

Hyunwoo Oh

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EDUCATION

M.S. in Electronic Engineering

2023

Seoul National University of Science and Technology (SEOULTECH)

Seoul, Korea

- Thesis: Research on Optimized Processor and Floating-point Unit Architecture for Embedded Systems

Advisor: Seung Eun Lee

B.S. in Electronic Engineering

2021

Seoul National University of Science and Technology (SEOULTECH)

Seoul, Korea

RESEARCH INTERESTS

Hardware/Software Co-Design: Developing co-optimization techniques to enhance energy efficiency and performance in the context of digital VLSI.

- Parameterized Hardware: Designing configurable, scalable architectures and generators for tailoring the hardware for target specifications.
- Software Stack: Optimizing software architectures to practically adapt to various hardware configurations.

Computer Architecture: Finding the efficient processor architectures and compiler architectures to fulfill the domain-specific computing requirements.

- Heterogeneous Computing: Designing the optimized processor architecture to integrate the emerging parallel architectures (PIM, NPU, etc.) and conventional general-purpose processors.
- Compilers: Developing domain-specific compilers optimized for targeted hardware designs.

SELECTED PUBLICATIONS [\[SEE ALL ↓↓\]](#)

Conference Papers (2 of 8)

C8. **An SoC FPGA-based Integrated Real-time Image Processor for Uncooled Infrared Focal Plane Array.**

Hyun Woo Oh, Cheol-Ho Choi, Jeong Woo Cha, Hyunmin Choi, Joon Hwan Han, Jung-Ho Shin.

Euromicro Conference on Digital System Design (DSD), Durres, Albania, Sep. 2023. [Accepted] [Long Presentation]

C6. **RF2P: A Lightweight RISC Processor Optimized for Rapid Migration from IEEE-754 to Posit.**

Hyun Woo Oh, Seongmo An, Won Sik Jeong, Seung Eun Lee.

ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED), Vienna, Austria, Aug. 2023. [Accepted] [Oral Presentation]

Journal Articles (3 of 6)

J6. **The Design of Optimized RISC Processor for Edge Artificial Intelligence Based on Custom Instruction Set Extension.**

Hyun Woo Oh, Seung Eun Lee.

IEEE Access, Vol. 11, pp. 49409-49421, May 2023.

J3. **ASimOV: A Framework for Simulation and Optimization of an Embedded AI Accelerator.**

Dong Hyun Hwang, Chang Yeop Han, Hyun Woo Oh, Seung Eun Lee.

Micromachines, Vol. 12, No. 7, Jul. 2021.

J2. **The Design of a 2D Graphics Accelerator for Embedded Systems.**

Hyun Woo Oh, Ji Kwang Kim, Gwan Beom Hwang, Seung Eun Lee.

Electronics, Vol. 10, No. 4, Feb. 2021.

AWARDS AND HONORS

Academic Scholarship , SEOULTECH	2021
Future Talent Scholarship to pursue a M.S., SEOULTECH	2021 - 2022
President of the Institute of Semiconductor Engineers Award , 21st Korea Semiconductor Design Contest	2020

WORK EXPERIENCE

FPGA & Firmware Engineer, Core H/W Team, Hanwha Systems, Korea	Jan. 2023 - present
<ul style="list-style-type: none">Designed SoC FPGA-based integrated thermal image processor for infrared focal plane arrays. [DSD 2023 (C8)]<ul style="list-style-type: none">Designed several AXI4-compliant accelerators for thermal image processing on Zynq Ultrascale+ MPSoC.Developed RTOS firmware based on FreeRTOS with AMP to control the image processor.Designed the PCB schematic for the digital signal processing module, including Zynq Ultrascale+ MPSoC.Developed RTOS for Heterogeneous MPSoC (TI TDA3x SoC for ADAS) using the Vision SDK platform.<ul style="list-style-type: none">Activated the Control Area Network (CAN) driver to establish communication with automotive processors.Developed the driver for external heater manipulation using the GPIO and timer peripheral.	

