

**The 22nd IEEE International Conference on Industrial Informatics INDIN
2024, August 17-20, 2024, Beijing, China.**

Tutorial Proposal

Title of the Proposal:

Advances in Control and Optimization for Disturbance/uncertainty Rejection with Applications to Industrial Sectors

- Presenter(s):

Professor Shihua Li, Southeast University, China.

Professor Jinhui Zhang, Beijing Institute of Technology, China.

Professor Dapeng Tian, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese academy of sciences, China.

Professor Xiang Yu, Beihang University, China.

Professor Jun Yang, Loughborough University, U. K.

Professor Wenchao Xue, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, China.

- Brief description:

Disturbance/uncertainty rejection has increasingly become the focal point of control design in many industrial sectors, including power and energy, robotics, motion, and process control. The idea of disturbance estimation and negation has been realized by many effective methods including active disturbance rejection control (ADRC), disturbance observer-based control (DOBC), equivalent-input-disturbance approach (EIDA), composite hierarchical anti-disturbance control (CHADC), to name a few. These methods, developed in academia, have been successfully applied in industry, especially by the industry leaders such as Texas Instruments, FreeScale, Danfoss, etc. To achieve stronger capability and performance of disturbance/uncertainty rejection control for intelligent autonomous systems, optimization and learning methods are gradually attracting increasing attention from researchers.

This tutorial is launched to introduce the key idea and basic principles of disturbance rejection control. Furthermore, the solutions of disturbance rejection, overlap many fields of research such as electromechanical systems, robotic systems, precision motion control systems, and many other hot issues, will be presented. Moreover, the tutorial will show some advances in disturbance/uncertainty rejection by data-driven mechanisms and exploiting the information and models. The tutorial provides and discusses the new generation of disturbance rejection control technologies being formulated. This tutorial will provide an opportunity to enhance understanding and insights for these disturbance rejection methods and offer practitioners a roadmap of relevant academic and practical studies.

-Duration: 3 hours

- Outline:

The outline of the Tutorial is summarized as follows

- 1) New advances on disturbances observer based control methods with applications to mechatronic systems (30 minutes):
- 2) Composite disturbance rejection control methods and technologies for autonomous systems (30 minutes)
- 3) Disturbances rejection control problems and design methods in precision motion control systems (30 minutes)
- 4) Safety control for unmanned aerial vehicles and flight vehicles under disturbances and uncertainties (30 minutes)
- 5) Formal safety-critical control under disturbances: a control barrier function approach (30 minutes)
- 6) Design methods and theoretical foundation of linear active disturbance rejection control for nonlinear uncertain systems (30 minutes):

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-Brief CV:



Shihua Li received his bachelor, master, Ph.D. degrees all in Automatic Control from Southeast University, Nanjing, China in 1995, 1998 and 2001, respectively. Since 2001, he has been with School of Automation, Southeast University, where he is a Chief Professor, Jiangsu Specially Appointed Professor. He is the chairman of IEEE IES Nanjing Chapter, Fellow of IEEE, IET and AAIA. He is also the Director General of Jiangsu Association of Automation. His main research interests include modeling and nonlinear control theory with applications to mechatronic systems. He is a winner of the 6th Nagamori Award in 2020. (lsh@seu.edu.cn)



Jinhui Zhang received the Ph.D. degree in Control Science and Engineering from Beijing Institute of Technology, Beijing, China, in 2011. He was an Associate Professor in the Beijing University of Chemical Technology, Beijing, from March 2011 to March 2016, a Professor in the School of electrical and automation engineering, Tianjin University, Tianjin, from April 2016 to September 2016. He joined Beijing Institute of Technology in October 2016, where he is currently a Professor. His research interests include networked control systems and composite disturbance rejection control. (zhangjinh@bit.edu.cn)



Dapeng Tian received B.S. degree from Beijing Institute of Technology and Ph.D. from Beihang University. He is now a professor of Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Science. He is the recipient of the National Excellent Youth Fund, leader of the Chinese Academy of Sciences' stable support for basic research youth team, and project leader of the National Key Research and Development Program for Young Scientists. Dr Tian has received awards such as the National Science and Technology Progress First Prize. (d.tian@ciomp.ac.cn)



Xiang Yu is currently a Professor with the School of Automation Science and Electrical Engineering, Beihang University, Beijing, China. His current research interests include safety control of unmanned aerial vehicles, autonomous navigation and control of flight vehicles. Dr. Yu was a recipient of the Recruitment Program for Young Professionals, First Prize of Science and Technology Progress Award of China Instrument and Control Society, Youth Science and Technology Award of Chinese Society of Aeronautics and Astronautics, Gold Medal for outstanding performances at the 48th International Exhibition of Inventions of Geneva 2023. (xiangyu_buaa@buaa.edu.cn)



Jun Yang received the B.S. degree from the Department of Automatic Control, Northeastern University, Shenyang, China, in 2006, and the Ph.D. degree from the School of Automation, Southeast University, Nanjing, China, in 2011. Since 2020, he has been with the Department of Aeronautical and Automotive Engineering, Loughborough University, Loughborough, U.K., and was promoted to a Reader in 2023. His research interests include disturbance observer, motion control, visual servoing, nonlinear control, and autonomous systems. He was the recipient of the EPSRC New Investigator Award. He is a Fellow of IEEE, IET and AAIA. (J.Yang3@lboro.ac.uk)



Wenchao Xue received B.S. degree in applied mathematics from Nankai University, in 2007, and Ph.D. degree in control theory from the Academy of Mathematics and Systems Science (AMSS), Chinese Academy of Sciences (CAS) in 2012. He is now a professor of AMSS, CAS. His research interests include active disturbance rejection control, nonlinear uncertain system control and nonlinear uncertain system filtering. He is in the editorial boards of IFAC Journal of Control Engineering Practice and Journal of Systems Sciences and Mathematic (In Chinese). (wenchaoxue@amss.ac.cn)

- Relevant publications:

- [1] Han J. From PID to active disturbance rejection control. *IEEE Trans Ind Electron.* 2009;56(3):900-906
- [2] Li S., Yang J., Chen W.-H., and Chen X. *Disturbance Observer-Based Control: Methods and Applications.* Boca Raton, FL: CRC Press; 2013.
- [3] Chen W.-H., Yang J., Guo L., and Li S., Disturbance-observer-based control and related methods—An overview, *IEEE Trans. Ind. Electron.*, vol. 63, no. 2, pp. 1083–1095, Feb. 2016.
- [4] Xue W., Chen S., Zhao C., Huang Y. and Su J., On Integrating Uncertainty Estimator into PI Control for A Class of Nonlinear Uncertain Systems, *IEEE Transactions on Automatic Control*, Vol. 66, No. 7, pp. 3409-3416, 2021