Yuhang Song

+44 7427 657141
Yuhang@fractile.ai
scholar.google.com/citations?user=cyd3EsgAAAAJ
YuhangSong
yuhang-song

My interest is to decipher and extract the learning principles of biological neural systems, so as to reverse-engineer them as algorithms or even specialized hardware. Such a route of research would, on the one hand, bring us one step closer to true artificial intelligence, and, on the other hand, improve our understanding of the most sophisticated part of our body, the brain, so that diseases related to learning, and broadly, to neural systems, can be better understood and treated.

BIOGRAPHY

2024 – Now **CEO & Co-founder**, *Perturbation Ltd*.

2022 – 2024 **CTO & Co-founder**, *Fractile Ltd*.

2021 – 2022 **J.P. Morgan AI Research Fellow**, *University of Oxford*.

2018 – 2022 **Ph.D.**, *Department of Computer Science* & *Nuffield Department of Clinical Neurosciences*, *University of Oxford*.

2014 – 2018 **B.S.**, *Beihang University*.

Fellowships / Scholarships

2024 *Thomas Willis Early Career Researcher Prize, University of Oxford*

2024 *Ideas 2 Impact (I2I) Fellow, Saïd Business School, University of Oxford*

2022 *J.P. Morgan AI Research Fellowship* ***$100,000 | A total of 11 awardees worldwide***

2019 *Special Project Grant* @ *Somerville College* ***£2,000 | Top-tier***

2018 *Honorary China Oxford Award* | ***15 among 1,000*** ***£3,000 |1st Prize***

2017 *National Innovation Scholarship* | ***20 among 200,000+*** ***$12,000 | 1st Prize***

Awarded by the National Ministry of Industry and Information.

2016 Outstanding Science and Technology Scholarship | ***12 among 256*** ***$220 |1st Prize***

2015 *Airbus Academic Scholarship* | ***2 among 600+*** ***$1,200 |2nd Prize***

PUBLICATIONS

(∗: Corresponding Author. †: Co-first author.)

[1] Journal **Yuhang Song**∗, Beren Millidge, Tommaso Salvatori, Zhenghua Xu∗, Thomas Lukasiewicz∗, Rafal Bogacz∗. *Inferring Neural Activity Before Plasticity: A Foundation for Learning Beyond Backpropagation.* **Nature Neuroscience, IF: 28.77**. [Link]

[2] Under-review Beren Millidge, **Yuhang Song**∗, Armin Lak, Mark E. Walton, Rafal Bogacz∗. *Reward-Bases: Dopaminergic Mechanisms for Adaptive Acquisition of Multiple Reward Types.* **Under 2nd round peer review at Nature Communications (bioRxiv 2023.05.09.540067)**. [Link]

[3] Conference Tommaso Salvatori[†], **Yuhang Song**[*†], Yordan Yordanov, Beren Millidge, Lei Sha, Cornelius Emde, Zhenghua Xu, Rafal Bogacz, Thomas Lukasiewicz. *A Stable, Fast, and Fully Automatic Learning Algorithm for Predictive Coding Networks.* **ICLR 2024**. [Link]

[4] Journal Mufeng Tang, Tommaso Salvatori, Beren Millidge, **Yuhang Song**, Thomas Lukasiewicz, Rafal Bogacz[*]. *Recurrent predictive coding models for associative memory employing covariance learning.* **PLOS Computational Biology**. [Link]

[5] Conference Tommaso Salvatori, Beren Millidge, **Yuhang Song**, Rafal Bogacz, Thomas Lukasiewicz. *Associative Memories in the Feature Space.* **ECAI 2023**. [Link]

[6] Conference Beren Millidge, **Yuhang Song**[*], Tommaso Salvatori, Thomas Lukasiewicz, Rafal Bogacz. *A Theoretical Framework for Inference and Learning in Predictive Coding Networks.* **ICLR 2023**. [Link]

[7] Conference Beren Millidge, **Yuhang Song**[*], Tommaso Salvatori, Thomas Lukasiewicz, Rafal Bogacz. *Backprop at the Weak-Feedback Limit of Energy-Based Models: Unifying Predictive Coding, Equilibrium Propagation, and Contrastive Hebbian Learning.* **ICLR 2023**. [Link]

[8] Conference Luca Pinchetti, Tommaso Salvatori, Yordan Yordanov, Beren Millidge, **Yuhang Song**[*], Thomas Lukasiewicz. *Predictive Coding beyond Gaussian Distributions.* **NeurIPS 2022**. [Link]

[9] Conference Tommaso Salvatori, Luca Pinchetti[†], Beren Millidge, **Yuhang Song**[*], Tianyi Bao, Rafal Bogacz, Thomas Lukasiewicz. *Learning on Arbitrary Graph Topologies via Predictive Coding.* **NeurIPS 2022**. [Link]

[10] Conference Beren Millidge, Tommaso Salvatori, **Yuhang Song**[*], Thomas Lukasiewicz, Rafal Bogacz. *Universal Hopfield Networks: A General Framework for Single-Shot Associative Memory Models.* **ICML 2022**. [Link]

[11] Conference Beren Millidge[†], Tommaso Salvatori[†], **Yuhang Song**[*], Rafal Bogacz, Thomas Lukasiewicz. *Predictive Coding: Towards a Future of Deep Learning beyond Backpropagation?* **IJCAI 2022**. [Link]