RESEARCH EXPERIENCE

Research Assistant, SoC Platform Lab., SEOULTECH, Korea	Dec. 2019 - Dec. 2022
Development for Processing Software on AI Semiconductor Devices Ministry of Science and ICT, Korea	Jul. 2022 - Dec. 2022
<ul style="list-style-type: none">Designed the RISC processor with a custom instruction set extension for flexible AI acceleration for edge devices. This work includes scalable k-NN coprocessor architecture with parameterized HDL generator software and hardware driver library using assembly and C. [IEEE Access 2023 (J6)]Researched optimized hardware and software architecture for applying posit number format to previous applications based on IEEE-754. This work includes scalable arithmetic unit architecture to provide versatility in terms of specifications, compiler (GCC) optimization to minimize the additional workloads for migration, and a practical evaluation platform for swift analysis of numeric performance. [ISLPED 2023 (C6)] [ISOCC 2022 (C5)]	
Next-Generation System Semiconductor Design Engineer Development Program Ministry of Trade, Industry and Energy, Korea	Mar. 2021 - Dec. 2022
<ul style="list-style-type: none">Designed local interconnect network (LIN) peripheral IP for ARM Cortex-Mo. My work was building a synthesis and verification environment, including automation scripts for Synopsys EDA tools, a randomized testbench pattern generator, and the LIN peripheral software driver. [ICCE 2022 (C4)]	
Multi-core Hardware Accelerator for High-Performance Computing (HPC) Ministry of Science and ICT, Korea	Dec. 2019 - Mar. 2022
<ul style="list-style-type: none">Researched processor architecture to provide a platform for building an accelerator-rich environment. This work includes designing a 32-bit pipelined MIPS core, cache controller, and system bus from scratch and building a GCC-based development environment for the designed processor. [ISOCC 2020 (C1)]	
Development of Embedded Artificial Intelligence Module and System Based on Neuromorphic Ministry of Trade, Industry and Energy, Korea	Dec. 2019 - Dec. 2021
<ul style="list-style-type: none">Developed the parameterized HDL generator software for reconfigurable embedded AI module based on the k-NN algorithm. [Micromachines 2021 (J3)]Researched applications using the embedded AI module. [IJCE 2022 (J5)] [Micromachines 2021 (J4)] [ICFICE 2022 (C3)] [ICCE 2021 (C2)]	

Development of Light-weight SW-SoC Solution for Respiratory Medical Device

Dec. 2019 - Dec. 2020

Ministry of Trade, Industry and Energy, Korea

- Designed a 2D graphics accelerator architecture based on Bresenham's line algorithm. This accelerator was mounted to the processor with ARM Cortex-Mo core and AHB bus, and specially optimized for graph visualization tasks in medical devices. [Electronics 2021 (J2)]
- Developed a software stack for hardware implementation of Lempel-Ziv 77 lossless decompression accelerator, which is used for PNG images. This work includes baseline C code for prototyping hardware, pre-processing software to extract ZLIB blocks and metadata, and visualization/analysis code written in MATLAB. [Micromachines 2021 (J1)]

Participated in designing several digital VLSI chips using Synopsys EDA tools. [See list ↓↓]

TEACHING EXPERIENCE

Teaching Assistant for "Computer Architecture", SEOULTECH

Fall 2021

- Grading

Teaching Assistant for "Digital System Design", SEOULTECH

Spring 2021

- Grading, preparation of lab lecture materials

TRAINING

ISO 26262:2018 Functional Safety Engineering Course: Automotive Foundation Level (FSE-AFL), DNV

2023.01.02-01.04

Design of High-speed Memory Interface, IDEC

2022.12.09

[Synopsys] Block-level Auto P&R utilizing IC Compiler II, IDEC

2021.11.01-11.05

Cell-based Chip Design Flow for Samsung 28nm Process, IDEC

2021.10.19-10.21

Cell-based Chip Design Flow, IDEC

2021.07.05-07.09

[Infineon] Automotive Semiconductor Expert Training - Basic Course, KSIA

2021.06.30-07.02

Cell-based Chip Design Flow, IDEC

2020.08.10-08.14

TECHNICAL SKILLS

Computer Programming	General Programming	C, C++, Python, Perl, Bash
	Mathematical	MATLAB (+ GNU Octave)
	Version Control	Git, SVN
	Operating System Development	FreeRTOS, TI Vision SDK, PetaLinux
	Machine Learning Toolkit	Tensorflow*, PyTorch*
Digital Hardware Design	Document Tools	LaTeX, Obsidian (Markdown)
	Hardware Description	Verilog, SystemVerilog, Chisel
	Simulation	Verilator, ModelSim
FPGA-based Design	Xilinx FPGA Tools	Vivado, Vitis
	Intel FPGA Tools	Quartus II/Prime, Nios II EDS
Digital VLSI Design	Synopsys EDA Tools	VCS (Simulation), Verdi (Analysis), Formality (Validation) Design Compiler (Synthesis), IC Compiler I/II (Layout) StarRCXT (Parasitic Extraction), PrimeTime (STA)
	Cadence EDA Tools	Virtuoso Layout Suite* (Layout) Calibre DRC*/LVS* (Physical/Layout Verification)
	Cadence CAD Tools	OrCAD Capture* (Schematic), Allegro PCB Designer* (Artwork)
	GUI Programming Framework	Winform/WPF* (C#), JavaFX* (Java), Qt* (C++), Kivy* (Python)
	Mobile Programming	Android* (Java)
PCB Design	Analytical Language	R* (Mostly used for data visualization)
Miscellaneous	Familiar OS for development	Ubuntu, Windows 10 (with WSL), CentOS

* stands for beginner level.

