XIANG LI

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EDUCATION

Yingcai Honors College, University of Electronic Science and Technology of China 2023 - 2027
Bachelor of Computer Science | **GPA:3.98/4.00**

AWARDS

- Honor Award for Scientific Research of Yingcai Honors College **(1%)** 2024
- **First Prize** in Asia and Pacific Mathematical Contest in Modelling **(5%)** 2024
- Outstanding Student Scholarship **(10%)** 2024
- IELTS 7.0 2024

PUBLICATIONS

[1] **Li, X.**, & Pi, B., Deng, L.-J., & Li, Q. (2025). Memory-Driven Q-Learning Model for Cooperation in Snowdrift Game with Dynamic Behavioral Types. *Applied Mathematical Modelling*.

Synopsis: In evolutionary games, the strategy-switching patterns of agents, termed behavioral types, are not static. Rather, agents dynamically adjust their behavioral types based on prior experiences. This study employs the game between profiteers and conformists as a case study, utilizing reinforcement learning to model these dynamic transitions. Additionally, the residual effects of agent memory are incorporated into the Q-learning reward structure. Experimental findings reveal that this reinforcement learning-based dynamic adjustment surpasses some alternative approaches in fostering cooperation. Moreover, experiments on memory-driven Q-learning indicate that agents prioritizing current payoffs in decision-making more effectively facilitate the emergence of cooperation.

SUBMITTED PAPERS

[1] **Li, X.**, & Pi, B., Deng, L.-J., Feng, M., & Chica, M. (2025). Three-Dimensional Q-Learning Model for the Co-evolution of Migration and Cooperation in Networked Populations. *IEEE Transactions on Cybernetics*. **(Under review)**

Synopsis: In networked populations, the positions of agents are not fixed; instead, agents migrate in response to their environmental conditions. We develop a migration mechanism based on agents' environmental comparison and explore its co-evolution with cooperation in an evolutionary game. To guide agents to make decisions, a novel three-dimensional Q-learning algorithm is proposed. This approach adeptly integrates the phenomenon of reputation loss associated with migration, as observed in real-world contexts. Experiments within the snowdrift game demonstrate that the evolutionary process with migration flows sustains elevated cooperation levels across all cost-to-benefit ratios by limiting strategy propagation.

RECENT WORK

- **Theoretical Derivation of the Integration of Aspiration and Conformity (Completed)**

  Synopsis: In real-world scenarios, agents' decision-making is shaped not only by their aspirations but also by the influence of their surrounding environment. Inspired by this observation, we integrate an aspiration-based update rule, characterized by "Satisfied-Cooperate, Unsatisfied-Defect", with an update rule of conformists. Employing Markov processes, master equations, and pair estimation methods, we systematically derive the conditions for cooperation success in finite, infinite, and structured populations, yielding surprising results. We note that, although the update strategy of conformists has been proposed and widely studied, its theoretical derivation remains largely unexplored. Thus, addressing this gap also constitutes one of the key contributions of this study.

OTHER PROJECT EXPERIENCES

- **Research on Image Processing Based on Total Variation Methods**

  Synopsis: Underwater images are often degraded by color casts, low illumination, and blurriness due to light absorption and scattering. Currently, there is a paucity of research that simultaneously addresses these three issues from a theoretical perspective. In this work, we propose a unified framework based on the total variation method within the LAB color space for images. We formulate three distinct optimization objectives tailored to each of the three problems. To solve these optimization problems, we employ algorithms such as gradient flow and primal-dual methods, specifically designed to process underwater images.

- **Research on the Application of Convolutional Neural Networks in Computer Vision**

  Synopsis: Pansharpening is a specialized field focusing on fusing high-resolution panchromatic images with low-resolution multispectral images to produce high-resolution multispectral images. Optimization techniques leveraging Convolutional Neural Networks have emerged as a prominent research focus in recent years. In this project, I utilized the established PanNet network as a code baseline to replicate the DiCNN and FusionNet networks, both of which are applied in the pansharpening domain. Furthermore, I restructured the code to implement a totally different network to accomplish the image rain removal task.

SKILLS

Coding (with AI assistant): Python, Matlab, C Language, Latex
Tools: Overleaf, Google Scholar, Jupyter Notebook, Zotero, Wolfram Mathematica
Personal Habits: Notion, Grammarly