Zhen Zhang

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Programming Skills

- Machine learning: PyTorch, Tensorflow, Scikit-learn, XGBoost, LightGBM
- Programming: Python, MATLAB, Linux command, LaTeX, SQL.

Education

- **Brown University** — Sep 2018 – Now
  Ph.D. in Applied Mathematics; Advisor: Prof. George Em Karniadakis — *GPA: 4.00/4.00*
- **City University of Hong Kong** — Sep 2014 – Jun 2018
  Major in Computing Mathematics; Advisor: Prof. Ding-Xuan Zhou; Minor in CS — *GPA: 4.08/4.30*

Scholarships and Awards

Fellowship for graduate students, Division of Applied Mathematics, Brown University — Sep 2018
HKSAR government scholarship (top 2% in university), HKSAR — Sep 2016, Sep 2017

Experiences

- **Graduate research work** — Brown University
  Supervisor: Dr. George Em Karniadakis, Dr. Guang Lin, Dr. Yeonjong Shin — *Sep 2019 - now*
  - Conduct research on structure-preserving neural networks utilizing prior physical knowledges. Responsible for the idea formulation, proof of universal approximation theorems and simulations (using PyTorch).
  - Develop symplectic neural networks (SympNets) for the prediction of time series which exhibit conservative properties. The prediction MSE is decreased by **90**% over the SOTA method Hamiltonian neural network on the three-body benchmark task.
  - Apply SympNets to the simultaneous optimal path planning problem of **256** agents (continuous in space). Optimize the algorithm to reduce the training time from 8 to **1.5** hours.
  - Develop Poisson neural networks as a generalization of SympNet, which allows training data to be written in arbitrary coordinates. Establish universal approximation theorems and propose the prediction of a nonlinear Schrödinger equation as a new benchmark.
  - Develop GENERIC formalsim informed neural networks for the prediction of time series which exhibit dissipative properties. The prediction MSE is decreased by one order of magnitude over the existing methods.
- **Summer research internship** — UTK/ORNL
  Supervisor: Dr. Kwai Wong, Dr. Cheng Liu, Dr. Lonnie Crosby — *May 2016 - Aug 2016*
  - Receive training on high performance computing (HPC) in Oak Ridge National Laboratory
  - Propose a parallel version of a dasymetric mapping algorithm in GIS and implemented it in MPI. The new method can incoporate multi-scale demographic datasets and improve running efficiency. The overall running speed is increased by **15** times when 16 processes are utilized.

Publications

* *indicates equal contribution or alphabetical order.*

Journals:

1. Pengzhan Jin*, **Zhen Zhang***, Aiqing Zhu, Yifa Tang and George Em Karniadakis. SympNets: Intrinsic structure-preserving symplectic networks for identifying Hamiltonian systems. *Neural Networks* 132. 166-179 (2020)
2. Sheng Zhang*, Joan Ponce*, **Zhen Zhang***, Guang Lin and George, Karniadakis. An integrated framework for building trustworthy data-driven epidemiological models: Application to the COVID-19 outbreak in New York City. *PLoS Comput Biol* 17(9)
3. Ehsan Kharazmi, Min Cai, Xiaoning Zheng, **Zhen Zhang**, Guang Lin and George Em Karniadakis. Identifiability and predictability of integer- and fractional-order epidemiological models using physics-informed neural networks. *Nature Computational Science* (2021)
4. **Zhen Zhang**, Yeonjong Shin and George Em Karniadakis. GFINNs: GENERIC Formalism Informed Neural Networks for Deterministic and Stochastic Dynamical Systems. (Accepted by *Philos. Trans. R. Soc. A*)

5. Pengzhan Jin, **Zhen Zhang**, Yannis Kevrekidis and George Em Karniadakis. Learning Poisson systems and trajectories of autonomous systems via Poisson neural networks. (Accepted by *IEEE TNNLS*)

6. Tingwei Meng*, **Zhen Zhang***, Jerome Darbon and George Em Karniadakis. SympOCnet: Solving optimal control problems with applications to high-dimensional multi-agent path planning problems. (Submitted to SISC)

Book chapters:

1. Mitchell Daneker, **Zhen Zhang**, George Em Karniadakis, Lu Lu. System biology informed neural network. (Under review, invited by book series *Methods in Molecular Biology*)

Invited talks

- **NUMDIFF-16** Halle, Germany
  SympNet & PNN: structure-preserving networks for identifying Hamiltonian & Poisson systems. *Sep 2021*

Other Services

- Reviewer: *JCP, CMAME*

- Teaching assistant: APMA 1170, Brown University: Introduction to Computational Linear Algebra (Fall 2019)
  APMA 1660, Brown University: Statistical Inference II (Spring 2020)