Eric Qu

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Kunshan, Jiangsu 215300, China

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 (Data Science) (by Duke)   GPA 3.86/4   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. "Hyperbolic Neural Networks for Molecular Generation." *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

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)

Hyperbolic Neural Networks for Molecular Generation
Eric Qu, Dongmian Zou† *arXiv:2201.12825*

· We propose a novel fully hyperbolic model for molecular generation utilizing the junction tree autoencoder framework. Other contributions include novel concatenation and split operations in Lorentz space and a formulation of fully hyperbolic WGAN with novel gradient penalty.

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 (Under review)*

· 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 (Under review)*

· 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.

Accurate Cell Segmentation through Vision Transformer

Eric Qu[*], Alex Jin[*], Dongmian Zou[†]   *Nov 2021 (In progress)*

· We use a modified version of vision transformer to enable accurate cell segmentation.
· Our model use Swin transformer as backbone and a novel transformer architecture as segment head. This enables it to achieve ultrahigh accuracy in the instance segment of crowded and repeated objects.

Honors & Awards

Summer Research Scholar - Duke Kunshan University	*Jun 2020*
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