Yan Ru Pei

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Academic 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 (summa cum laude) — *Sept 2014 – Sept 2016*

Publications/Preprints

Spin Glass:

- Non-equilibrium criticality and efficient exploration of glassy landscapes with memory dynamics (arXiv:2102.04557)
- On the Inefficiency of Cluster Algorithms (*In preparation.*)

Complexity Theory:

- Generating Weighted MAX-2-SAT Instances with Frustrated Loops: an RBM Case Study (JMLR, 2020)
- On the Universality of Memcomputing Machines (IEEE TNNLS, 2019)

Machine Learning/Optimization:

- Efficient solution of Boolean satisfiability problems with digital memcomputing (Sci. Reports, 2020)
- Mode-assisted unsupervised learning of restricted Boltzmann machines (Nat. Commun Phys, 2020)

Behavioral Economics:

- The Optimal Deterrence of Crime: A Focus on the Time Preference of DWI Offenders (SSRN, 2019)

Research Experience

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

- Currently trying to apply notions of supersymmetry to study the criticality of dynamical optimization.
- Studied the possibility of applying machine learning techniques to quantum many-body systems.
- Co-developed a continuous dynamical approach to constrained optimization.
- Developed a new pre-training method for RBMs based on modal sampling.
- Studied the connections between machine learning, optimization, and complexity.
- Explored a mathematical approach for describing analog computing architectures.

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

- Attempted to build a modular component for high precision magnetic field control for Dysprosium MOT chambers (under supervision of Nobel laureate 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).

Research Interests

spin glass, machine learning, quantum computing, complexity theory, memory simulation

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

Conference

APS Phyiscs March Meeting, Nashville (Virtual), 2021
APS Physics March Meeting, Denver, 2020
Harvard-MIT CUA Winter Retreat, 2017

Refereed Journals

IEEE Transactions on Neural Networks and Learning Systems

Graduate TA Experience

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