Jianhong Wang

PERSONAL DETAILS

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SHORT BIO

I am currently working as a Senior Research Associate, for a UK national AI hub named INFORMED-AI Hub, at its leading university, University of Bristol. My research interests are centred around learning for multi-agent systems and its applications to the future energy systems. To date, I have published over 10 papers on top AI venues, and received 867 citations in total, with h-index as 13 and i10-index as 16. Next, I list the 4 outstanding papers of my all publications in the last 5 years, as below:

1. **Jianhong Wang**, Yuan Zhang, Tae-Kyun Kim, and Yunjie Gu. "*Shapley Q-value: A Local Reward Approach to Solve Global Reward Games.*" In Proceedings of the AAAI Conference on Artificial Intelligence, vol. 34, no. 05, pp. 7285-7292. 2020. [142 citations, https://arxiv.org/pdf/1907.05707]

   This paper tackles the challenge of credit assignment in multi-agent learning for Markov games with a shared team reward. The authors introduce a novel approach that uses the Shapley value, traditionally a tool from cooperative game theory, to fairly distribute credit among agents. They theoretically establish that the cooperative game model underlying the Shapley value is equivalent to Markov games with a shared reward, thus justifying its application. Additionally, the resulting algorithm provides interpretability of agent behaviors through the fairness inherent in the Shapley value, as demonstrated by experimental results.

2. **Jianhong Wang**, Wangkun Xu, Yunjie Gu, Wenbin Song, and Tim C. Green. "*Multi-Agent Reinforcement Learning for Active Voltage Control on Power Distribution Networks.*" Advances in Neural Information Processing Systems 34 (2021): 3271-3284. [197 citations, https://arxiv.org/pdf/2110.14300]

   This paper formalizes the problem of distributed active voltage control in power distribution networks using a Decentralized Partially Observable Markov Decision Process (Dec-POMDP) framework. It serves as a basis for validating multi-agent reinforcement learning (MARL) as a viable solution to real-world voltage regulation challenges. Notably, the paper introduces the first open-source simulation environment that mimics scenarios involving solar panels (PVs) as decentralized renewable energy sources in power grids, a strategy currently pursued in the UK. The study investigates how AI agents controlling PV inverters can manage voltage stability, contrasts the performance of state-of-the-art MARL algorithms against traditional methods like droop control and optimal power flow, and outlines potential directions to enhance MARL approaches in this context.

3. **Jianhong Wang**, Yuan Zhang, Yunjie Gu, and Tae-Kyun Kim. "*SHAQ: Incorporating Shapley Value Theory into Multi-Agent Q-Learning.*" Advances in Neural Information Processing Systems 35 (2022): 5941-5954. [https://arxiv.org/pdf/2105.15013]

   This paper extends previous work from AAAI 2020 by formalizing the Shapley value within the context of Markov games that use a shared team reward, coining the term "Markov Shapley value." The authors demonstrate that all the desirable properties from the stateless version of the Shapley value are maintained in this extended framework. They integrate this Markov Shapley value into a multi-agent Q-learning algorithm, named Shapley Q-learning (SHAQ), to evaluate each agent's contribution based on its policy. The paper provides proofs for the convergence of SHAQ to the optimal Shapley values, as well as to the optimal joint policy. Additionally, experimental results validate that the Markov Shapley

value preserves its theoretical properties and can serve as an interpretive tool to understand agent behaviors, positioning SHAQ as an informed-AI algorithm with practical interpretability.

4. **Jianhong Wang**, Yang Li, Yuan Zhang, Wei Pan, and Samuel Kaski. "*Open Ad Hoc Teamwork with Cooperative Game Theory.*" In International Conference on Machine Learning, pp. 50902-50930. PMLR, 2024. [https://arxiv.org/pdf/2402.15259]

   This paper leverages cooperative game theory to model open ad hoc teamwork, a setting in which only one agent (the learner) is directly controlled while dynamically collaborating with varying numbers and types of teammates. Traditionally, Q-learning algorithms using Q-value expressions via message passing in a coordination graph have been applied, although the necessity and proper configuration of this graph were unclear. By introducing cooperative game theory, the authors explain the importance of this Q-value formulation for enhancing team collaboration, and they improve the Q-value expression to reduce the parameter search space during learning. They also analyze the convergence properties of Q-learning with this new formulation in open team scenarios. Experimentally, the proposed algorithm demonstrates superior performance compared to state-of-the-art baselines.

