**INDIN 2024 Special Sessions Proposal**

**Title of the Special Session:** Recent Developments in Sliding Mode Control and Its Industrial Applications

 **Brief description of the area of concern, with special focus on specific technical areas:**

**Outline of the Session**

Sliding mode control (SMC) is popular thanks to its insensitivity and robustness to system uncertainties, since in the actual operation many physical systems suffer from various uncertainties, such as external disturbance, parameter perturbation, actuator error and so on. With the high precision requirement of the industrial area, the SMC techniques in industrial systems have already played an important role. As a result, the recent developments on SMC have been paid much attention both from theory and application aspects. Although much progress has been made on SMC, their capability to singularity problem, chattering problems, observers and practical implementations is still challenging.

**Topics of the Session**

The purpose of this Special Issue is to highlight the latest theoretical and technological developments on the relevant topics on SMC. The authors are invited to present their new methods on controller design, novel algorithms on SMC-based observer, ideas on implementation, and applications. All the related papers on the theoretical methods and their application for SMC of linear or nonlinear systems are welcome, and the papers presenting newly emerging fields are especially welcome.

* Terminal Sliding Mode Control and Its Applications
* Higher-order Sliding Mode Control Theory and Its Applications
* Discrete-time Sliding Mode Control
* Sliding Mode Control of Nonlinear Systems with Mismatched Disturbances
* Sliding Mode Control of Mechatronic Systems
* Chattering-free Sliding Mode Control Theory
* Sliding Mode Control of Flight Control System
* Sliding Mode Observation Design
* Implementation methods of Sliding Mode Controller
* Sliding Mode Control in Power Electronics
* Motion Control Using Sliding Mode

**The name and contact information of two or more special session organisers and their background.**

Organizer(s):

*Organizer 1: Shihong DING, Jiangsu University, China,* *dsh@ujs.edu.cn*

****

 **Shihong DING** (M’11-SM’23) was born in Anhui, China, in 1983. He received the B.E. degree in mathematics from Anhui Normal University, China, in 2004, and the M.S. and Ph.D. degrees in automatic control from Southeast University, China, in 2007 and 2010, respectively. During the graduate studies, he visited The University of Texas at San Antonio from August 2008 to August 2009. After graduation, he held a research fellowship with the University of Western Sydney for one year. He also visited Yeungnam University, South Korea, from July 2018 to August 2018 and RMIT University, Australia, from December 2019 to February 2020, respectively. Since June 2010, he has been with the School of Electrical and Information Engineering, Jiangsu University, where he is currently a Full Professor. His research interests include sliding mode control and agricultural robot. He currently serves as a Subject Editor of Nonlinear Dynamics and an Associate Editor of International Journal of Adaptive Control and Signal Processing.

*Organizer 2:* *Shihua LI, Southeast University, China,* *lsh@seu.edu.cn*

**Shihua LI** (SM’10-F’19) was born in Pingxiang, China, in 1975. He received the bachelor’s, master’s, and Ph.D. degrees in automatic control from Southeast University, Nanjing, China, in 1995, 1998, and 2001, respectively. Since 2001, he has been with the School of Automation, Southeast University, where he is currently a Professor and the Director of the Mechatronic Systems Control Laboratory. He has authored or co-authored over 200 technical papers and two books. His current research interests include modelling, analysis, and nonlinear control theory with applications to mechatronic systems. Prof. Li serves as an Associate Editor or an Editor for the International Journal of Robust and Nonlinear Control, IET Power Electronics, the International Journal of Control, Automation and Systems, the International Journal of Electronics, and the Journal of Power Electronic, and the Guest Editor of the IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, the International Journal of Robust and Nonlinear Control, and IET Control Theory and Applications. He is the Vice Chairman of the IEEE CSS Nanjing Chapter.

