Chou-Wei Kiang

⌂ https://billkiang.github.io/
✉ billkiang@outlook.com

Research Interests

Quantum engineering (solid-state systems for quantum sensing, computing, and communications; superconducting microwave circuits), quantum optics, and sensing technologies.

Education

National Taiwan University (NTU), Taipei, Taiwan   Sept. 2018 – June 2022

B.S. in Electrical Engineering (EE) | GPA: **4.24/4.3**, ranked **top 4% (7/196)**

– Selected courses (straight A+): Solid State Electronics, Modern Physics, Integrated Circuit Design, Electromagnetics (I/II), Optoelectronic Electromagnetics, Electrical Engineering Lab (Photonics), Fourier Transform and Fourier Optics, RF Microwave Wireless Systems, Thermodynamics

Journal Articles

[1] **Chou-Wei Kiang** and Jean-Fu Kiang, "Wavelet-based quantum sensing of geomagnetic fluctuations with multiple NV ensembles," *IEEE Transactions on Quantum Engineering*, under revision, [pdf].

[2] **Chou-Wei Kiang**, Jian-Jiun Ding, and Jean-Fu Kiang "Quantum sensing of fast time-varying magnetic field with Daubechies wavelets," *IEEE Access*, vol. 12, pp. 23181-23189, Feb. 2024, [pdf] [IEEE Xplore].

[3] **Chou-Wei Kiang** and Jean-Fu Kiang, "Imaging on underwater moving targets with multistatic synthetic aperture sonar," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 60, Nov. 2022, Art. no. 4211218, [pdf] [IEEE Xplore].

[4] **Chou-Wei Kiang** and Jean-Fu Kiang, "Imaging and motion parameter estimation of flying helicopter with duo airborne SARs in X-Band," *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 15, pp. 9623-9638, Nov. 2022, [pdf] [IEEE Xplore].

Conference Presentation (*presenter)

[5] Ze-Wei Chen, **Chou-Wei Kiang**[*], Chia-Tse Tai, Hao-Chien Wang, Min-Jui Lin, Yen Chuang, and Jiun-Yun Li, "Weak antilocalization of two-dimensional hole gases in a modulation-doped GeSn/Ge heterostructure," *2024 APS March Meeting Session B13*, Minneapolis, MN, USA, Mar. 3-8, 2024 (oral), [abstract].

[6] Yu-Jui Wu[*], **Chou-Wei Kiang**, Tsung-Ying Li, Ze-Wei Chen, Min-Jui Lin, Wei-Hsiang Kao, and Jiun-Yun Li, "Conductance anomalies in nanoscale quantum point contact devices on an undoped GeSn/Ge heterostructure," *2024 APS March Meeting Session B13*, Minneapolis, MN, USA, Mar. 3-8, 2024 (oral), [abstract].

Research Experiences

Quantum Electronics Laboratory | Research Assistant   Mar. 2023 – present

Advisor: Prof. Jiun-Yun Li   Department of EE, NTU

– Characterize 2D hole gases in undoped and modulation-doped GeSn/Ge heterostructures with Hall measurements [5]
  - investigate strain and Sn effect on Rashba **spin-orbit coupling** by analyzing weak localization/anti-localization patterns
  - extract effective mass and analyze electrical/magneto-transport properties through temperature-dependent SdH oscillations
– Characterize GeSn/Ge, Ge/GeSi **quantum point contact** devices with differential conductance measurements [6]
  - analyze $0.25(2e^2/h)$ anomalies under large nonlinear source-drain bias attributed to spin-polarized current
  - investigate intrinsic $0.5(2e^2/h)$ zero-bias plateau at zero field potentially induced by Rashba spin-orbit coupling
– Maintain and operate two dilution refrigerators and their peripheral instruments
– Set up apparatus and write Matlab codes to control lock-in amplifiers and voltage sources for remote measurements