EDUCATION

Imperial College London, UK *2019.01-2023.01*
Ph.D. in Electrical and Electronic Engineering Research for the thesis titled: ***Shapley Value Based Multi-Agent Reinforcement Learning: Theory, Method and Its Application to Energy Network***
Scholarship: *The Engineering and Physical Sciences Research Council of UK under awards EP/S000909/1*
Supervisors: *Dr Yunjie Gu, Prof Tim C. Green (FREng, FIEEE) and Prof Tae-Kyun Kim*

University College London, UK *2017.09-2018.09*
M.Res. in Web Science and Big Data Analytics
Supervisor: *Prof Jun Wang*
Grade: *Distinction* degree

Imperial College London, UK *2016.09-2017.09*
M.Sc. in Computing (Machine Learning)
Supervisor: *Prof Bjoern Schuller (FIEEE)*
Grade: *Merit* degree

University of Liverpool, UK *2012.09-2016.07*
B.Eng. in Computer Science and Electronic Engineering
Supervisors: *Prof Danushka Bollegala and Prof Karl Tuyls*
Grade: *First-class honours* degree

PROFESSIONAL MEMBERSHIP

- **Member of the *European Lab for Learning and Intelligent Systems* (ELLIS)**, endorsed by *Prof Frans A. Oliehoek (ELLIS Fellow)* and *Dr Aleksei Tiulpin (ELLIS Member)*, as recognition for achievements of multi-agent learning.

RESEARCH INTERESTS

- **Multi-Agent Reinforcement Learning:** Designing multi-agent reinforcement learning algorithms grounded in game-theoretic principles and graph theory.
- **Ad Hoc Teamwork:** Investigating a paradigm on how an agent makes decisions to collaborate on the fly with unknown teammates, which may potentially reinforce the deployment of traffic networks and power grids.
- **Machine Learning for Real-World Problems:** Applying reinforcement learning, game-theoretical models and end-to-end learning from system-wide optimization perspective, to solve real-world applications, such as swarm robotics, power grids, energy markets, dialogue systems, etc.

WORKING EXPERIENCE

University of Bristol *2024.09-Present*

Senior Research Associate

Responsibility: Conduct research on developing trustworthy, resilient, and interpretable learning-based multi-agent systems within the INFORMED-AI Hub, working with *Prof Jonathan Lawry*. This work aims to advance the foundational understanding and practical design of multi-agent AI systems that are transparent and reliable, thereby enabling their safe and efficient deployment in real-world environments involving multiple interacting agents.

University of Manchester *2023.02-2024.09*

Research Associate

Responsibility: Investigate how an autonomous agent can effectively collaborate with previously unknown agents during the learning process in multi-agent systems, working with *Prof Samuel Kaski (ELLIS Fellow)*. This line of research supports the development of open and adaptive AI systems, with potential applications in dynamic real-world settings—such as future energy systems—where the number and identity of participating agents may vary over time.

Huawei London Research Center *2020.11-2021.03*

Part-Time Research Internship

Responsibility: Investigate the switching control mechanism for reward shaping in reinforcement learning, working with *Dr David Mguni*. It is a framework between two agents: A reward-shaping agent employed switching controls to determine which states to add shaping rewards to the original rewards for more efficient learning, while another agent learned the optimal policy for a task using the integrated rewards. This framework was also extended to the scenarios involving multiple agents.

SELECTED PUBLICATIONS

1. **Jianhong Wang**, Yang Li, Samuel Kaski, and Jonathan Lawry. "*Shapley Machine: A Game-Theoretic Framework for N-Agent Ad Hoc Teamwork.*" arXiv preprint arXiv:2506.11285 (2025), Under Review.

2. **Jianhong Wang**, Yang Li, Yuan Zhang, Wei Pan, and Samuel Kaski. "*Open Ad Hoc Teamwork with Cooperative Game Theory.*" In International Conference on Machine Learning, pp. 50902-50930. PMLR, 2024.