*Organizer 3: Jinwu Gao, Jilin University, China,* *gaojw@jlu.edu.cn*

**Jinwu Gao** received the B.Eng. degree from the Department of Automation Measurement and Control Engineering, Harbin Institute of Technology, Harbin, China, in 2005, and the Ph.D. degree from the Department of Control Science and Engineering, Harbin Institute of Technology, in 2012. From 2012 to 2014, he was an Assistant Professor with Sun Yat-sen University, Guangzhou, China. In July 2014, he was a Post-Doctoral Researcher with the Department of Engineering and Applied Science, Sophia University, Tokyo, Japan. From 2016 to 2020, he was an Associate Professor with Jilin University, Changchun, China, where he has been a Professor since September 2020. His research interests include control theory and application in automotive powertrain.

**A list of potential reviewers and their affiliations:**

* Ruting Jia, California State University, USA, ruting.jia@csun.edu
* Hai Wang, Murdoch University, Australia, hai.wang@murdoch.edu.au
* Zongyu Zuo, Beihang University, China, zzybobby@buaa.edu.cn
* Barbot Jean-Pierre, ENSEA, France, barbot@ensea.fr
* Kamal, Shyam, Banaras Hindu University, India, shyamkamal.eee@iitbhu.ac.in
* Hao Shen, Anhui University of Technology, China, haoshen10@gmail.com
* Hua Chen, Hohai University, China, chenhua112@163.com
* Lunz Davin, University of Oxford, UK, davin.lunz@maths.ox.ac.uk
* Somarin Hasan Mousavi, Istanbul Technical University, Turkey, somarin@itu.edu.tr
* Jing Na, Kunming University of Science & Technology, China, najing25@163.com
* Fulwani Deepak, Indian Institute of Technology Jodhpur, India, df@iitj.ac.in
* Xiaodi Li, Shangdong Normal University, China, lxd@sdnu.edu.cn
* Jyoti P. Mishra, RMIT University, Austrlia, s3558339@student.rmit.edu.au
* Zongyao Sun, Qufu Normal University, China, sunzongyao@sohu.com
* Juliang Yin, Guangzhou University, China, yin\_juliang@hotmail.com
* Chih-Chiang Chen,National Cheng Kung University, Taiwan, ccchenevan@mail.ncku.edu.tw
* Haibo Du, Hefei University of Technology, China, haibo.du@hfut.edu.cn
* Xiangze Lin, Nanjin Agricultural University, China, xzlin@njau.edu.cn
* Ming Liu, Harbin Institute of Technology, China, mingliu23@hit.edu.cn
* Sferlazza Antonino, University of Palermo, Italy, antonino.sferlazza@unipa.it
* Martinez-Salamero, Luis, University of Rovira i Virgili, Spain, luis.martinez@urv.cat
* Keighobadi Jafar, University of Tabriz, Iran, keighobadi@tabrizu.ac.ir
* Xing-gang Yan, University of Kent, UK, x.yan@kent.ac.uk
* Huawen Ye, Central South University, China, yehuawen2001@yahoo.com.cn

 Short CV of the proposers.:

*Curriculum Vitae*

*of*

Dr. Shihong Ding

**Basic Information**

E-mail: dsh@ujs.edu.cn

Birth Date: February 1983

Affiliation: School of Electrical and Information Engineering,

Jiangsu University, Jiangsu, China, 212013

Phone: +8615862999578

**Education**

03/2007-06/2010 School of Automation, **Southeast University,** P. R. China, PhD

09/2008-09/2009 Department of Electrical and Computer Engineering,

**University of Texas at San Antonio**, United States, Jointed-PhD student

09/2004-02/2007 School of Automation, **Southeast University**,

P. R. China, M.S

09/2000-07/2004 Department of Mathematics, **Anhui Normal University**,

P. R. China, B.S

**Work Experiences**

05/2017-Present **Professor**, School of Electrical and Information Engineering, **Jiangsu University,** P. R. China

12/2019-02/2020 **Visiting Fellow**,School of Electrical and Computer Engineering, **RMIT University,** Australia

07/2018-08/2018 **Visiting Fellow,** Department of Electrical Engineering, **Yeungnam University,** Republic of Korea

05/2013-04/2017 **Associate Professor**, School of Electrical and Information Engineering, **Jiangsu University,** P. R. China

06/2010-04/2013 **Assistant Professor**, School of Electrical and Information Engineering, **Jiangsu University,** P. R. China

