Miao Sun

PhD candidate in
Fudan University

Date of Birth: Sep. 25, 1996

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Interests

- SPAD Imaging
- Depth Completion
- Single-Point Imaging
- Domain-Specific Accelerator
- DLA SoC

Skills

Programming:

- Verilog,Python
- MATLAB, spyglass, verdi
- C++

Tools:

- Pytorch
- Open3d
- PCL

CAD Tools:

- Synospys
- Vivado

About me

Say hello here! My name is Miao Sun. I am currently a PhD student in the School of Microelectronics at Fudan University, pursuing a five-year program. I am expected to obtain my doctoral degree in June 2023. My advisor is Prof. Patrick Yin Chiang and my research focuses on chip and system design based on SPAD (Single-Photon Avalanche Diode) and depth completion technology. I am looking for some potential postdoctoral positions, mainly focused on digital system design, digital processing and applications of near-sensor end. I am a chip guy, designing much cooler chips, and working with excellent ICers are ideal goals for me now!

Academic Biography

During her doctoral studies, Miao Sun specialized in the design and implementation of a dedicated accelerator chip for deep sensor imaging algorithms. As the first author, she completed the design of a dToF (direct time-of-flight) depth completion accelerator and successfully fabricated and verified it through the 40nm process technology of SMIC (Semiconductor Manufacturing International Corporation). The corresponding research results were published on TCAS-II. The chip is capable of completing sparse 32x32 point cloud images into 640x480 depth images, accelerating the post-processing part of algorithms by implementing a RISC-V with a vector processor. It is currently the only hardware acceleration work in the field of depth completion, providing practical solutions for the implementation and deployment of LiDAR automatic driving. This work has received unanimous recommendations from reviewers. In addition, a single-point imaging system based on dToF was proposed, which used monocular depth imaging algorithms based on RGB images to accurately recover depth images from the full histogram generated by the depth sensor. This is currently the only optical system for single-point depth sensor imaging.

Education

Postgraduate Studies

2018 – 2023 **PhD in Microelectronics and Solid State Electronics** **Fudan University, Shanghai**

Title: Research and Design of SPAD and depth completion Technology based LiDAR Chip and System.
Supervisors: Dr. Patrick Yin Chiang
Grade: CGPA: 3.42
Honor: Outstanding Graduates from Fudan University

SPAD Imaging | SoC design | DNN Accelerator | Depth Completion

Undergraduate Studies

2014 – 2018 **Bachelor in Electronic Science and Technology** **Southwest University, Chongqing**

Title: Circuit implementation of digitally programmable transconductance amplifier in analog simulation of reaction-diffusion neural model.
Supervisors: Prof. Xing He.
Grade: CGPA: 3.81
Honor: Outstanding Graduates from Chongqing

Digital Circuit | Analog Circuit | Neural Network | Transconductance Amplifier

Project Experience

2020 – 2022 **Depth-Completion Neural Network Accelerator SoC**

Working as the designer and architect of the deep completion accelerator SoC. Be responsible for evaluating the feasibility of network quantification, proposing the dedicated hardware acceleration scheme, and participating in the front-end design. Collaborating with the SPAD imaging team to combine a 32x32 SPAD array with a neural network to achieve depth completion for VGA-resolution depth images. I am also responsible for the training and quantization of the depth completion neural network and designing the hardware structure of accelerators. For non-convolutional operations, I introduce a RISC-V core with vector accelerators to process them. Finally, it has been verified through chip type out and real-time imaging can be achieved, which is currently the only acceleration work in the depth correction application track for LiDAR.

2022 – 2023 **Single-Point dToF sensor Imaging based on RGB-guided Super-Resolution neural network**

Be responsible for the proposal of ideas, the scheme design of the single point imaging system, the evaluation of accelerator network structure, and participating in front-end design work. In this work, the 256 SPADs from a 16x16 dToF sensor were combined to capture global depth information and the prediction result of the depth estimation neural network in monocular imaging was improved to output a more accurate depth image. Ultimately, the system achieved real-time imaging of 228x304 resolution. After the experimental measurements, it has achieved leading imaging results compared to the current most SOTA depth estimation algorithms and high-resolution LiDAR.

2019 – 2020 **A Power Efficient Edge-Computing SOC for Face Detector**

Mainly responsible for proposing and deploying quantization schemes, using lightweight neural network Retina face and PTQ scheme to implement int8 quantization for network entities. Write an accelerator driver to tile and configure registers for each convolutional layer. And write a C++ program for the post-processing part of face detection NMS(Non-Maximum Suppression) to perform operations in the ARM kernel.

Invited Talks

Dec. 2019 **IEEE International Symposium on Signal Processing & Information Technology** Ajman Univ., Dubai

Gave a 30 mins lecture on 'Deep Temporal Filter: An LSTM based approach to filter noise from TDC based SPAD Receiver'.

May 2023 **The IEEE International Symposium on Circuits and Systems** Online

Gave a 30 mins lecture on 'A 40nm 2TOPS/W Depth-Completion Neural Network Accelerator SoC with Efficient Depth Engine for Realtime LiDAR Systems'.

Publications

Journals

- **Miao, S.**, Cao, Y., Qian, J., Li, J., Zhou, S., Zhao, Z., ... Zhuo, S. (2023). A 40nm 2TOPS/W Depth-Completion Neural Network Accelerator SoC with Efficient Depth Engine for Realtime LiDAR Systems. IEEE Transactions on Circuits and Systems II: Express Briefs.
- **Miao, S.**, Zhuo, S., Chiang, P. Y. (2022). Multi-Scale Histogram-Based Probabilistic Deep Neural Network for Super-Resolution 3D LiDAR Imaging. Sensors, 23(1), 420.
- Zhuo, Shenglong, Tao Xia, Lei Zhao, **Miao Sun**, Yifan Wu, Lei Wang, Hengwei Yu et al. "Solid-State dToF LiDAR System Using an Eight-Channel Addressable, 20-W/Ch Transmitter, and a 128×128 SPAD Receiver With SNR-Based Pixel Binning and Resolution Upscaling." IEEE Journal of Solid-State Circuits (2022).
- Zhuo, Shenglong, Yuwei Wang, Tao Xia, Yifan Wu, Wei Zheng, **Miao Sun**, Zhihong Lin, and Patrick Yin Chang. "A 200 MHz 14 W Pulsed Optical Illuminator with Laser Driver ASIC and On-chip DLL-Based Time Interpolator for Indirect Time-of-Flight Applications." IEEE Transactions on Circuits and Systems II: Express Briefs (2022).

Conferences

- **Miao Sun**, Gurjeet Singh, and Patrick Yin Chiang. "Anti-Gan: Discriminating 3D reconstructed and real faces for robust facial Identity in Anti-spoofing Generator Adversarial Network." 2020 IEEE International Symposium on Signal Processing and Information Technology (ISSPIT). IEEE, 2020.
- **Miao Sun**, Yingjie Cao and Patrick Yin Chiang, "Energy-aware Retinaface: A Power Efficient Edge-Computing SOC for Face Detector in 40nm," 2021 IEEE 14th International Conference on ASIC (ASICON), Kunming, China, 2021, pp. 1-4, doi: 10.1109/ASICON52560.2021.9620286.