3. **Jianhong Wang**, Yuan Zhang, Yunjie Gu, and Tae-Kyun Kim. "*SHAQ: Incorporating Shapley Value Theory into Multi-Agent Q-learning.*" Advances in Neural Information Processing Systems 35 (2022): 5941-5954.

4. **Jianhong Wang**, Wangkun Xu, Yunjie Gu, Wenbin Song, and Tim C. Green. "*Multi-Agent Reinforcement Learning for Active Voltage Control on Power Distribution Networks.*" Advances in Neural Information Processing Systems 34 (2021): 3271-3284.

5. **Jianhong Wang**, Yuan Zhang, Tae-Kyun Kim, and Yunjie Gu. "*Modelling Hierarchical Structure between Dialogue Policy and Natural Language Generator with Option Framework for Task-oriented Dialogue System.*" In International Conference on Learning Representations. 2021.

6. **Jianhong Wang**, Yuan Zhang, Tae-Kyun Kim, and Yunjie Gu. "*Shapley Q-value: A Local Reward Approach to Solve Global Reward Games.*" In Proceedings of the AAAI Conference on Artificial Intelligence, vol. 34, no. 05, pp. 7285-7292. 2020. [**Oral**]

7. Dawei Qiu, **Jianhong Wang**, Guangchun Ruan, Qianzhi Zhang, and Goran Strbac. "*Robust Reinforcement Learning for Decision Making Under Uncertainty in Electricity Markets.*" IEEE Transactions on Power Systems (2024).

8. Wangkun Xu, **Jianhong Wang**, and Fei Teng. "*E2E-AT: A Unified Framework for Tackling Uncertainty in Task-Aware End-to-End Learning.*" In Proceedings of the AAAI Conference on Artificial Intelligence, vol. 38, no. 14, pp. 16220-16227. 2024.

9. Yuan Zhang, **Jianhong Wang**, and Joschka Boedecker. "*Robust Reinforcement Learning in Continuous Control Tasks with Uncertainty Set Regularization.*" In Conference on Robot Learning, pp. 1400-1424. PMLR, 2023.

10. Dawei Qiu, **Jianhong Wang**, Zihang Dong, Yi Wang, and Goran Strbac. "*Mean-Field Multi-Agent Reinforcement Learning for Peer-to-Peer Multi-Energy Trading.*" IEEE Transactions on Power Systems (2022).

11. Mingrui Zhang, **Jianhong Wang**, James B. Tlhomole, and Matthew Piggott. "*Learning to Estimate and Refine Fluid Motion with Physical Dynamics.*" In International Conference on Machine Learning, pp. 26575-26590. PMLR, 2022. [**Spotlight**]

12. Dawei Qiu, **Jianhong Wang**, Junkai Wang, and Goran Strbac. "*Multi-Agent Reinforcement Learning for Automated Peer-to-Peer Energy Trading in Double-Side Auction Market.*" In IJCAI, pp. 2913-2920. 2021.

13. Rui Luo, **Jianhong Wang**, Yaodong Yang, Jun Wang, and Zhanxing Zhu. "*Thermostat-Assisted Continuously-Tempered Hamiltonian Monte Carlo for Bayesian Learning.*" Advances in Neural Information Processing Systems 31 (2018).

14. Yang Li, Wenhao Zhang, **Jianhong Wang**, Shao Zhang, Yali Du, Ying Wen and Wei Pan. "*Aligning Individual and Collective Objectives in Multi-Agent Cooperation.*" Advances in Neural Information Processing Systems 37 (2024).

15. Yuan Zhang, Umashankar Deekshith, **Jianhong Wang** and Joschka Boedecker. "*Improving the Efficiency and Efficacy of Multi-Agent Reinforcement Learning on Complex Railway Networks with a Local-Critic Approach.*" In Proceedings of the International Conference on Automated Planning and Scheduling. 2024, 34: 698-706.

16. David Mguni, Taher Jafferjee, **Jianhong Wang**, Nicolas Perez-Nieves, Wenbin Song, Feifei Tong, Matthew Taylor et al. "*Learning to Shape Rewards using a Game of Two Partners.*" In Proceedings of the AAAI Conference on Artificial Intelligence, vol. 37, no. 10, pp. 11604-11612. 2023.