01/2011-12/2011 **Post-doctoral Fellow**, School of Computing, Engineering & Math, **University of Western Sydney,** Australia

**Awards and Honours**

* Highly Cited Researcher Award by Clarivate in 2022 and 2023
* Most Cited Chinese Researchers Award by Elsevier in 2021 and 2022
* Distinguished Young Scholar Award by the Jiangsu Natural Science Foundation in China in 2018
* Outstanding Reviewer of ***Automatica*** for 2014-2015
* Outstanding Reviewer of ***IET Control Theory and Applications***for 2014
* Natural Science Award (Second Prize) of Ministry of Education of China , 2015
* Science and Technology Award (Second Prize) of Machinery Industry of China, 2014.

**Research Interests**

1. **Sliding Mode Control and Its Applications**

There are two main problems for the conventional first-order sliding mode control (SMC). One is the chattering problem and the other is that the relative degree of the sliding variable has to be one, which restricts the wide application of the SMC. However, the higher-order SMC could solve the above two problems. Our team focuses on how to design the effective higher-order sliding mode controllers that could be applied to the mechatronic systems.

1. **Vehicle Dynamics and Control**

The dynamics of the electric vehicles are very complex nonlinear system, while the safety driving is the most important. To avoid the accident, the active safety system plays a very important role. Based on the basic information provided by the vehicle sensors, our aim is to design an active safety control system, which could control the vehicle to avoid the accident in the case of emergency.

1. **Agricultural Robot Navigation and Control**

The agricultural robots, such as the harvest robot, rice transplanter, etc, play an important role in the agricultural area, while the navigation system determines the working performance. One of the main problems for the existing agricultural robot is that the navigation accuracy is not satisfactory. In this area, we are going to use the advanced software and hardware technologies to improve the navigation accuracy.

**Professional Activities**

2020-Present, Senior Member of IEEE, Member of Chinese Society of Automation

2012-Present, Session Organizers or Chairs in the Chinese Control Conference (2012, 2015, 2016，2017，2019) and IEEE International Conference on Industrial Technology (2016)

2020/10-Present, Associate Editor, International Journal of Adaptive Control and Signal Processing

2019/12-Present, Subject Editor, Nonlinear Dynamics

2017/12-Present, Associate Editor, International Journal of Intelligent Computing and Cybernetics

2019/09-2023/06, Associate Editor, IEEE Access

2021/08-Present, Associate Editor, International Journal of Adaptive Control and Signal Processing

Since 2008, frequent reviewer for various journals and conferences including:

* IEEE Transactions on Automatic Control
* Automatica
* IEEE Transactions on Industrial Informatics
* IEEE Transactions on Control Systems and Technology
* IEEE Transactions on Industrial Electronics
* IET Control Theory & Applications
* International Journal of Robust and Nonlinear Control,
* International Journal of Systems Science,
* Journal of the Franklin Institute
* International Journal of Control
* IEEE Conference on Decision and Control,
* American Control Conference.

**Student advising**

1. **Ph.D dissertation**

1. Dissertation Advisor for Chen Ding, Ph.D. Dissertation: “*Higher-order sliding mode control for Agricultural Vehicles*” , Expected 2024 .

2. Dissertation Advisor for Qiankang Hou, Ph.D. Dissertation: “*Higher-order sliding mode control for PMSM systems*” , 2023 .

2. Dissertation Advisor for Keqi Mei, Ph.D. Dissertation: “*Fuzzy Higher-order sliding mode controller Design*” , 12/2021.

3. Dissertation Advisor for Lu Liu, Ph.D. Dissertation: “*Higher-order sliding mode control under mismatched disturbances*” , 12/2020 .

4. Dissertation Advisor for Liandi Fang, Ph.D. Dissertation: “*Finite-time control of higher-order stochastic systems*” , 12/2019 .

1. **Master theses**

1. Thesis Advisor for Yuexia Jiang, M.S. Thesis: “*Finite-time control and guidance of agricultural vehicles*” (completed, June 2015), Jiangsu University.

