Jiyao Pu

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Biography

Jiyao Pu received his Bachelors degree in 2016 from University of Electronic Science and Technology of China. After that, He received the M.Sc. degree from the School of Computing Science, The University of Newcastle, UK, in 2020. He is currently a Ph.D. student in the Hybrid Intelligence Lab, Department of Computer Science, Durham University. His research interests include reinforcement learning, rule generation, natural language processing, multi-agent system, automated game design, procedural content generation, and social modeling.

Research Summary

My research develops an AI framework that integrates rule generation, causal inference, and reinforcement learning to model complex social systems. Based on Triadic Reciprocal Dynamics, the Strategy Evaluation Rule (SER) system comprises a neural network rule generator, a multi-agent simulation environment for strategic exploration, and an evaluator for social metrics like cooperation and fairness. Through iterative training, the system refines its predictive and optimization capabilities, contributing novel insights to AI, social modeling, and automated game design.

Inerests and Motivation

My research interests lie in unraveling the underlying dynamics of social behavior using rule generation and behavioral data. By treating society as a dynamic system where rational agents adapt their strategies, my work investigates how variations in rules shape behavior and guide the evolution of these systems. This approach intersects with causality, reinforcement learning, and multi-agent interactions, providing a foundation for designing innovative interventions and strategic models across diverse domains.

My motivation stems from exploring how AI can design and refine rules to model complex social systems. In an early project, I leveraged GPT to generate scenarios, identify adjustable rules, and simulate these within a game environment to train AI agents for strategic decision-making. Building on this, a recent paper focused on crafting "controllable rules" that enhance cooperation among agents. I am now advancing this approach to develop adaptive, fair, and efficient rule-based systems that improve fault tolerance and provide deeper insights into societal dynamics.

Education

- **Durham University** — *March 2021 - Now*
  Ph.D Computer Science — Durham, UK
- **Newcastle University** — *September 2019 - September 2020*
  MSc Computer Science — Newcastle, UK
  - Grade: 76.6%
- **University of Electronic Science and Technology of China** — *September 2012 - June 2016*
  BSc Electronic science and technology — Chengdu, China

Projects

- **Digital Twin Dreamscape: AI's Odyssey into Reality** — *Jun 2023 - Dec 2023*
  Raspberry Pi, Python, Unity, Web/Mobile Technologies, OpenCV, Reinforcement Learning
  - Developed an integrated control system for real-time video streaming and remote control via web/mobile interfaces.
  - Implemented a digital twin in Unity that mirrors the physical car's movements, achieving synchronized control between virtual and physical spaces.
  - Created a proportional virtual model of the robotic arm car and incorporated target recognition pipelines with OpenCV, ensuring accurate digital representation.
  - Applied reinforcement learning techniques to train an intelligent agent for autonomous control of the virtual car, optimizing performance through real-time feedback.
- **EyeGaze Smart Wheelchair: Vision-Enabled Mobility Control** — *Jul 2022 - Dec 2022*
  Electric Wheelchair Platform, Camera Module, Python, OpenCV, Eye-Tracking Algorithms
  - Developed a vision module integrated with a traditional electric wheelchair, capturing real-time eye images via a camera sensor.
  - Implemented eye-tracking algorithms using OpenCV to analyze gaze data and translate it into control commands for wheelchair movement.
  - Created a responsive interface linking the visual sensor input to the wheelchair's control system, ensuring intuitive navigation.
  - Applied real-time image processing techniques to achieve accurate eye movement detection, enhancing the overall system performance.

- **Laser Beam Combining via LCOPA Control** *Sept 2014 - Jun 2015*

  FPGA, DSP, LCOPA, VHDL, Image Processing, Target Recognition
  - Developed a hardware control system integrating FPGA-based video acquisition for real-time image capture.
  - Implemented DSP-based video processing algorithms for efficient target recognition.
  - Created the LCOPA (Liquid Crystal Optical Phased Array) control module, ensuring precise optical phase adjustments.
  - Applied advanced image processing techniques to optimize laser beam combining performance.

PUBLICATION

C=CONFERENCE, J=JOURNAL, P=PATENT, S=IN SUBMISSION, T=THESIS

[J.1] Pu, J., Duan, H., Zhao, J. and Long, Y., 2023. Rules for Expectation: Learning to Generate Rules via Social Environment Modelling. IEEE Transactions on Circuits and Systems for Video Technology.

[C.1] Gao, R., Wan, F., Organisciak, D., Pu, J., Duan, H., Zhang, P., Hou, X. and Long, Y., 2023. Privacy-enhanced zero-shot learning via data-free knowledge transfer. In 2023 IEEE International Conference on Multimedia and Expo (ICME) (pp. 432-437). IEEE.

MANUSCRIPT IN PREPARATION

C=CONFERENCE, J=JOURNAL, P=PATENT, S=IN SUBMISSION, T=THESIS

[J.1] Triadic Reciprocal Dynamics: The AI Framework for Social Rule Evolving. Plan to submit *Nature Machine Intelligence* for consideration.

[J.2] Integrating Extrinsic and Flow Intrinsic Rewards for Adaptive Rule Generation in Dynamic Environment. Plan to submit *Nature Humanities and Social Sciences Communications* for consideration.

[C.1] Flow-Centric Rule Design: Evolving Rules for Optimal Difficulty and AI Skill Balance. Submitted to *2025 ACM Multimedia*.

SKILLS

- **Programming Languages:** Python, C, C++, C#, Java, JavaScript, HTML, CSS, PHP, SQL, Shell.
- **Platform:** Linux, Unity, Unreal Engine 5, Godot Engine, SER, AWS, Windows.
- **AI:** Reinforcement learning, Zero-shot learning, Generative models, Contrastive learning, Deep learning, Few-Shot learning.
- **Hardware & Embedded Systems:** MSP430, Raspberry Pi, Electric Wheelchair Platform, Mechanical Arm Car Platform, Camera Modules, Sensor Integration, Motor Drivers, DSP, FPGA, Hand Controllers.