

CURRICULUM TEMPLATE

1. DEGREES

1.1. DOCTORAL DEGREE

Doctoral Program: Control Science and Engineering, Beijing Institute of Technology

Legal Duration: 01/09/2018 - 24/06/2022

Supervisor: Xuemei Ren

1.2. OTHER DEGREES

MSc degree on 20/06/2018

Program: Control Engineering, Beijing Technology and Business University

Legal Duration: 01/09/2016 - 01/07/2018

Supervisor: Xuebo Jin

BSc degree

Program: Automation, Chongqing University

Legal Duration: 01/09/2012 - 01/07/2016

2. ACADEMIC APPOINTMENTS

2.1. POST-DOCTORAL RESEARCH POSITIONS

Position type: Research fellow (Type B-Junior)

Selection type: Open call

Organization: Department of Information Engineering, University of Padova

Effective Duration: 23/03/2023 - Ongoing

Position type: Research collaborator

Selection type: Direct assignment

Organization: School of Artificial Intelligence, Beijing Technology and Business University

Effective Duration: 01/9/2022 - 01/03/2023

Position type: Postdoc (Type A)

Selection type: Direct assignment

Organization: Department of Information Engineering, University of Padova

Effective Duration: starting date 15/08/2022 - ending date 14/11/2022

2.2. PRE-DOCTORAL RESEARCH POSITIONS

Position type: Visiting Scholar

Selection type: Open call

Organization: China Scholarship Council (CSC)

Hosting organization: Department of Information Engineering, University of Padova

Effective Duration: 01/09/2019 - 01/03/2021

3. RESEARCH ACTIVITY SUMMARY (max 2000 char)

My research spans various areas, including signal processing, robust estimation, identification theory, machine learning and deep learning.

During my doctoral and post-doctoral programs, I devoted to solving state estimation problems, especially when the underlying dynamics of systems are complex, unreachable, nonlinear, and challenging to accurately characterize with a tractable model. My methodological contributions mainly concern estimation paradigms based on the Kalman filter, which account for model uncertainty and the fact that the second-order moments of the noise processes must be learned from the data. Furthermore, I also undertook practical tasks, specifically focusing on: 1) **localization technologies** and 2) **engineering structure maintenance and risk management**. For the first task, I developed a positioning estimation algorithm for UAV navigation and a switching approach for smartphone-based pedestrian navigation in GPS-challenged environments. Regarding the second task, I have developed algorithms which learn the inter-story drift of a four-story steel structure during seismic testing and the dynamics of shallow liquids in tuned liquid dampers.

I have published **17 academic articles**, including **7 journal articles** and one book chapter. Moreover, I actively participated in international conferences several times, and I regularly presented my findings to the global research community. Moreover, I have **2 granted patents**.

Furthermore, I contribute to the academic field as a reviewer for various prestigious journals and conferences, including Automatica, IEEE Transactions on Industrial Electronics, Journal of the Franklin Institute, IEEE Control Systems Letters, and the IEEE Conference on Decision and Control (IEEE CDC) and others.

4. LIST OF MAIN ACHIEVEMENTS

4.1 Participation in research projects with national or international funding

Name: Robust Navigation for Unmanned Aerial Vehicles.

Effective Duration: 23/03/2023 - Ongoing

Role: PI

Financial support: University of Padova with a funding amount of approximately 21.5K euros

Main contributions: I have proposed a robust position estimation algorithm for vehicle in GPS signal-challenged environment. The corresponding results have been summarized in a draft paper and submitted to the IEEE CDC 2024. Moreover, I am developing robust nonlinear filtering paradigms which are based on the second order approximation of the state-space model. These results were summarized in a draft paper that we plan to submit soon.

Name: Dynamic Substructure Testing Methods and Implementation for Base-Isolated Structures.

Effective Duration: 01/9/2022 - 01/03/2023

Role: Participant

Financial support: NSFC. (No. 51978016) with a funding amount of 600K RMB (\approx 80K euros)

Main contributions: I have designed a dynamic substructure testing method and performed a structural seismic test using an earthquake simulation shaking table. The corresponding results have been summarized in a journal paper and published in International Journal of Robust and Nonlinear Control.

Name: Robust Filtering for Nonlinear Systems under Model Uncertainty.

Effective Duration: 15/08/2022 - 14/11/2022

Role: Participant

Financial support: University of Padova with a funding amount of 4500 euros.

Main contributions: I have proposed a robust extended Kalman smoother for nonlinear systems. The corresponding results have been summarized in a conference paper and published in 27th International Conference on System Theory, Control and Computing (ICSTCC). Moreover, I have been also proposed a general class of risk sensitive filters, and the corresponding findings have been summarized in a journal paper and published in Systems & Control Letters.

Name: Nonlinear tracking system under spatio-temporal performance index.

