# Chun Wei Liu

✉ cl3762@columbia.edu | 🏠 https://lufteracademy.netlify.app | 🐙 Lufter

## Research Interests

Quantum Information, Quantum Simulation, Computer Simulating Physics, Applications of Machine Learning in Material Design.

## Education

**Columbia University** *New York, NY*

M.S. IN APPLIED PHYSICS *09/2021-PRESENT*

- Incoming student

**National Cheng Kung University (NCKU)** *Tainan, Taiwan*

B.S. IN CIVIL ENGINEERING *06/2020*

- Overall GPA: 3.55/4.3, Physics Core: 4.16/4.3
- Courses: Physcis (Quantum Physics I&II, Electromagnetism I&II, Solid State Physcis), Computational Science, Engineering, Material Science

## Research Experience

***Research Assistant*, Physics Dept. Matterwave Lab,** Prof. Pei Chen Kuan *Tainan, Taiwan*

MULTIPLE WAY QUANTUM WALK (MWQW) *08/2019 - PRESENT*

- Explored the potential of simulating Dirac Cellular Automata and through MWQW by revocering the Hamiltonian.
- Examined the error tolerance when implementing MWQW on AMO apparatus by analytical and numerical methods.
- Discussed charateristic of the modification of MQWQ when simulating quantum topological phases.

SENSITIVE MEASUREMENTS THROUGH MATTER WAVES.

- Research on implementing double-diffraction Bloch oscillation to cancel the phase perterbation when performing sensitive measurements.

***Research Assistant*, Civil Engineering Dept. AI Material Lab,** Prof. Yun Che Wang *Tainan, Taiwan*

MACHINE LEARNING IN MATERIAL DESIGN. [**APCOM2019**] [**CTAM44**][**MLDT2021**][**USNCCM16**] *02/2019 - 06/2020*

- Applied generative adversarial networks (GAN) to generate high fidelity microstructure images.
- Proposed regression VGG networks (rVGG) that can predict mechanical properties from material images with 95% accuracy.
- Outperformed Finite Element Methods (FEM) in predicting time over 100 times.
- Investigated a Bayesian-optimization model that can fine-tune GAN-generated microstructure geometry through the rapid-labeling rVGG.

CONSTRUCTING HOMOGENOUS MATERIALS UNSING COMPUTATIONAL METHODS.

- Implemented pruning protocol on 96-core CPUs to generate auxetic networks inspired by "Auxetic metamaterials from disordered networks".
- Implemented a stochastic protocol to produce large scale homogenous microstructure datasets by two-point correlation function.

## Publication

[1] *Chun Wei Liu*, Pei Chen Kuan, *"Symmetric Quantum Walk With Phase Transition Feature"*. (In preparation).

[2] Yun-Che Wang, *Chun Wei Liu*, Tsai-Wen Ko, *"Optimization of Chiral Metamaterials via Deep Neural Networks"*, 16th U.S. National Congress on Computational Mechanics (USNCCM16), 2021.

[3] Yun-Che Wang, *Chun Wei Liu*, Tsai-Wen Ko, *"Using Deep Neural Networks to Generate Hierarchical Metamaterials for Enhanced Mechanical Properties"*, Mechanistic Machine Learning and Digital Twins for Computational Science, Engineering and Technology (MMLDT), 2021.

[4] Yun-Che Wang, *Chun Wei Liu*, Pei-Chen Cheng, Jyun-Ping Wang, Tsai-Wen Ko *"Design of Chiral Metamaterials via Deep Neural Networks"*, 44th National Conference on Theoretical and Applied Mechanics (CTAM44), 2020.

## Honors & Awards

2020 **Chairman Special Award (entering final round)**, IBMq Qiskit Hackathon Taiwan
2018 **5th Place (out of 250 students)**, Asia Pacific Mechanics Contest for College Students
2017 **Dean's list**, GPA in top 5% of the department

## Presentation

***Design of Viscoelastic Auxetic Materials Through Machine Deep Learning* |Link** *Taipei, Taiwan*

ASIAN PACIFIC CONGRESSON COMPUTATIONAL MECHANICS (APCOM2019) *12/2019*

- Discussed the use of VGG networks as an alternative of Finite Element Methods (FEM) when labeling mechanical properties for microstructures.

## Selected Projects

**Predicting Handwriting Recognition With Parametrized Quantum Circuit |Link** *Xitou, Taiwan*

FOR IBMQ QISKIT HACKTHON TAIWAN 2020 *09/2020*

- Implemented 4qubit-Ry gate circuits in predicting MNIST dataset with the learning curve converged after ten iterations.
- Analized the potential in predicting molecular ground state energies with Quantum LSTM Meta-Learner and VQE.

## Skills

**Languages:** Python **Libraries/Tools:** MATLAB, Qiskits, Mathematica, PyTorch **Other Technologies:** GNU/Linux, Raspberry Pi, Git, LAMMPS, LaTeX