Guanbo Shao

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Address: 9685 Genesee Ave, La Jolla 92121, CA, US

Education

University of California, San Diego 09/2021-04/2023
Master of Science in Statistics | Link to all courses ***GPA: 3.78/4***
Relevant Courses: Asymptotic statistics, High-dimensional statistics, Mathematical statistics, Advanced time series, Survival analysis, Stochastic differential equations.

Southeast University (Top 20 among China) 09/2016–06/2020
Bachelor of Science in Mathematical and Applied Mathematics | ***GPA: 83.98/100***

UC Riverside Visiting scholar (Prof. Wei Ren) 06/2022–09/2022

RESEARCH INTERESTS

- Data-enabled predictive control, Control Lyapunov functions, Model predictive control, Linear cruise control, Control barrier functions, Nonlinear multi-agents dynamics, Stochastic process.

PUBLICATIONS

- **Guanbo Shao**, Duxin Chen, Wenwu Yu and Wei Lin., Phase transition in nonlinear dynamics flocks: Natural Intrinsic Period induced by noise disturbance. (submitted to PRL,2023.06.)
- Duxin Chen, Yongzheng Sun, **Guanbo Shao**, Wenwu Yu, Hai-Tao Zhang and Wei Lin, Coordinating directional switches in pigeon flocks: the role of nonlinear interactions. The Royal Society, Volum 8, Issue 9, Sept. 2021, doi: https://doi.org/10.1098/rsos.210649

RESEARCH

Develop safety- critical control strategy utilizing discrete-time control barrier functions (CBFs)
Research Assistant|Prof. YangZheng

Scalable Optimization and Control (SOC) Lab, UC San Diego 04/2023 - Ongoing

- Optimize the process of merging under the intervention of connected and autonomous vehicles (CAVs) at traffic intersections while guaranteeing state, control, and safety constraints.
- Reproduced CBF-QP in the LCC scenario and observed the simulation results under different parameters. Focus on the design of perturbed safety control, includes corresponding controller design, perturbed safety sets, and finite-time performance, especially ISSF-CBF (Input to state safety), and disturbance-observer based CBF.
- Combining the data-driven method especially the Koopman-operator with the disturbance CBF to approach the performance boundary of given safety control scenario, equivalent solving the robustness optimization problem.

Marginal velocity patterns to reproduce the noise resistance and long-range correlation of bird's flocks
Research Assistant|Prof. Wenwu Yu

Jiangsu Provincial Key Laboratory of Network Group Intelligence, Southeast University 05/2022—Ongoing

- Proposed a characterization method to describe the noise immunity of marginal ferromagnetism. And extended this method to quantify the noise resistance capability of collective motion.
- Analyzed the Hamiltonian dynamics of marginal ferromagnetism, and obtained the format of Gibbs free energy. Characterized the endogenous noise immunity of the bare potential family by expanding the Gibbs free energy around the velocity reference value, the divergence of the velocity reference value from the typical value of the system velocity.
- Investigated the quantified influence of the mathematical format of the potential energy of the system on the capability of noise resistance.

Phase transition in nonlinear dynamics flocks: Natural Intrinsic Period induced by noise disturbance.
Research Assistant|Prof. Wenwu Yu

Jiangsu Provincial Key Laboratory of Network Group Intelligence, Southeast University 01/2021—07/2021

- Developed an SDE-Based framework for directly quantifying the phase transition called NIP
- Quantify the effects of the driven and stochastic terms (Gaussian white noise) on the system evolution from Fokker-Planck equation. Then confirmed that the state of nematic is an unusual form of scale-free, as a generalized triple point, some indicators appear singularity, such as correlation length, speed of information propagation, and so on.
- Explained why the particle swarm appears in the so-called liquid crystal state (nematic bands).

Coordinating directional switches in pigeon flocks: the role of nonlinear interactions
Research Assistant|Prof. Wenwu Yu

Jiangsu Provincial Key Laboratory of Network Group Intelligence, Southeast University 10/2020—02/2021

- Investigated the directional switches in free flight of pigeon flocks, where individuals hover above their home loft with spontaneous changes of rotational directions, and systematically reveal the interplay between the inter-agent coupling dynamics and the transition of equilibrium states.
- Established a data-driven particle model (Sparse Bayesian Learning) with two potential wells and estimates the mean switching times of rotational direction.
- Derived the following Itô stochastic differential equation for average spin of pigeon S(t). Calculated mean first passage time from one well (equilibrium) of the effective potential to the other in pigeon flocks with the bimodal normal function.

Skills

Technical Expertise: :

SDE, SUMO, PDE, Nonparametric Estimation

Computer Skills:

C++, Python, R, Matlab