Eric Qu

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Education

Duke Kunshan University / Duke University dual degree UG program *Sep 2019 - Present*
B.S. in Data Science (by Duke Kunshan) Kunshan, China / Durham, USA
B.S. in Interdisciplinary Studies (Subplan: Data Science; by Duke) GPA 3.88/4 Major GPA 3.98/4

Research Interest

My research interest mainly falls on **Hyperbolic Machine Learning**, **Graph Neural Networks**, and **Generative Models**. I also have experience in reinforcement learning and computer vision. In general, I am interested in combining ideas from mathematics with machine learning, and using machine learning to solve interdisciplinary problems.

Publications

Qu, Eric, and Dongmian Zou. "Lorentzian Fully Hyperbolic Generative Adversarial Network." *arXiv preprint arXiv:2201.12825* (2022).

Qu, Eric, Andrew M. Jimenez, Sanat K. Kumar, and Kai Zhang. "Quantifying Nanoparticle Assembly States in a Polymer Matrix through Deep Learning." *Macromolecules* 54, no. 7 (2021): 3034-3040.

Experience

Research Intern *May 2022 - Aug 2022*
Microsoft Research Aisa, Shanghai AI Group *Microsoft Research*

Teaching Assistant *Jan 2022 - May 2022*
STATS 303 Statistical Machine Learning *Duke Kunshan University*

Research Intern *Jun 2021 - Aug 2021*
Victory Software, Data Analysis Department *China Petrochemical Corporation*

Research Assistant *Mar 2021 - Present*
Mentor: Dongmian Zou *Duke Kunshan University*

Research Assistant *Apr 2020 - Nov 2021*
Kumar Research Group *Columbia University*

Research Assistant *Nov 2019 - Present*
Mentor: Kai Zhang *Duke Kunshan University*

Manuscripts & Projects

([†]Corresponding author, [*]Equal contribution)

Lorentzian Fully Hyperbolic Generative Adversarial Network
Eric Qu, Dongmian Zou[†] *arXiv:2201.12825 (Under review)*

- We propose a hyperbolic generative adversarial network (GAN) for generating hyperbolic data, and verified it using synthetic datasets. Moreover, we construct HAEGAN using a combination of hyperbolic GAN and autoencoder. Experiments show that HAEGAN is able to generate complex data with state-of-the-art performance.

Quantifying Nanoparticle Assembly States in a Polymer Matrix through Deep Learning
Eric Qu, Andrew Matthew Jimenez, Sanat K. Kumar, Kai Zhang† *Macromolecules, 54 (7), 3034-3040*

· We develop and apply a deep-learning based image analysis method to quantify the distribution of spherical NPs in a polymer matrix directly from their real-space TEM images.

Solving Sticky Hard Sphere Packing Problem through Deep Learning
Eric Qu, Kai Zhang†, Dongmian Zou† *May 2021 (In progress)*

· We propose a method of solving sticky hard sphere packing problem. The packing state of the spheres could be mapped to a graph according to the sphere connections.
· A modified version of Graph Isomorphism Network (GIN) is trained to identify the valid packing with high accuracy. Then, we train a Mento Carlo Search Tree to generate new packings with the reward based on perviously trained GIN.
· This is an attempt to solve challenging physics problem using deep learning.

Finding Optimal Order Parameter for Particle Systems
Eric Qu, Max Yueqian Lin, Kai Zhang† *Oct 2021 (In progress)*

· We develop a model to find the optimal order parameter for particle packing systems. The packing state is represented by the 3D point cloud data.
· We proposed a novel Kernel Point Autoencoder model using KPConv as encoder and our Kernel Point Generator as decoder. Then, the bottleneck layer is extracted to be the order parameter.
· The main contribution is a novel design of Kernel Point Generator layer.

Square Object Detection using Bounding Circles
Eric Qu, Anish Kumar Nayak, Tejus Shastry, Sanat K. Kumar, Kai Zhang† *Jan 2021 (In progress)*

· We propose a deep learning model for detecting square objects.
· The square objects could have different orientations, which means that the result of old coordinate aligned bounding boxes is not uniform and representative. We change the bounding boxes to be bounding circles in YOLO and use the model to detect the position an size of DNA nanoCrystals.

***In-situ* AFM tracking of Nanoparticle Diffusion in Semicrystalline Polymers**
Kamlesh Bornani, Nico Mendez, Abdullah S. Altorbaq, Alejandro Muller, Kai Zhang, Max Yueqian Lin, Eric Qu, Sanat K. Kumar†, Linda S. Schadler† *Dec 2021 (Under review)*

· We design a model for detecting and tracking the drift of nanoparticles in TEM videos.

Honors & Awards

Dean's List	*Fall 2019, Fall 2020, Sring 2021, Fall 2021, Spring 2022*
Summer Research Scholar - Duke Kunshan University	*Jun 2020, Jun 2022*
Mathematical Contest In Modeling - Honorable Mention	*Apr 2020*
Canadian Computing Competition Senior Division Top 25% (China 2nd, World 35th)	*Mar 2019*
China National Olympiad in Informatics Senior Group, Frist prize	*2016, 2017*

Skills

Programming: Proficient in Python, C++, R, MATLAB, Mathematica, LaTeX
Frame: Pytorch, TensorFlow, Keras, Gym for RL
English: GRE (V 156, Q 168), IELTS 7.0