Yanbo Zhang Ph.D.

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Research

AI for Science & Science for AI: My research bridges fundamental science and artificial intelligence. I leverage core scientific principles—such as macrostates, evolution, equilibrium, and game theory—to analyze and interpret cutting-edge AI models. Conversely, I employ advanced machine learning models as novel instruments to investigate fundamental scientific questions. This dual approach led to establishing an equivalence between generative models and biological evolution and uncovering connections between emergent patterns and system dynamics. My work also explores broader methodologies for AI-assisted scientific discovery.

Physics of Complex Systems: I apply a physicist's approach to uncovering the universal laws that govern complex systems. My research focuses on identifying the foundations of these laws by studying general and reusable macroscopic representations. A key component of this work involves developing robust methods for modeling complex systems across multiple scales.

Education

University of Science and Technology of China — Hefei, China
B.S. of Condensed Matter Physics — 2013 - 2018
- Advisor: Prof. Youjin Deng

Karolinska Institutet — Stockholm, Sweden
Visiting Student — 2017
- Advisor: Prof. Hector Zenil
- Research area: Complex Systems, Cellular Automata

Arizona State University — Tempe, USA
Beyond Center, Ph.D. — 2018 - 2023
- Advisor: Prof. Sara I. Walker
- Research area: Complex Systems, Origin of Intelligence, Machine Learning

Work

Tufts University — Boston, USA
Allen Discovery Center, Postdoc scholar — 2023 - 2026 (expected)
- Advisor: Prof. Michael Levin
- Research area: Complex Systems, Origin of Intelligence, Machine Learning

Publications

1. **Yanbo Zhang**, & Levin, M. (2025). "Equilibrium flow: From Snapshots to Dynamics." *arXiv preprint arXiv:2509.17990*.
2. **Yanbo Zhang**, Hartl, B., Hazan, H., & Levin, M. "Diffusion Models are Evolutionary Algorithms". *In The Thirteenth International Conference on Learning Representations (ICLR 2025)*.
3. Le, N., Erickson, P., **Yanbo Zhang**, Levin, M., & Bongard, J. (2025, July). "Giving Simulated Cells a Voice: Evolving Prompt-to-Intervention Models for Cellular Control". *In Proceedings of the Genetic and Evolutionary Computation Conference Companion* (pp. 2327-2335).
4. **Yanbo Zhang**, Khan, S. A., Mahmud, A., Yang, H., Lavin, A., Levin, M., ... & Zenil, H. (2025). "Exploring the role of large language models in the scientific method: from hypothesis to discovery". *npj Artificial Intelligence*, 1(1), 14.
5. Hartl, B., **Yanbo Zhang** **(co-first author)**, Hazan, H., & Levin, M. (2024). "Heuristically adaptive diffusion-model evolutionary strategy". *Advanced Science* (accepted).
6. **Yanbo Zhang**, & Walker, S. "Relational Macrostate Theory Guides Artificial Intelligence to Learn Macro and Design Micro". *In ICLR 2023 Workshop on Physics for Machine Learning*.
7. Zenil, H., **Yanbo Zhang**, & Kiani, N. A. (2022). "Model Discovery and Discrete Inverse Problems with Cellular Automata and Boolean Networks". *In Automata and Complexity: Essays Presented to Eric Goles on the Occasion of His 70th Birthday* (pp. 433-453). Cham: Springer International Publishing.
8. Zhang, J., Dong, L., **Yanbo Zhang**, Chen, X., Yao, G., & Han, Z. (2020). "Investigating time, strength, and duration of measures in controlling the spread of COVID-19 using a networked meta-population model". *Nonlinear Dynamics*, 101(3), 1789-1800.
9. **Yanbo Zhang** (2018). "Definition and Identification of Information Storage and Processing Capabilities as Possible Markers for Turing Universality in Cellular Automata". *Complex Systems*, 27(1).
10. Wu, Y., Wu, Y., Ma, C., **Yanbo Zhang**, Ding, H., Pan, N., & Wang, X. (2016). "The role of a few-layer TiO x surfactant: remarkably-enhanced succeeding radial growth and properties of ZnO nanowires". *Journal of Materials Chemistry C*, 4(40), 9569-9575.

Patents

Yanbo Zhang & M. Levin. Recovering Dynamics from Pattern Snapshots without Time Information. Invention Disclosure, *Tufts University (Office for Technology Transfer & Industry Collaboration)*, IDF000395, submitted Sep 1, 2025; status: Approved (updated Sep 2, 2025).
Yanbo Zhang, H. Hazan, B. Hartl, M. Levin. System and Method for Improved Computing Efficiency with Greater Diversity and Adaptability. *PCT patent application. Tufts University (Office for Technology Transfer Industry Collaboration)* Status: Pending.