Group of Electromagnetic Applications | Research Assistant   June 2020 – present

Advisor: Prof. Jean-Fu Kiang   Department of EE, NTU

– Simulate **quantum sensing** of sub-nT geomagnetic fluctuations using nitrogen-vacancy (NV) center ensembles [1]
  - propose short Ramsey sequences to control quantum sensors for extracting DC offset in arbitrary magnetic waveforms
  - examine the fidelity of arbitrary waveform reconstruction through numerical simulations that consider spin-bath noise
– Collaborate with **Prof. Jian-Jiun Ding (NTU)** on applying Daubechies wavelets for **quantum sensing** [2]
  - propose a Daubechies wavelet-modulated microwave control sequence to operate qubits for extracting wavelet coefficients
  - achieve smooth reconstruction of fast time-varying magnetic fields using qubit sensors through simulation experiments
– Design synthetic aperture sonar (SAS) imaging algorithm (**remote sensing & signal processing**) [3]
  - propose a multistatic SAS configuration to estimate the velocity vector of a moving submarine within an error of 3%
  - design a modified range-Doppler algorithm to acquire SAS images by integrating three different time-frequency transforms
– Design synthetic aperture radar (SAR) imaging algorithm (**remote sensing & microwave radar imaging**) [4]
  - propose a two-stage template matching method to separate backscattered signals from fuselage and fast-spinning rotors
  - propose a duo airborne SAR and phase matching transform to estimate target velocity within 0.03% of error
– Model and simulate optical radiation force exerted on nanoparticles (**optics & electromagnetics**) (Report:[pdf])
  - integrate Fourier transform for decomposing an incident Gaussian beam, Lorenz-Mie theory for computing scattered electromagnetic fields, and Maxwell stress tensor for computing the radiation force exerted on a spherical particle

Honors & Awards

NTUEE graduation ceremony representative – Top 10 in the class of 2022	2018–2022
Dalongdong Baoan Temple Scholarship (5 times) – Merit-based undergraduate scholarship	2018–2022
NTU Presidential Award – Academic Excellence Award	Fall 2018

Skills

Physical modeling & simulations: classical simulation of quantum systems; EM, optics, and microwave systems
mK cryogenic system operations: TeslatronPT + KelvinoxJT insert, ProteoxMX (Oxford Instruments)
Transport & conductance measurements: B1500A semiconductor device analyzer (DC I-V measurement),
   SR830, SR865A lock-in amplifiers, pre-amplifier, Basel low-noise/high-resolution DAC, superconducting magnet
Fabrication techniques: photolithography, reactive-ion etching (RIE)
Programming: Matlab, Python (QuTiP, Tensorflow), C/C++, Verilog
Other skills: LaTeX(Texmaker, PCTeX), Visio, Linux, Solidworks, Meshlab
Languages: English (**TOEFL: 106/120**), Mandarin Chinese

Selected Course Projects

Autofocus Methods for Synthetic Aperture Radar (SAR) Imaging   Spring 2022
Term paper for Fourier Transform and Fourier Optics, [pdf]
- investigate and derive phase gradient autofocus (PGA) and minimum entropy autofocus (MEA) algorithms
- implement PGA and MEA with Matlab on blurred point targets and blurred images acquired from experimental SAR data

Digital Integrated Circuit (IC) Design of an Image Processing Filter   Spring 2021
Term project for Integrated Circuit Design
- design IC circuit with Verilog to perform pixel-wise census transform and median filter on an input image
- implement pipeline design to improve area-time (AT) performance
- simulate an entire design flow, including register transfer level (RTL) design, synthesis, and auto-place and route (APR)

Double-Stub Impedance Matching Simulation   Spring 2020
Simulation project for Electromagnetics II, [demo]
- derive double-stub impedance matching theory with nine phasors and nine boundary conditions
- simulate voltage and current variation with time on the main transmission line and both stubs with Matlab

Leadership Experiences

Feb. 2016 – Jan. 2017	Vice-Chairman of Student Association, Taipei Municipal Chien-Kuo Senior High School