

# Eric Qu

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Kunshan, Jiangsu 215300, China

## EDUCATION

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<b>Duke Kunshan University</b>	GPA 3.86/4	Major GPA 3.95/4	<i>Sep 2019 - Present</i>
<i>Bachelor of Science in Data Science (by Duke Kunshan)</i>		Kunshan, China/Durham, USA	
<i>Bachelor of Science in Interdisciplinary Studies (by Duke)</i>			

## RESEARCH INTEREST

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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

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**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

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<b>Teaching Assistant</b> STATS 303 Statistical Machine Learning	<i>Jan 2022 - May 2022</i> <i>Duke Kunshan University</i>
<b>Research Intern</b> Victory Software, Data Analysis Department	<i>Jun 2021 - Aug 2021</i> <i>China Petrochemical Corporation</i>
<b>Research Assistant</b> Mentor: Dongmian Zou	<i>Mar 2021 - Present</i> <i>Duke Kunshan University</i>
<b>Research Assistant</b> <a href="#">Kumar Research Group</a>	<i>Apr 2020 - Nov 2021</i> <i>Columbia University</i>
<b>Research Assistant</b> Mentor: Kai Zhang	<i>Nov 2019 - Present</i> <i>Duke Kunshan University</i>

## MANUSCRIPTS & PROJECTS

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(<sup>†</sup>Corresponding author, \*Equal contribution)

### Hyperbolic Neural Networks for Molecular Generation

[Eric Qu](#), Dongmian Zou<sup>†</sup> *arXiv:2201.12825*

- We propose a novel fully hyperbolic model for molecular generation utilizing the junction tree auto-encoder 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<sup>†</sup> *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<sup>†</sup>, Dongmian Zou<sup>†</sup>

May 2021 (In submission)

- 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<sup>†</sup>

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<sup>†</sup>

Jan 2021 (In submission)

- 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<sup>†</sup>, Linda S. Schadler<sup>†</sup>

Dec 2021 (In submission)

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

## Accurate Cell Segmentation through Vision Transformer

Eric Qu<sup>\*</sup>, Alex Jin<sup>\*</sup>, Dongmian Zou<sup>†</sup>

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

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Summer Research Scholar - Duke Kunshan University	Jun 2020
Mathematical Contest In Modeling - Honorable Mention	Apr 2020
Canadian Computing Competition Senior Division Top 25% (China 2 <sup>nd</sup> , World 35 <sup>th</sup> )	Mar 2019
China National Olympiad in Informatics Senior Group, Frist prize	2016, 2017

## SKILLS

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**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