2. Thesis Advisor for Xuebin Li, M.S. Thesis: “*Second-order sliding mode control and its application to inverted pendulum*” (completed, June 2015), Jiangsu University.

3. Thesis Advisor for Jiadian Wang, M.S. Thesis: “*Second-order Sliding mode controller design and implementation of Buck converters*” (completed, June 2016), Jiangsu University.

4. Thesis Advisor for Shendao Zhang, M.S. Thesis: “*Direct yaw-moment control of in-wheel vehicles*” (completed, June 2017), Jiangsu University.

5. Thesis Advisor for Changqing Wang, M.S. Thesis: “*Disturbance observer based control of Buck converters*” (completed, June 2017), Jiangsu University.

6. Thesis Advisor for Yuanyuan Ni, M.S. Thesis: “*The composite second-order sliding mode control of DC-DC converters*” (completed, June 2018), Jiangsu University.

7. Thesis Advisor for Yang Jin, M.S. Thesis: “*The integrated active safety contro for electric vehicle based on AFS and DYC*” (completed, June 2018), Jiangsu University.

8. Thesis Advisor for Jialong Chen, M.S. Thesis: “*The PMSM regulation problem based on sliding mode control and a new disturbance observer*” (completed, June 2019), Jiangsu University.

9. Thesis Advisor for Gong hua, M.S. Thesis: “*The intelligent control system design for Air Purifier*” (completed, June 2020), Jiangsu University.

10. Thesis Advisor for Rong Huang, M.S. Thesis: “*The composite super-twisting control of PMSM systems*” (completed, June 2021), Jiangsu University.