Effective Duration: 01/09/2021 - 01/07/2022

Role: Participant

Financial support: NSFC (No. 61973036) with a funding amount of 610K RMB (\approx 81K euros)

Main contributions: I have participated in the simulated tracking software construction, and proposed a second-order adaptive model for the online filtering algorithm. The corresponding results have been summarized in a journal paper and published in Control Theory & Applications.

Name: Critical Health Pattern Recognition Method for Intelligent Monitoring of Large Buildings.

Effective Duration: 01/03/2021 - 30/08/2021

Role: Participant

Financial support: NSFC (No. 61903009) with a funding amount of 600K RMB (\approx 80K euros)

Main contributions: I have participated in writing the project proposal and proposed an adaptive Kalman filter. The corresponding results have been summarized in a conference paper and published in Chinese Intelligent Systems Conference (CISC) 2020.

Name: Robust Estimation for Uncertain Systems

Effective Duration: 01/09/2019 - 01/03/2021

Role: PI

Financial support: CSC (No. 201906030139) with a funding amount of 150K RMB (\approx 20K euros)

Main contributions: I have proposed: 1) a robust Kalman filter which works even in the case that the transition probability density is unknown and possibly degenerate; 2) a fixed-lag smoothing approach which is robust to model uncertainty; and 3) a robust extended Kalman filter for nonlinear uncertain systems. These findings have been summarized in two journal papers, which have been published in IEEE Transactions on Automatic Control and Journal of the Franklin Institute as the full papers, as well as two conference papers, which have been published in IEEE CDC 2020 and American Control Conference (ACC) 2021.

Name: Experimental Technology of High-performance Shaking Table Substructure based on Real-time Simulation Compensation.

Effective Duration: 01/03/2019 - 30/08/2019

Role: Participant

Financial support: NSFC (No. 51608016) with a funding amount of 600K RMB.

Main contributions: I have participated in writing the project proposal and engaged in the vibration testing. The corresponding results were summarized in two patents and granted on 03/12/2019 and 04/09/2020, respectively.

Name: Identification and Evolution Analysis of High Dimensional Motion Features Based on Space-time Large Data Group Objects.

Effective Duration: 01/09/2018 - 01/03/2019

Role: Participant

Financial support: NSFC (No. 61673002) with a funding amount of 600K RMB

Main contributions: I have participated in the tasks for the dynamics characterization and modeling of moving targets. The corresponding results have been summarized in a book chapter (Book title: Innovative Techniques and Applications of Modelling, Identification and Control), as well as a conference paper, which has been published IEEE Data Driven Control and Learning Systems Conference (DDCLS) 2019.

4.2 Presentations in national and international congresses and conferences

a) Oral presentations

1. IEEE Conference on Decision and Control (CDC), 2020, "Low-rank Kalman filtering under model uncertainty."
2. Chinese Intelligent Systems Conference (CISC), 2020, "Robust Online Filter Based on a Second-Order Adaptive Model."
3. IEEE Data Driven Control and Learning Systems Conference (DDCLS), 2019, "An Improved Kalman Filter Based on Self-adaptive Adjustment Parameters."
4. CISC, 2018, "A Fourth-Order Current Adaptive Model for Online Denoising by Kalman Filter."
5. International Conference on Unmanned Systems (ICUS), 2017, "Improved smartphone-based indoor localization via drift estimation for accelerometer."

6. International Conference on Modelling, Identification and Control (ICMIC), 2017. "An improved online denoising algorithm based on Kalman filter and adaptive current statistics model."

b) Poster presentations

1. American Control Conference (ACC), 2021, 'Learning the tuned liquid damper dynamics by means of a robust EKF'.
2. Chinese Control And Decision Conference (CCDC), 2017, "Gesture detected by inertial sensor."

4.3 Seminars, webinars, tutorials held by the candidate

Webinars

Title: Robust position estimation under GPS signal-challenged environments.

Date: 18/05/2024

Department: Department of Information Engineering, University of Padova

Webinars

Title: Robust adaptive Kalman filtering for structural performance assessment.

Date: 12/03/2023

Institution: The Key Laboratory of Urban Security and Disaster Engineering, Ministry of Education, Beijing University of Technology.

Seminar

Title: Robust Kalman filtering: The case of degenerate densities.

Date: 15/10/2022

Department: School of Electronic Information Engineering, Shandong University of Science and Technology

Seminar

Title: Robust estimation methods for uncertain systems.

Date: 25/05/2022

Department: Control Science and Engineering, Beijing Institute of Technology

4.4 Patent ownership or development

1. Xuebo Jin, **Shenglun Yi**, Tingli Su and Jianlei Kong, "An online denoising method based on adaptive filtering for sensor data." CN107122724B, patent granted.
2. Xuebo Jin, **Shenglun Yi**, Tingli Su and Jianlei Kong, "A GPS measurement data processing method." CN107229060B, patent granted.

