Yan Ru Pei

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Educational Background

University of California, San Diego — Advisor: *Massimiliano Di Ventra*
PhD in Physics (Computational Science Specialization) — *Sept 2017 – Present*

Massachusetts Institute of Technology — PI: *Wolfgang Ketterle*
Research Support Associate at CUA — *Sept 2016 – Sept 2017*

University of California, Los Angeles — Advisor: *Robert Cousins*
BS in Physics and Applied Mathematics — *Sept 2014 – Sept 2016*

Research Interests

spin-glass, complexity theory, machine learning, memory, graph theory

Publications/Preprints

Spin glass:

- **Yan Ru Pei**, Massimiliano Di Ventra. *Non-equilibrium criticality and efficient exploration of glassy landscapes with memory dynamics.* arXiv: 2102.04557 (2021).
- **Yan Ru Pei**, Massimiliano Di Ventra. *A finite-temperature phase transition for the Ising spin-glass in* $d \geq 2$. arXiv: 2105.0118 (2021).

Complexity theory:

- **Yan Ru Pei**, Haik Manukian, Massimiliano Di Ventra. *Generating weighted MAX-2-SAT instances with frustrated loops: an RBM case study.* JMLR: 21(159),1-55 (2020).
- **Yan Ru Pei**, Fabio Lorenzo Traversa, Massimiliano Di Ventra. *On the universality of Memcomputing machines.* IEEE TNNLS: 30,6 (2019).

Machine learning & Optimization:

- Sean Bearden, **Yan Ru Pei**, Massimiliano Di Ventra. *Efficient solution of Boolean satisfiability problems with digital Memcomputing.* Sci Reports: 10,19741 (2020).
- Haik Manukian, **Yan Ru Pei**, Sean Bearden, Massimiliano Di Ventra. *Mode-assisted unsupervised learning of restricted Boltzmann machines.* Comm Phys: 3,105 (2020).

Behavioral economics:

- Yuqing Wang, **Yan Ru Pei**. *The Optimal Deterrence of Crime: A Focus on the Time Preference of DWI Offenders.* SSRN: 3457220 (2019).

Research Projects

Graduate Student Researcher — Sept 2017 – Present
UCSD — *San Diego, CA*

- Developing a dynamic RG method to study non-equilibrium criticality induced by memory.
- Proved the existence of a finite T_c for the Ising spin-glass using a random cluster representation.
- Studied the effectiveness of using RBM to represent the variational wavefunctions of quantum ground states.
- Developed a continuous dynamical approach for constrained optimization.
- Developed a new pre-training method for RBMs based on modal sampling.
- Constructed a categorical formalism for comparing analog computing architectures.

Reesarch Support Associate Sept 2016 – Sept 2017
MIT *Boston, MA*

- Studied the hysteresis effect of temperature fluctuations on mirror stability.
- Attempted to build a modular component for high precision magnetic field control for Dysprosium MOT chambers (under supervision of Wolfgang Ketterle).

Undergraduate Research Assistant December 2015 – Sept 2016
UCLA *Los Angeles, CA*

- Analyzed the rigor of the method of data unfolding in high energy experiments in a Bayesian context (under supervision of Robert Cousins).
- Designed and simulated a voltage array for collimating ion beams (under supervision of Eric Hudson).

Technical Skills

Algorithms: deep network training, constrained optimization, variational quantum monte carlo
Programming: MATLAB, Python, C++, R, Labview, Latex, Mathematica
Interdisciplinary expertise: complexity theory, signed graph theory, behavioral economics
Engineering: circuit design, ultra-high vacuum, water pump system

Talks

Simulating frustrated spin systems with memory dynamics. APS Physics March Meeting 2021.
Generating weighted MAX-2-SAT instances with tunable frustration on an RBM. APS Physics March Meeting 2020.
Harvard-MIT CUA Winter Retreat, 2017 (poster session).

Services

Referee for IEEE TNNLS

TA Experience (graduate courses)

Spring 2019: UCSD Phyiscs 212C - Quantum Mechanics III
Winter 2019: UCSD Phyiscs 200B - Theoretical Mechanics II
Fall 2018: UCSD Phyiscs 243 - Stochastic Methods