**Selected Publications**

1. Qiankang Hou, Huanzhi Wang, Chenhao Zhao, Shoukun Xu, Yuefei Zuo, Christopher Lee\*, **Shihong Ding**\*, Super-twisting extended state observer based quasi-proportional-resonant controller for permanent magnet synchronous motor drive system, IEEE Transactions on Transportation Electrification, 2023, 10.1109/TTE.2023.3285761.
2. Qiankang Hou, Yuefei Zuo, Jinlin Sun, Christopher HT Lee\*, Youyi Wang, **Shihong Ding**\*, Modified nonlinear active disturbance rejection control for PMSM speed regulation with frequency domain analysis, IEEE Transactions on Power Electronics, 2023, 10.1109/TPEL.2023.3262519
3. Xin Ji, **Shihong Ding**\*, Bingbo Cui, Chen Ding, Xinhua Wei\*. Barrier function-based nonsingular terminal sliding mode control for path tracking of tractor-like with experimental validation. IEEE Transactions on Circuits and Systems-II: Express Briefs, 2023, Published Online, DOI: 10.1109/TCSII.2023.3248039.
4. Keqi Mei, **Shihong Ding**\*, Xinghuo Yu\*. A generalized super-twisting algorithm, IEEE Transactions on Cybernetics, 2023, 53(6):3951-3960.
5. Keqi Mei, Chunjiang Qian, **Shihong Ding**. Design of adaptive SOSM controller subject to disturbances with unknown magnitudes. IEEE Transactions on Circuits and Systems I: Regular Papers, 2023, 70(5):2133-2142.
6. **Shihong Ding\***, Qiankang Hou, Hai Wang. Disturbance-observer-based second-order sliding mode controller for speed control of PMSM drives, IEEE Transactions on Energy Conversion, 2023, 38(1): 100-110.
7. Lu Liu, Wei Xing Zheng\*, **Shihong Ding**\*. Global finite-time controller design for HOSM dynamics subject to upper-triangular structure,  IEEE Transactions on Circuits and Systems--I: Regular Papers, 2022, 69 (9), 3701-3714.
8. Lina Zhang, **Shihong Ding**\*, Li Ma, Tianhong Pan. SOSM controller design for output constrained systems subject to disturbances with unknown magnitudes, IEEE Transactions on Circuits and Systems-II: Express Briefs , 2022,  69 (9), 3799-3803.
9. Keqi Mei, **Shihong Ding**\*, Chih-Chiang Chen, Fixed-time stabilization for a class of output-constrained nonlinear systems, IEEE Transactions on Systems, Man and Cybernetics: Systems, 2022, 52 (10), 6498-6510.
10. **Shihong Ding**, Keqi Mei, Xinghuo Yu\*, Adaptive second-order sliding mode control: a Lyapunov approach, IEEE Transactions on Automatic Control, 2022, 67(10), 5392-5399.
11. **Shihong Ding**\*, Binbin Zhang, Keqi Mei, Ju H Park. Adaptive Fuzzy SOSM Controller Design With Output Constraints, IEEE Transactions on Fuzzy Systems, 2022, 30(7), 2300–2311.
12. Qiangkang Hou, **Shihong Ding**\*, Finite-time extended state observer based super-twisting sliding mode controller for PMSM drives with inertia identification,IEEE Transactions on Transportation Electrification , 2022,8(2):1918-1929.
13. Liandi Fang, **Shihong Ding**\*, Jessie Park\*, Li Ma, Adaptive fuzzy control for non-triangular stochastic high-order nonlinear systems subject to asymmetric output constraints, IEEE Transactions on Cybernetics, 2022, 52(2), 1280-1291
14. Qiankang Hou, **Shihong Ding**\*, Xinghuo Yu. A super-twisting-like fractional controller for SPMSM drive system, IEEE Transactions on Industrial Electronics, 2022,69(9), 9376-9384.
15. Keqi Mei, **Shihong Ding**\*, and Wei Xing Zheng\*. Fuzzy adaptive SOSM based control of a type of nonlinear systems, IEEE Transactions on Circuits and Systems-II: Express Briefs, 2022, 69(3),1342-1346..
16. Liandi Fang, **Shihong Ding**\*, Jessie Park\*, Li Ma, Adaptive fuzzy control for  stochastic high-order nonlinear systems with output constraints, IEEE Transactions on Fuzzy Systems, 2021, 29 (9) , 2635-2646.
17. Qiankang Hou, **Shihong Ding**\*, Xinghuo Yu, Composite super-twisting sliding mode control design for PMSM speed regulation problem based on a novel disturbance observer, IEEE Transactions on Energy Conversion, 2021, 36 (4) , pp.2591-2599.
18. Lu Liu, **Shihong Ding**\*, Xinghuo Yu, Second-order sliding mode control design subject to an asymmetric output constraint, IEEE Transactions on Circuits and Systems-II: Express Briefs, 2021, 68(4), 1278-1282.
19. Keqi Mei, **Shihong Ding**\*, Second-order sliding mode controller design subject to an upper-triangular structure, IEEE Transactions on Systems, Man and Cybernetics: Systems, 2021, 51(1):497-507.
20. Qiankang Hou, **Shihong Ding**\*, GPIO based super-twisting sliding mode control for PMSM, IEEE Transactions on Circuits and Systems-II: Express Briefs, 2021, 68(2): 747-751.
21. Lu Liu, Wei Xing Zheng\*, **Shihong Ding**\*. An adaptive SOSM controller design by using a sliding-mode-based filter and its application to buck converter. IEEE Transactions on Circuits and Systems-I: Regular Papers, 2020, July, 67(7), 2409-2418.
22. Lu Liu, Wei Xing Zheng , **Shihong Ding**. An adaptive SOSM controller design by using a sliding-mode-based filter and its application to buck converter. ***IEEE Transactions on Circuits and Systems-I: Regular Papers***, 2020, 67(7), 2409-2418.
23. **Shihong Ding**, Ju H. Park, Chih-Chiang Chen. Second-order sliding mode controller design with output constraint, Automatica, 2020, 121, article number: 108704.
24. **Shihong Ding**, Wen-hua Chen, Keqi Mei, David Murray-Smith. Disturbance observer design for nonlinear systems represented by input-output models. ***IEEE Transactions on Industrial Electronics***, 2020, 67(2),1222-1232.
25. **Shihong Ding**, Keqi Mei, Shihua Li. A new second-order sliding mode and its application to nonlinear constrained systems. ***IEEE Transactions on Automatic Control*,** 2019, 64(6): 2545-2552.