Chengpeng Hu

+86 18665844272| hucp2021@mail.sustech.edu.cn | HcPlu@outlook.com | https://hcplu.github.io/

Education

Southern University of Science and Technology Sep. 2021 – June 2024 (expected)
Master student of Computer Science (Degree in Electronics Science and Technology) *Shenzhen, China*

Southern University of Science and Technology Sep. 2017 – June 2021
B.E. in Computer Science and Technology *Shenzhen, China*

Research Projects

Reinforcement Learning (RL) → Decision-making 2021 – Present
Southern University of Science and Technology (Supervisors: Dr. Jialin Liu and Prof. Xin Yao)

- Constrained RL: Combine constrained evolutionary algorithm and reinforcement learning for robot controlling.
- Multi-Agent RL: Multi-robot task allocation via constrained multi-agent reinforcement learning.
- Evolutionary RL: Combine evolutionary computation and reinforcement learning. (co-supervised by Prof. Kay Chen Tan (PolyU))

Game AI → Playing 2020 – Present
Southern University of Science and Technology (Supervisors: Dr. Jialin Liu and Prof. Xin Yao)

- Review on Game-based platforms for AI research → playing and content generation
- Reinforcement learning with dual-observation for general video game playing
- Rank first in the 2020 GVGAI Learning Competition.

Smart Logistics → Optimising, Planning and Scheduling 2020 – Present
Southern University of Science and Technology (Supervisors: Dr. Jialin Liu and Prof. Xin Yao)

- Dynamic material handling problem formulation, simulator, problem dataset and constrained reinforcement learning based agent for scheduling.
- Constrained evolutionary reinforcement learning for dynamic material handling.
- Formulate and design heuristics to solve the split delivery vehicle routing problems with three-dimensional loading constraints.

Simultaneous Localization and Mapping with Millimeter-wave Radar 2020
Southern University of Science and Technology (Supervisor: Dr. Jin Zhang)

Services & Experiences

Session Chair on Reinforcement Learning I 2023
2023 International Joint Conference on Neural Networks

Publicity Co-chair 2023
2023 IEEE Conference on Games

Volunteer 2022
2022 IEEE Conference on Games

Teaching assistant 2021
2021 Computational Intelligence Summer School

Robotics Intern in UBTECH 2020
Navigation and localization group, Shenzhen Research Institute, UBTECH

Teaching

Teaching Assistant
Southern University of Science and Technology

- 2023 Reinforcement Learning, graduate course
- 2022-2023 Introduction to Computer Programming A, undergraduate course
- 2022-2023 Computer System Design and Applications A, undergraduate course
- 2021-2022 Advanced Artificial Intelligence, graduate course

Awards

Outstanding Undergraduate Dissertation 2021

- *"Layer-based Heuristics for Split Delivery Vehicle Routing Problems with Three-dimensional Loading Constraints"*

The 2020 GVGAI Learning Competition 1st Place Winning AI 2020

Asia Supercomputer Community Second Class Prize 2018

China Parallel Application Challenge on Domestic CPU Second Class Prize 2018

XiaoAi Skill (NLP) Development Competition Third Prize 2018

Scholarships & Grants

SUSTech Graduate Student Travel Grants 2023

IEEE CIS Graduate Student Research Grants (only 6 awarded globally in 2023) 2023

- *"Distilling Evolutionary Reinforcement Learning via Cooperative Coevolution"*
- Supervised by Dr. Jialin Liu, Prof. Kay Chen Tan (PolyU) and Prof. Xin Yao

Sony AI Scholarship 2022

Supervision

Risk Scenario Generation for Safe Multi-agent Reinforcement Learning 2023

- Yueyun Zhong (research assistant), co-supervise with Dr. Jialin Liu

Prey-Predator: Competitive Multi-agent Path Finding via Reinforcement Learning 2022-2023

- Zengrui Lu, Xingyang Feng, Kunyi Yu (undergraduate), co-supervise with Dr. Jialin Liu and Prof. Xin Yao

Publications

* equal contribution.

9. Ziqi Wang, **Chengpeng Hu**, Jialin Liu, Xin Yao. "Negatively Correlated Ensemble Reinforcement Learning for Online Diverse Game Level Generation", 2023 (under review).
8. **Chengpeng Hu**, Ziming Wang, Jialin Liu, Chengqi Zhang and Xin Yao. "Robust dynamic material handling via adaptive constrained evolutionary reinforcement learning learning", IEEE Transactions on Evolutionary Computation, 2023 (Under review).
7. Shuo Huang, **Chengpeng Hu**, Julian Togelius, Jialin Liu. "Generating redstone style cities in Minecraft", IEEE Conference on Games, 2023 (accepted). [PDF]
6. Yunlong Zhao*, **Chengpeng Hu***, Jialin Liu. "Playing with Monte-carlo tree search", IEEE Computational Intelligence Magazine (accepted), 2023.
5. **Chengpeng Hu**, Yunlong Zhao, Ziqi Wang, Haocheng Du, Jialin Liu. "Game-based platforms for artificial intelligence research", IEEE Transactions on Artificial Intelligence, 2023 (under review). [PDF] [Code]
4. **Chengpeng Hu**, Ziming Wang, Jialin Liu, Junyi Wen, Bifei Mao, Xin Yao. "Constrained reinforcement learning for dynamic material handling", in *2023 International Joint Conference on Neural Networks*, 2023, pp. 1-9. [PDF] [Code]
3. **Chengpeng Hu**, Jiyuan Pei, Jialin Liu, Xin Yao. "Evolving constrained reinforcement learning policy", in *2023 International Joint Conference on Neural Networks*, 2023, pp. 1-8. [PDF] [Code]
2. **Chengpeng Hu**, Ziqi Wang, Tianye Shu, Hao Tong, Julian Togelius, Xin Yao, Jialin Liu. "Reinforcement learning with dual-observation for general video game playing". *IEEE Transactions on Games*, vol. 15, no. 2, pp. 202-216, 2023. [PDF] [Code]
1. Jiyuan Pei, **Chengpeng Hu**, Jialin Liu, Yi Mei and Xin Yao. "Bi-objective splitting delivery VRP with loading constraints and restricted access", in *2021 IEEE Symposium Series on Computational Intelligence*, pp. 1-9, 2021. [PDF] [Code]