17. Dawei Qiu, Yi Wang, **Jianhong Wang**, Ning Zhang, Goran Strbac, and Chongqing Kang. "*Resilience-Oriented Coordination of Networked Microgrids: a Shapley Q-Value Learning Approach.*" IEEE Transactions on Power Systems (2023).

18. Wangkun Xu, Martin Higgins, **Jianhong Wang**, Imad M. Jaimoukha, and Fei Teng. "*Blending Data and Physics against False Data Injection Attack: An Event-Triggered Moving Target Defence Approach.*" IEEE Transactions on Smart Grid (2022).

19. David Mguni, Taher Jafferjee, **Jianhong Wang**, Nicolas Perez-Nieves, Oliver Slumbers, Feifei Tong, Yang Li, Jiangcheng Zhu, Yaodong Yang, and Jun Wang. "*LIGS: Learnable Intrinsic-Reward Generation Selection for Multi-Agent Learning.*" In International Conference on Learning Representations. 2021.

20. David Mguni, Haojun Chen, Taher Jafferjee, **Jianhong Wang**, Longfei Yue, Xidong Feng, Stephen Marcus Mcaleer, Feifei Tong, Jun Wang, and Yaodong Yang. "*MANSA: Learning Fast and Slow in Multi-Agent Systems.*" In International Conference on Machine Learning, pp. 24631-24658. PMLR, 2023.

21. Dawei Qiu, Juxing Xue, Tingqi Zhang, **Jianhong Wang**, and Mingyang Sun. "*Federated Reinforcement Learning for Smart Building Joint Peer-to-Peer Energy and Carbon Allowance Trading.*" Applied Energy 333 (2023): 120526.

22. Taher Jafferjee, Juliusz Ziomek, Tianpei Yang, Zipeng Dai, **Jianhong Wang**, Matthew E. Taylor, Kun Shao, Jun Wang, David Henry Mguni. "*Taming Multi-Agent Reinforcement Learning with Estimator Variance Reduction.*" In Proceedings of the 24th International Conference on Autonomous Agents and Multiagent Systems (AAMAS '25). International Foundation for Autonomous Agents and Multiagent Systems, Richland, SC, 1042–1050.

ACADEMIC SERVICES

Working as a PC Member of the following AI conferences

AAAI, ECAI, etc.

Working as a Reviewer for the following AI conferences

NeurIPS, ICML, ICLR, AAMAS, RLC, etc.

Nominated as a *Notable Reviewer* for ICLR 2025.

Working as a Reviewer for the following journals

IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE Transactions on Smart Grid, IEEE Transactions on Power Systems, IEEE Robotics and Automation Letters, etc.

ACADEMIC ACTIVITIES

Co-organized a workshop called *The 2nd Coordination and Cooperation in Multi-Agent Reinforcement Learning* at Reinforcement Learning Conference (RLC) 2025 *2025.08*

***Aim and Scope**: This workshop aims to accelerate the advancement of cooperative and coordinated multi-agent reinforcement learning in both theory and real-world applications (e.g. swarm robotics, traffic management and smart grids). To achieve the goal, the agenda is constituted of paper submissions, invited talks and panel discussions.*

Organizer (`https://sites.google.com/view/cocomarl2025/home`).

Co-organized a workshop called *Multi-Agent Reinforcement Learning Workshop* at Distributed Artificial Intelligence (DAI) 2024 *2024.12*

***Aim and Scope**: This workshop delves into the dynamic and complex world of multi-agent systems (MAS) operating in challenging environments, where solutions may involve multi-agent reinforcement learning (MARL) or other advanced techniques. Participants are invited to share case studies and real-world applications, showcasing how MAS can drive innovation in areas like embodied agents, autonomous vehicles, robotics, and more.*

Organizer (`https://sites.google.com/view/dai-2024-marl`).

Co-organized a workshop called *Coordination and Cooperation in Multi-Agent Reinforcement Learning* at Reinforcement Learning Conference (RLC) 2024 *2024.08*

***Aim and Scope**: This workshop aims to accelerate the advancement of cooperative and coordinated multi-agent reinforcement learning in both theory and real-world applications (e.g. swarm robotics, traffic management and smart grids). To achieve the goal, the agenda is constituted of paper submissions, invited talks and panel discussions.*

Organizer (`https://sites.google.com/view/cocomarl-2024/home`).