3. Xuebo Jin, **Shenglun Yi** and Tingli Su, "An adaptive online filtering method", CN107169478A, application submitted.

4.5 National and international prizes and awards for research activities

Award name: Best Paper Award of the 2017 Chinese Intelligent Systems Conference

Awarded paper: **Yi S**, Jin X, Su T, et al. A Fourth-Order Current Adaptive Model for Online Denoising by Kalman Filter. 2017 Chinese Intelligent Systems Conference: Volume II. Springer Singapore, 2018: 135-145.

Awarding organization: Chinese Association for Artificial Intelligence

5. TEACHING ACTIVITY AND SERVICE TO STUDENTS

Academic year: 2020/21

Course name: Learning dynamical systems

Degree name: Master degree on Control System Engineering, University of Padova

My role: Tutor for the project "Learning the Tuned Liquid Damper (TLD) Dynamics". In particular, my duties were: 1) explain to the students how to apply the Kalman filter to estimate the state dynamics of the TLD system, 2) provide students the experimental datasets and teach them how to use the data. 3) guide them in completing a conference paper which has been published in the IEEE American Control Conference.

6. FULL LIST OF PUBLICATIONS

6.1 Articles in international/national journals

1. **Yi S**, Zorzi M, Jin X, Su T. A Switched Approach for Smartphone-Based Pedestrian Navigation. *Sensors*, 2024, 24(16): 5247.
2. **Yi S**, Su T, Tang Z Y. Robust adaptive Kalman filter for structural performance assessment. *International Journal of Robust and Nonlinear Control*, 2024, 34(9): 5966-5982.
3. Zorzi M, **Yi S**. On the convergence of degenerate risk sensitive filters. *Systems & Control Letters*, 2024, 185: 105732.
4. **Yi S**, REN X. Robust Bayesian estimation method for unreachable systems. *Control Theory & Applications*, 2024, 41(2): 221-228.
5. **Yi S**, Zorzi M. Robust fixed-lag smoothing under model perturbations. *Journal of the Franklin Institute*, 2023, 360(1): 458-483.
6. **Yi S**, Zorzi M. Robust kalman filtering under model uncertainty: The case of degenerate densities. *IEEE Transactions on Automatic Control*, 2021, 67(7): 3458-3471.
7. **Yi S**, Jin X, Su T, et al. Online denoising based on the second-order adaptive statistics model. *Sensors*, 2017, 17(7): 1668.

6.2 Papers in international/national conference proceedings

1. **Yi S**, Zorzi M. Robust extended Kalman smoothing under model uncertainties. 27th International Conference on System Theory, Control and Computing (ICSTCC). IEEE, 2023: 82-87.
2. Longhini A, Perbellini M, Gottardi S, **Yi, S**, et al. Learning the tuned liquid damper dynamics by means of a robust EKF. American Control Conference (ACC). IEEE, 2021: 60-65.
3. **Yi S**, Ren X. Robust Online Filter Based on a Second-Order Adaptive Model. Chinese Intelligent Systems Conference: Volume II. Springer Singapore, 2021: 691-698.
4. **Yi S**, Zorzi M. Low-rank Kalman filtering under model uncertainty. 59th IEEE Conference on Decision and Control (CDC). IEEE, 2020: 2930-2935.
5. **Yi S**, Ren X, Su T. An Improved Kalman Filter Based on Self-adaptive Adjustment Parameters. 8th Data Driven Control and Learning Systems Conference (DDCLS). IEEE, 2019: 1060-1064.
6. **Yi S**, Jin X, Su T, et al. A Fourth-Order Current Adaptive Model for Online Denoising by Kalman Filter. 2017 Chinese Intelligent Systems Conference: Volume II. Springer Singapore, 2018: 135-145.
7. **Yi S**, Su T, Jin X. Improved smartphone-based indoor localization via drift estimation for accelerometer. International Conference on Unmanned Systems (ICUS). IEEE, 2017: 379-383.
8. **Yi S**, Jin X, Su T. An improved online denoising algorithm based on Kalman filter and adaptive current statistics model. 9th International Conference on Modelling, Identification and Control (ICMIC). IEEE, 2017: 782-786.
9. Xiang N, Wang F, Wang B, **Yi S**, et al. Gesture detected by inertial sensor. 29th Chinese Control And Decision Conference (CCDC), IEEE, 2017: 7740-7743.

6.3 Abstracts in international/national conference proceedings

6.4 International/national books

6.5 Chapters in international/national books

1. Su T, **Yi S**, Jin X, et al. An Improved Online Denoising Algorithm Based on the Adaptive Noise Covariance. Innovative Techniques and Applications of Modelling, Identification and Control, 2018:119-132.

6.6 Other contributions (e.g. contributions in public repositories)