

# Chun Wei Liu

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## Research Interests

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

## Education

### Columbia University

M.S. IN APPLIED PHYSICS

- Incoming student

New York, NY

09/2021-PRESENT

### National Cheng Kung University (NCKU)

B.S. IN CIVIL ENGINEERING

- 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

Tainan, Taiwan

06/2020

## 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 through MWQW by recovering the corresponding Hamiltonian.
- Examined the error tolerance when implementing MWQW on AMO apparatus by analytical and numerical methods.
- Discussed characteristics 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 perturbation 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.
- Analyzed 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, 编程