Representative Publications

- **Chengpeng Hu**, Ziqi Wang, Tianye Shu, Hao Tong, Julian Togelius, Xin Yao, Jialin Liu. "Reinforcement learning with dual-Observation for general video game playing". *IEEE Transactions on Games*, vol. 15, no. 2, pp. 202-216, 2023.
  - **Link:** https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9748033
  - **Abstract:** Reinforcement learning (RL) algorithms have performed well in playing challenging board and video games. More and more studies focus on improving the generalization ability of RL algorithms. The General Video Game AI (GVGAI) Learning Competition aims to develop agents capable of learning to play different game levels that were unseen during training. This article summarizes the five years' GVGAI Learning Competition editions. At each edition, three new games were designed. The training and test levels were designed separately in the first three editions. Since 2020, three test levels of each game were generated by perturbing or combining two training levels. Then, we present a novel RL technique with dual-observation for general video game playing, assuming that it is more likely to observe similar local information in different levels rather than global information. Instead of directly inputting a single, raw pixel-based screenshot of the current game screen, our proposed general technique takes the encoded, transformed global, and local observations (LOs) of the game screen as two simultaneous inputs, aiming at learning local information for playing new levels. Our proposed technique is implemented with three state-of-the-art RL algorithms and tested on the game set of the 2020 GVGAI Learning Competition. Ablation studies show the outstanding performance of using encoded, transformed global, and LOs as input.
- **Chengpeng Hu**, Jiyuan Pei, Jialin Liu, Xin Yao. "Evolving constrained reinforcement learning policy", in *2023 International Joint Conference on Neural Networks*, 2023, pp. 1-8.
  - **Link:** https://arxiv.org/pdf/2304.09869.pdf
  - **Abstract:** Evolutionary algorithms have been used to evolve a population of actors to generate diverse experiences for training reinforcement learning agents, which helps to tackle the temporal credit assignment problem and improves the exploration efficiency. However, when adapting this approach to address constrained problems, balancing the trade-off between the reward and constraint violation is hard. In this paper, we propose a novel evolutionary constrained reinforcement learning (ECRL) algorithm, which adaptively balances the reward and constraint violation with stochastic ranking, and at the same time, restricts the policy's behaviour by maintaining a set of Lagrange relaxation coefficients with a constraint buffer. Extensive experiments on robotic control benchmarks show that our ECRL achieves outstanding performance compared to state-of-the-art algorithms. Ablation analysis shows the benefits of introducing stochastic ranking and constraint buffer.
- **Chengpeng Hu**, Ziming Wang, Jialin Liu, Junyi Wen, Bifei Mao, Xin Yao. "Constrained reinforcement learning for dynamic material handling", in *2023 International Joint Conference on Neural Networks*, 2023, pp. 1-9.
  - **Link:** https://arxiv.org/pdf/2305.13824.pdf
  - **Abstract:** As one of the core parts of flexible manufacturing systems, material handling involves storage and transportation of materials between workstations with automated vehicles. The improvement in material handling can impulse the overall efficiency of the manufacturing system. However, the occurrence of dynamic events during the optimisation of task arrangements poses a challenge that requires adaptability and effectiveness. In this paper, we aim at the scheduling of automated guided vehicles for dynamic material handling. Motivated by some realworld scenarios, unknown new tasks and unexpected vehicle breakdowns are regarded as dynamic events in our problem. We formulate the problem as a constrained Markov decision process which takes into account tardiness and available vehicles as cumulative and instantaneous constraints, respectively. An adaptive constrained reinforcement learning algorithm that combines Lagrangian relaxation and invalid action masking, named RCPOM, is proposed to address the problem with two hybrid constraints. Moreover, a gym-like dynamic material handling simulator, named DMH-GYM, is developed and equipped with diverse problem instances, which can be used as benchmarks for dynamic material handling. Experimental results on the problem instances demonstrate the outstanding performance of our proposed approach compared with eight state-of-the-art constrained and non-constrained reinforcement learning algorithms, and widely used dispatching rules for material handling.