TEACHING EXPERIENCE

PhD Students Supervision

- Xiaomei Mi, University of Manchester (2023-2025)
  - Research topic: *Human-AI Collaborative Learning Paradigm Design for Auctions*
  - Now being a final-year PhD student at University of Manchester
- Yang Li, University of Manchester (2023-2024)
  - Research topic: *Mixed-Motive Multi-Agent Reinforcement Learning*
  - Now being a researcher at Huawei London Research Center
- Wangkun Xu, Imperial College London (2020-2024)
  - Research topic: *Machine Learning for Operation and Anomaly Detection in Power Grids*
  - Now being a Postdoctoral Research Associate at Imperial College London

Master Students Supervision

- Jesung Park, University of Bristol (2025-Present)
  - Research topic: *Reinforcement Learning for Formula One Racing*
  - Now being a master student at University of Bristol
- Peilin Zou, University of Bristol (2025-Present)

  - Research topic: *Taming Relative Overgeneralization in Multi-Agent Learning*
  - Now being a master student at University of Bristol
- Junyu Mao, Imperial College London (2019-2020)
  - Research topic: *Reinforcement Learning for Controlling Actual Spherical Pendulum*
  - Now pursuing his PhD degree in Control Theory at Imperial College London
- Wei Chen, Imperial College London (2019-2020)
  - Research topic: *Reinforcement Learning for Controlling Robot Manipulators*
  - Now being a research engineer specialized in Reinforcement Learning at Huawei Central Research Institute

Teaching Tutorials

- Working as a Tutor, School of Mathematics, University of Bristol (2025-Present)
  - Teaching tutorials for the course *Applied Analysis B*

OPEN-SOURCE SOFTWARE CONTRIBUTIONS

MAPDN (`https://github.com/Future-Power-Networks/MAPDN`): An open-source environment for multi-agent active voltage control on power distribution networks and the paper titled "Multi-Agent Reinforcement Learning for Active Voltage Control on Power Distribution Networks." [**266 stars**]

RESEARCH PROJECT CONTRIBUTIONS

[1] EPSRC AI hubs: Information theory for distributed AI (INFORMED-AI) *2024.09 - Present*
Supported by Engineering and Physical Sciences Research Council (EPSRC)
Senior Research Associate

[2] Turing AI World-Leading Researcher Fellowship: Human-AI Research Teams - Steering AI in Experimental Design and Decision-Making *2023.02 - 2024.09*
Supported by UK Research & Innovation (UKRI)
Postdoctoral Research Associate

GRANT APPLICATIONS

- **GW4 Building Communities Generator Fund Round 6**
  Title: AI-Driven Digital Transformation For Sustainable Energy Transition Network
  PI: Dawei Qiu (Exeter)
  Co-I: Zhong Fan (Exeter), Laiz Souto (Bath), Furong Li (Bath), Meysam Qadrdan (Cardiff), Bethan Charles (Bristol), **Jianhong Wang (Bristol)**, Ruzanna Chitchyan (Bristol)
  Funding: £20,000
  Duration: June 2025 - May 2026
  Status: **Awarded - 26 Mar 2025**

REFEREES

- **Prof Jonathan Lawry** (`J.Lawry@bristol.ac.uk`), University of Bristol, Full Professor, My Line Manager at University of Bristol
- **Prof Samuel Kaski** (*ELLIS Fellow*, `samuel.kaski@manchester.ac.uk`), University of Manchester / Aalto University, Full Professor, My Line Manager at University of Manchester
- **Prof Tim C. Green** (*Fellow of the Royal Academy of Engineering*, *IEEE Fellow*, `t.green@imperial.ac.uk`), Imperial College London, Full Professor, My PhD Supervisor
- **Prof Jun Wang** (`jun.wang@cs.ucl.ac.uk`), University College London (UCL), Full Professor, My Master Supervisor and Research Collaborator
- **Dr Yunjie Gu** (`yunjie.gu@imperial.ac.uk`), Imperial College London, Assistant Professor, My PhD Supervisor