复杂系统与网络科学研究中心

Research Center for Complex Systems and Network Sciences

The Fifty-eighth Workshop of Research Center for Complex Systems and Network Sciences

第五十八届复杂系统与网络科学研究中心论坛

暨华为-东南大学网络群体智能联合创新实验室第三期论坛

程序册

论坛资助： 东南大学数学与人工智能交叉创新引智计划、国家自然科学基金委科技部国家重点研发计划政府间国际科技创新合作

主办：华为-东南大学网络群体智能联合创新实验室（拟）
承办：东南大学复杂系统与网络科学研究中心
江苏省网络群体智能重点实验室 江苏国家应用数学中心 数学学院
复杂工程系统测量与控制教育部重点实验室 自动化学院
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中国工业与应用数学学会复杂网络与复杂系统专业委员会

历届论坛主页：https://nci.seu.edu.cn/dndxsxxyfzwlyxtkxlt_30702/list.htm

Purple Mountain Laboratories

HUAWEI

Inquiry: Simone Baldi (103009004@seu.edu.cn)、虞文武(wwyu@seu.edu.cn)

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时间：2022 年 6 月 22 日，周三 （Beijing Time: 15:00-17:00）
(Europe time: 9:00-10:00, 10:00-11:00)
Time: June 22th, 2022, Wednesday
会议方式（Meeting Method）：Tencent Meeting
会议号（Meeting ID）：553 987 958
会议密码（Meeting password）：641258
会议链接：https://meeting.tencent.com/dm/UtO2NyhyUk7r

时间：2022 年 6 月 22 日，周三 （Beijing Time: 21:00-22:00）
(USA time: 9:00-10:00)
Time: June 22th, 2022, Wednesday
会议号（Meeting ID）：626 646 783
会议密码（Meeting password）：641258
会议链接： https://meeting.tencent.com/dm/IMQd8gOEA204

Hybrid control design for robust global stabilization of rotation systems

Dr. Alessandro Bosso, University of Bologna

Beijing Time: 15:00-16:00

(Rome time: 9:00-10:00)

Towards the acquisition of advanced manipulation skills

Dr. Jihong Zhu, TU Delft and University of York

Beijing Time: 16:00-17:00

(Amsterdam time: 10:00-11:00)

Provably safe control and learning for dynamic uncertain systems

Prof. Changliu Liu, Carnegie Mellon University

Beijing Time: 21:00-22:00

(Pittsburgh time: 9:00-10:00)

Inquiry: Simone Baldi (103009004@seu.edu.cn)、虞文武(wwyu@seu.edu.cn)

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Hybrid control design for robust global stabilization of rotation systems

Dr. Alessandro Bosso（University of Bologna）

Abstract

In several physical domains, it is possible to find dynamics that evolve on nonlinear manifolds. This property is typical of applications involving rotations such as mechanical systems (attitude of vehicles and robots), power networks (phasors of AC systems), and biological systems (neuronal synchronization). In the context of rotation systems, the design of control and observation algorithms with global asymptotic stability guarantees is met by major design obstacles. Namely, since the state space is non-contractible, i.e., not isomorphic to any Euclidean space, it is impossible to globally asymptotically stabilize an equilibrium point through continuous feedback. For quaternion-like representations as the one typically used for 3-D attitude control, this issue is further complicated by the fact that any desired rotation corresponds to two distinct quaternions. In general, these issues can only be addressed by introducing discontinuous feedback. However, when static discontinuities are employed, stability becomes non-robust to a large class of perturbations, causing high sensitivity and chattering behaviors. In this context, recent works have shown that robustness can be ensured if the discontinuities are inherently dynamic, i.e., the controller/observer is designed as a hybrid dynamical system.

Given the above discussion, this seminar provides an overview of stability analysis tools from hybrid systems theory, control design for 2-D and 3-D rotation systems, and recent research directions. These topics will also be accompanied by examples derived from mechatronic applications.

About the Speaker

Alessandro Bosso received the master's degree in automation engineering from the University of Bologna, Italy, in 2016. He then received the Ph.D. degree in automatic control in 2020 from the same university, working on constrained adaptive control of nonlinear systems and sensorless observers for electric machines. As a Ph.D. student, he held a visiting position in 2018 at The Ohio State University. Currently, he is a Postdoctoral Researcher and Adjunct Professor at the Department of Electrical, Electronic, and Information Engineering (DEI), University of Bologna. His research interests include distributed and constrained adaptive control of nonlinear and hybrid systems, mechatronic control applications, and sensorless control and observation of electric machines.

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Towards the acquisition of advanced manipulation skills

Dr. Jihong Zhu（TU Delft and University of York）

Abstract

The acquisition of advanced manipulation skills is crucial for robot autonomy. The manipulation complexity may come from objects/humans in the environment. In this talk, I will exemplify the acquisition of relevant manipulation skills using control and imitation learning in tasks such as shape control of soft objects and dressing assistance. All algorithms in the talk are validated on the real robot setup and illustrated with experiment videos.

About the Speaker

Jihong Zhu is an incoming lecturer of robotics at University of York. He is currently a postdoctoral researcher at Cognitive Robotics, TU Delft and Honda Research Institute, Europe working with Prof. Jens Kober and Dr. Michael Gienger. He obtained his PhD in robotics from University of Montpellier (France) working on the H2020 project VERSATILE. Jihong serves as an Associate Editor for ICRA since 2021 and IEEE Robotics and Automation Letters (RA-L) since 2022. He was the Lead Guest Editor for RA-L Special Issue on “Robotic Handling of Deformable Objects”.

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Provably safe control and learning for dynamic uncertain systems

Prof. Changliu Liu（Carnegie Mellon University）

Abstract

In this talk, I will introduce methods to ensure safety in dynamic uncertain systems. One example of such systems is a human-robot system. We develop our method under the framework of energy-function-based safe control, where a scalar energy function will be synthesized first such that only safe states are with low energy. Then the safe control law is chosen such that the system always dissipates energy. Conventionally, these methods are applied to white-box control-affine systems. This talk will introduce new approaches to guarantee safety when the system dynamics are uncertain or contain non-interpretable components (e.g., dynamics described by neural networks), which are common in human-robot systems. The resulting safety controller can be added to a supervisory loop for any other nominal controllers (e.g., MPC controller, reinforcement learning controller, etc.).

About the Speaker

Dr. Changliu Liu is an assistant professor in the Robotics Institute, School of Computer Science, Carnegie Mellon University (CMU), where she leads the Intelligent Control Lab. Prior to joining CMU, Dr. Liu was a postdoc at Stanford Intelligent Systems Laboratory. She received her Ph.D. from University of California at Berkeley and her bachelor degrees from Tsinghua University. Her research interests lie in the design and verification of intelligent systems with applications to manufacturing and transportation. She published the book “Designing robot behavior in human-robot interactions” with CRC Press in 2019. She received NSF Career Award, Amazon Research Award and Ford URP Award.