

Shengnan (Vivian) Miao

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EDUCATION

Rensselaer Polytechnic Institute, Troy, NY 2018.09 – **Expected 2022.05**

M.S. in Applied Mathematics GPA: 4.0/4.0

Courses: Machine Learning & Optimization, Computer Vision, Deep Learning, Probability Theory and Statistics, Data Mining.

M.Eng., Semiconductor Optics in department of Chemical Engineering GPA: 3.81/4.0

Research focus: Nanoscale Optics & Electronics, 2D Optoelectronic Devices, Image & Signal Processing, Semiconductor Physics
Howard P. Isermann Fellowship. Oral presentations at American Physical Society (APS) Meeting in 2020 & 2021.

Nanjing University, Jiangsu, China 2014.09 – 2018.06

B.S. in Physics, National Elite Program GPA: 4.41/5.0 (top 8%)

TECHNICAL SKILLS

Programming Language: Python (Scikit-Learn, PyTorch, TensorFlow, OpenCV, Keras), MATLAB, C/C++, R, LabVIEW

Machine Learning: Deep Learning, Optimization, Computer Vision, NLP, Predictive Modeling, Regression, Image Processing.

Optical Engineering: CCD/CMOS detectors, camera, spectrometer, lasers, microscopes, lens, waveplates, waveguides, LED, quantum dots; E-beam lithography, CVD, ALD, AFM, SEM, XRD; Raman, PL, FTIR spectroscopy; Monte Carlo, FDTD, RCWA

PROFESSIONAL EXPERIENCE

Research Assistant in Machine Learning, Rensselaer Polytechnic Institute, Troy, NY *Advisor: Prof. Yangyang Xu*

- **Accelerating Decentralized Momentum SGD in Large-batch Deep Learning for Object Detection** 2021.11 – present
 - Conducted baseline model based on PmSGD and DmSGD for object detection on Cifar-10 and ImageNet dataset using Pytorch.
 - Derived convergence analysis of SGD models in both non-convex and strongly convex scenarios for algorithm optimization.
 - Evaluated performance of DecentLAM with state-of-art models (Faster-RCNN, YOLO) on COCO dataset, achieved linear speedup as PmSGD, reduced inconsistency bias exponentially by $(1 - \beta^2)$, saved 60% communication costs per iteration.
- **Stochastic Optimization and Data Compression in Distributed Learning for Image Classification** 2021.05 – 2021.10
 - Developed deep learning model based on LeNet5 and FCNNs for image classification on Fashion-MNIST and Cifar10 datasets.
 - Applied Top-k Sparsification and Low-bit Quantization for data compression, saved memory usage by 77%.
 - Simulated the distributed/federated learning based on Error Compensated SGD, got 93.6% accuracy with 20% time reduction.

Research Assistant in Semiconductor Optics, Rensselaer Polytechnic Institute, Troy, NY *Advisor: Prof. Sufei Shi*

- **Spectroscopy and Simulation Revealed Strong Interaction of Insulating States in Moiré Superlattice** 2020.08 – 2021.04
 - Fabricated a WSe_2/WS_2 moiré Superlattice with piezo stage. Performed SHG spectroscopy to determine the crystal orientation.
 - Implemented Microwave Impedance Microscopy to study the low conductivity at correlated insulating states.
 - Performed PL spectroscopy to study the strong interaction between interlayer excitons and correlated electrons in superlattice.
 - Identified integer filling of Mott insulator and fractional fillings of Wigner crystals, with opposite valley polarization.
- **Metasurface Integrated 2D Material WSe_2 -SiN system for Photonic Crystal Cavities** 2019.10 – 2020.06
 - Fabricated SiN metasurface by LPCVD and inductive-coupled plasma etching. Coupled monolayer WSe_2 to SiN metasurface.
 - Simulated the guided mode resonances (GMR) of the WSe_2 -SiN photonic crystal cavities by RCWA, FDTD and COMSOL.
 - Performed Energy-Momentum Spectroscopy in self-built back-focal-plane imaging setup. Observed Rabi splitting of 18meV.
 - Demonstrated the existence of exciton-polariton with high Q factor~143, inspiring future applications in lasers and displays.
- **Unit Valley Polarization Quantum Bits Control in $\text{WSe}_2/\text{MoSe}_2$ Heterostructure** 2018.11 – 2019.08
 - Fabricated twisted heterostructure under microscope. Wrote electrodes by E-beam lithography. Characterized devices by AFM.
 - Identified spin-triplet and singlet interlayer excitons with PL spectroscopy by tuning electric, magnetic field and temperature.
 - Conducted helicity resolved PLE spectroscopy, discovered 100% valley polarization for future quantum computing application

COURSE PROJECTS

- **Real-time Parking Space Detection – Image Signal Processing & Computer Vision** 2021.03 – 2021.05
 - Applied multiple image processing methods with OpenCV for image augmentation, expanded train dataset size by 10 times.
 - Conducted image segmentation based on Hough Transform, Harris Corner Detector and Canny Edge Detector.
 - Performed feature detection and matching, homography estimation with MOPS descriptor, SIFT descriptor and RANSAC.
 - Built and trained CNN model based on VGG16 and MobileNet for identification using Keras, got 92.4% validation accuracy.

SELECTED PUBLICATIONS

1. Strong Interaction Between Interlayer Excitons and Correlated Electrons in WSe_2/WS_2 Moiré Superlattice
S. Miao#, T. Wang#, X. Huang#, D. Chen# et al. **Nature Communications** 12, 1-6 (2021) (# equally contribution)
2. Metasurface Integrated Monolayer Exciton Polariton
Y. Chen#, **S. Miao**#, T. Wang# et al. **Nano Letters** 20, 5292–5300 (2020).
3. Giant Valley-Zeeman Splitting from Spin-Singlet and Spin-Triplet Interlayer Excitons in $\text{WSe}_2/\text{MoSe}_2$ Heterostructure.
T. Wang#, **S. Miao**# et al. **Nano Letters** 20, 694–700 (2019).
4. Correlated insulating states at fractional fillings of the WS_2/WSe_2 moiré lattice (2021)
X. Huang#, T. Wang#, **S. Miao**# et al. **Nature Physics** 17, 715–719 (2021).