

# 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

*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

**Optical Engineering:** CCD/CMOS detectors, camera, spectrometer, lasers, microscopes, lenses, CVD, ALD, AFM, SEM, XRD.

**Machine Learning:** Deep Learning, Optimization, Computer Vision, NLP, Predictive Modeling, Regression, Hypotheses Testing

## 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.
  - Implemented DecentLAM to solve inconsistency bias caused by data heterogeneity for large-batch(>8k) deep training.
  - 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 using Pytorch.
  - Implemented 3 momentum-accelerated proximal Stochastic Gradient Descent (SGD) methods (Hybrid-SGD, SpiderBoost and PStorm) from paper for further algorithm optimization of neural networks, got accuracy of 93.6% 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  $\text{WSe}_2/\text{WS}_2$  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  $\text{WSe}_2$ -SiN system for Photonic Crystal Cavities** 2019.10 – 2020.06
  - Fabricated SiN metasurface by LPCVD and inductive-coupled plasma etching. Coupled monolayer  $\text{WSe}_2$  to SiN metasurface.
  - Simulated the guided mode resonances (GMR) of the  $\text{WSe}_2$ -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 – Computer Vision** 2021.03 – 2021.05
  - Captured 600+ parking lots images from video with OpenCV and pre-processed images based on Grayscale Transform.
  - Applied multiple image processing methods 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  $\text{WSe}_2/\text{WS}_2$  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).