[12] Conference Tommaso Salvatori, **Yuhang Song**[*], Zhenghua Xu, Thomas Lukasiewicz, Rafal Bogacz. *Reverse Differentiation via Predictive Coding.* **AAAI 2022**. [Link]

[13] Conference Tommaso Salvatori, **Yuhang Song**[*], Yujian Hong, Lei Sha, Simon Frieder, Zhenghua Xu, Rafal Bogacz, Thomas Lukasiewicz. *Associative Memory via Predictive Coding.* **NeurIPS 2021**. [Link]

[14] Conference **Yuhang Song**, Thomas Lukasiewicz, Zhenghua Xu[*], Rafal Bogacz. *Can the Brain Do Backpropagation? –Exact Implementation of Backpropagation in Predictive Coding Networks.* **NeurIPS 2020**. [Link]

[15] Conference **Yuhang Song**, Andrzej Wojcicki, Thomas Lukasiewicz, Jianyi Wang, Abi Aryan, Zhenghua Xu[*], Mai Xu, Zihan Ding, Lianlong Wu. *Arena: A General Evaluation Platform and Building Toolkit for Multi-Agent Intelligence.* **AAAI 2020**. [Link]

[16] Conference **Yuhang Song**, Jianyi Wang, Thomas Lukasiewicz, Zhenghua Xu[*], Shangtong Zhang, Andrzej Wojcicki, Mai Xu. *Mega-Reward: Achieving Human-Level Play without Extrinsic Rewards.* **AAAI 2020**. [Link]

[17] Conference **Yuhang Song**, Jianyi Wang[†], Thomas Lukasiewicz, Zhenghua Xu[*], Mai Xu. *Diversity-Driven Extensible Hierarchical Reinforcement Learning.* **AAAI 2019**. [Link]

[18] Journal Mai Xu*, **Yuhang Song**†, Jianyi Wang, Minglang Qiao, Liangyu Huo, Zulin Wang. *Predicting Head Movement in Panoramic Video: A Deep Reinforcement Learning Approach.* **TPAMI, IF: 17.861**. [Link]

[19] Conference **Yuhang Song**, Mai Xu*, Shengxi Li. *Watching Videos with Certain and Constant Quality: PID-based Quality Control Method.* **DCC 2017**. [Link]

[20] Conference Xin Deng, Hao Wang†, Mai Xu*, Yichen Guo, **Yuhang Song**, Li Yang. *LAU-Net: Latitude Adaptive Upscaling Network for Omnidirectional ImageSuper-resolution.* **CVPR 2021**. [Link]

[21] Conference Jianyi Wang, Xin Deng, Mai Xu*, Congyong Chen, **Yuhang Song**. *Multi-level Wavelet-based Generative Adversarial Network for Perceptual Quality Enhancement of Compressed Video.* **ECCV 2020**. [Link]

[22] Journal Jianyi Wang, Mai Xu*, Lai Jiang, **Yuhang Song**. *Attention-based Deep Reinforcement Learning for Virtual Cinematography of 360° Videos.* **IEEE Transactions on Multimedia, IF: 5.452**. [Link]

[23] Workshop **Yuhang Song**, Mai Xu*, Songyang Zhang, Liangyu Huo. *Generalization Tower Network: A Novel Deep Neural Network Architecture for Multi-Task Learning.* **Deep Reinforcement Learning Symposium at NeurIPS 2018**. [Link]

[24] Journal Liangyu Huo, Zulin Wang, Mai Xu*, **Yuhang Song**. *A Task-Agnostic Regularizer for Diverse Subpolicy Discovery in Hierarchical Reinforcement Learning.* **IEEE Transactions on Systems, Man, and Cybernetics: Systems, IF: 13.451**. [Link]

[25] Technical report **Yuhang Song**, Christopher Grimm, Xianming Wang, Michael Littman*. *Learning Approximate Stochastic Transition Models.* **2018**. [Link]

[26] Technical report Hao Sun, Ziping Xu, **Yuhang Song**, Meng Fang, Jiechao Xiong, Bo Dai, Zhengyou Zhang, Bolei Zhou. *Supervised Q-Learning for Continuous Control.* **2021**. [Link]

[27] Technical report Christopher Grimm, **Yuhang Song**, Michael Littman*. *Summable Reparameterizations of Wasserstein Critics in the One-Dimensional Setting.* **2018**. [Link]

Patents

[28,...,35] **Yuhang Song**, Xianglong Kong. *A Power / Joint / Servo / Connector Module Device in a Modular UAV System.* 4 Invention & 4 Utility Model Patents. ZL201620302692.X, ZL201620302142.8, ZL201620302048.2, ZL201620302137.7, 201610224780.7, 201610225217.1, 201610225216.7, 201610224853.2.

TEACHING

2019 **Advanced Machine Learning**, *Department of Computer Science*, *University of Oxford*.
- Role: Teaching Assistant & Tutor
- Lecturers:
  - *Prof. Yarin Gal*
  - *Prof. Thomas Lukasiewicz*

2019 **Imperative Programming 3**, *Department of Computer Science*, *University of Oxford*.
- Role: Teaching Assistant & Tutor
- Lecturers:
  - *Prof. Peter Jeavons*

2018 **Introduction to Machine Learning**, *Beihang University*.
- Role: Teaching Assistant & Tutor
- Lecturers:
  - *Prof. Mai Xu*