

# SIHAN SHAO

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## EDUCATION

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### **Aalto University, Finland**

*Sep 2022 - Present*

M.Sc. in Electronics and Nanotechnology (major) and Machine Learning (minor), GPA: 4,65/5

**Honors:** Finland Government Scholarship

### **Changchun University of Science and Technology University, China**

*Sep 2018 - 2022*

B.Eng. in Opto-Electronics Information Science and Engineering, GPA: 3,74/5 (87/100)

**Honors:** First-Class Academic Scholarship

**Research Skills:** MATLAB, Python/Pytorch, Zemax, CST Microwave Studio, AWR Microwave Office

## RESEARCH & PROJECTS

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### **Neural Dispersive Hologram for Computational Submillimeter-wave Imaging (Master's Thesis)**

**Supervisor: Prof. Zachary Taylor and D.Sc. Aleksi Tamminen**

*Millimetre Wave and THz Techniques Lab.*

*September 2023 - Present*

- Developed a PyTorch code of the angular spectrum method-based wave propagation model for multi-wavelength parallel simulation.
- Utilized a differentiable framework for co-optimizing hardware design of hologram-based frequency-diverse sub-millimeter imaging system along with its corresponding neural networks.
- Proposed a surrogate gradient method using the Gumbel-SoftMax trick for optimizing heavily-quantized hologram to reduce the mismatch between the simulation and measurement.
- Constructed an imaging system featuring an optimized hologram element, and validating the performance of the proposed method through real measurements.

### **Design of Smartwatch Bluetooth Rim Antenna**

**Instructor: Dr. Holopainen Jari**

*Antenna Workshop Project*

*September 2023 - December 2023*

- Conceptualized and optimized a smartwatch rim antenna using CST and AWR software, focusing on integration into the lateral faces of the device.
- Manufactured the optimal rim antenna design, testing it with hand phantom and battery cover considerations. Achieved notable results with a -1.0dB realized gain and a 10m coverage area for received power.
- Preparing findings for submission to EuCAP 2024, with a focus on miniaturized smartwatch antenna design, demonstrating advancements in wearable technology antenna design.

### **Coded Aperture Design for Infrared Lens-less Imaging System (Bachelor's Thesis)**

**Supervisor: Prof. Wenjun He**

*Optoelectronic Measurement and Optical Information Transmission Lab.*

*June 2021 - June 2022*

- Developed a coded aperture model for amplitude modulation of the wave field, utilizing Fresnel propagation to simulate a point spread function.
- Implemented a convolutional neural network for deconvolution images from simulated measurements based on the LLVIP dataset, focusing on optimizing aperture patterns and network parameters.
- Compared the reconstruction quality to traditional model-based methods such as FISTA.

## Feature-Level Denoising Methodology in Synthetic Aperture Radar Ship Detection

Supervisor: Prof. Shifeng Wang

*Artificial Intelligent and Photoelectric Perception Lab.*

*April 2020 - July 2021*

- Studied the imaging mechanism of synthetic aperture radar and the formation of noise in SAR images and analyzed the impact of noise and complex background in SAR images ship detection.
- Transferred soft thresholding function for wavelet domain denoising to feature map domain in deep learning and proposed a feature-level denoising method combining soft thresholding function and attention mechanism.
- Applied soft-thresholding attention (STA) block into typical neural network and conducted experiments on SAR ship detection datasets with various algorithms such as Faster R-CNN, Cascade R-CNN.
- Various detection algorithms with STA have high prediction accuracy for SAR ship detection with around 2% average precision improvement.

## Lidar Sensor-based Objects Recognition Using Machine Learning

Supervisor: Prof. Shifeng Wang

*Artificial Intelligent and Photoelectric Perception Lab.*

*April 2019 - October 2020*

- Spearheaded the development of a Lidar sensor-based data collection system, yielding a robust classification dataset of pedestrian and vehicle samples.
- Utilized filtering and data clustering techniques, significantly enhancing point cloud data classification accuracy.
- Successfully implemented PCA and SVM classifier, achieving 93.75% classification accuracy with a 33.25% reduction in training features.

## LEADERSHIP EXPERIENCES

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### President of IEEE Photonics Student Branch of CUST

*October 2020 - October 2021*

- Joined IEEE R10 SAC Outreach Volunteer and responsible for the information exchange of Harbin Section.
- Reached a cooperation with local primary and middle school to give regular optical class as optical youth education.

## AWARDS

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- National College Mathematical Contest in Modeling competition | National Second Prize      November 2020
- Undergraduate Artificial Intelligence Innovation Competition | Province First Prize      December 2020
- National Undergraduate Optoelectronic Design Competition | Province First Prize      July 2021

## PUBLICATIONS

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- **S. Shao**, A. Tamminen, S. V. Pälli, S. Gamaethige, & Z. Taylor, Quantized THz Diffractive Optics Design via Automatic Differentiation. 2024 International Conference on Infrared, Millimeter, and Terahertz Waves.
- S.R. Gamaethige, S. V. Pälli, A. Tamminen, **S. Shao**, et al. Harnessing Frequency Diversity for Improved Holographic Imaging Systems. 2024 International Conference on Infrared, Millimeter, and Terahertz Waves.
- **S. Shao**, H. Li., & S. Wang., SAR Ship Detection from Complex Background Based on Dynamic Shrinkage Attention Mechanism, 2021 SAR in Big Data Era (BIGSARDATA), 2021, pp.1-5
- R. Wang, **S. Shao**, M. An, J. Li, S. Wang, & X. Xu. Soft Thresholding Attention Network for Adaptive Feature Denoising in SAR Ship Detection[J]. IEEE Access, 2021, 9: 29090-29105.)
- R. Wang, M. An, **S. Shao**, et al. Lidar Sensor-Based Object Recognition Using Machine Learning[J]. Journal of Russian Laser Research, 2021: 1-10.