

Yuhang Song

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



My interest is to decipher learning principles of biological neurons, so as to reverse-engineer them as new algorithms or specialized hardware. Such a route would, on the one hand, bring us one step closer to the true machine intelligence (as our attempt in *Fractile*); on the other hand, improve our understanding of the most sophisticated part of our body, the brain (as our attempt in *the Nature Neuroscience paper*).

BIOGRAPHY

- 2024 – Now **CSO & Co-founder**, *Circlemind 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] **Journal** Beren Millidge, **Yuhang Song***, Armin Lak, Mark E. Walton, Rafal Bogacz*. *Reward-Bases: Dopaminergic Mechanisms for Adaptive Acquisition of Multiple Reward Types*. **PLOS Computational Biology**. [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*, Shang-tong 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 Image Super-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.
 o Role: Teaching Assistant & Tutor
 o Lecturers:
 - *Prof. Yarin Gal*
 - *Prof. Thomas Lukasiewicz*
- 2019 **Imperative Programming 3**, Department of Computer Science, University of Oxford.
 o Role: Teaching Assistant & Tutor
 o Lecturers:
 - *Prof. Peter Jeavons*
- 2018 **Introduction to Machine Learning**, Beihang University.
 o Role: Teaching Assistant & Tutor
 o Lecturers:
 - *Prof. Mai Xu*