi-Agent Systems with Iteration-Switching Topologies. The 31st Chinese Control and Decision Conference, Nanchang, China, June 3-5, 2019.
27. **Ganggui Qu**, **Dong Shen***. A Learning Control Algorithm for Networked Stochastic Systems with Fading Channels. The 31st Chinese Control and Decision Conference, Nanchang, China, June 3-5, 2019.
28. Panpan Zhu, Xuhui Bu*, Jiaqi Liang, **Dong Shen**. Data Driven Control for a Class of Nonlinear SISO Systems with Uniform Quantizer using Encoding and Decoding Mechanism. The IEEE 8th Data Driven Control and Learning Systems Conference (DDCLS'19), Dali, China, May 24-27, 2019.
29. **Ganggui Qu**, **Dong Shen***. Iterative Learning Control for Discrete-time Linear Systems Through Fading Channels via Stochastic Approximation. The 5th IFAC Symposium on Telematics Applications (TA2019), Chengdu, China, September 25-27, 2019.
30. **Chen Liu**, **Dong Shen***, Xuhui Bu. Adaptive Learning Control for Second-Order Nonlinear Multi-Agent Systems with Iteration-Switching Topologies. The 5th IFAC Symposium on Telematics Applications (TA2019), Chengdu, China, September 25-27, 2019.