Conference Papers

C8. **An SoC FPGA-based Integrated Real-time Image Processor for Uncooled Infrared Focal Plane Array.**

Hyun Woo Oh, Cheol-Ho Choi, Jeong Woo Cha, Hyunmin Choi, Joon Hwan Han, Jung-Ho Shin.

Euromicro Conference on Digital System Design (DSD), Durres, Albania, Sep. **2023**. [Accepted] [Long Presentation]

C7. **Disparity Refinement Processor Architecture utilizing Horizontal and Vertical Characteristics for Stereo Vision Systems.**

Cheol-Ho Choi, **Hyun Woo Oh**.

Euromicro Conference on Digital System Design (DSD), Durres, Albania, Sep. **2023**. [Accepted] [Long Presentation]

C6. **RF2P: A Lightweight RISC Processor Optimized for Rapid Migration from IEEE-754 to Posit.**

Hyun Woo Oh, Seongmo An, Won Sik Jeong, Seung Eun Lee.

ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED), Vienna, Austria, Aug. **2023**. [Accepted] [Oral Presentation]

C5. **Evaluation of Posit Arithmetic on Machine Learning based on Approximate Exponential Functions.**

Hyun Woo Oh, Won Sik Jeong, Seung Eun Lee.

International SoC Design Conference (ISODC), Gangneung, Korea, Oct. **2022**.

C4. **A Local Interconnect Network Controller for Resource-Constrained Automotive Devices.**

Kwonneung Cho, **Hyun Woo Oh**, Jeongeun Kim, Young Woo Jeong, Seung Eun Lee.

IEEE International Conference on Consumer Electronics (ICCE), Las Vegas, NV, USA, Jan. **2022**.

C3. **Intelligent Transportation System based on an Edge AI.**

Young Woo Jeong, **Hyun Woo Oh**, Su Yeon Jang, Seung Eun Lee.

International Conference on Future Information & Communication Engineering (ICFICE), Jeju, Korea, Jan. **2022**.

C2. **Vision-based Parking Occupation Detecting with Embedded AI Processor.**

Kwonneung Cho, **Hyun Woo Oh**, Seung Eun Lee.

IEEE International Conference on Consumer Electronics (ICCE), Las Vegas, NV, USA, Jan. **2021**.

C1. **Design of 32-bit Processor for Embedded Systems.**

Hyun Woo Oh, Kwon Neung Cho, Seung Eun Lee.

International SoC Design Conference (ISODC), Yeosu, Korea, Oct. **2021**.

Journal Articles

J6. **The Design of Optimized RISC Processor for Edge Artificial Intelligence Based on Custom Instruction Set Extension.**

Hyun Woo Oh, Seung Eun Lee.

IEEE Access, Vol. 11, pp. 49409-49421, May **2023**.

J5. **An Edge AI Device based Intelligent Transportation System.**

Youngwoo Jeong, **Hyun Woo Oh**, Soohee Kim, Seung Eun Lee.

Journal of Information and Communication Convergence Engineering, Vol. 20, No. 3, pp. 166-173, Sep. **2022**.

J4. **A Multi-Core Controller for an Embedded AI System Supporting Parallel Recognition.**

Suyeon Jang, **Hyun Woo Oh**, Young Hyun Yoon, Dong Hyun Hwang, Won Sik Jeong, Seung Eun Lee.

Micromachines, Vol. 12, No. 8, Jul. **2021**.

J3. **ASimOV: A Framework for Simulation and Optimization of an Embedded AI Accelerator.**

Dong Hyun Hwang, Chang Yeop Han, **Hyun Woo Oh**, Seung Eun Lee.

Micromachines, Vol. 12, No. 7, Jul. **2021**.

J2. **The Design of a 2D Graphics Accelerator for Embedded Systems.**

Hyun Woo Oh, Ji Kwang Kim, Gwan Beom Hwang, Seung Eun Lee.

Electronics, Vol. 10, No. 4, Feb. **2021**.

J1. **Lossless Decompression Accelerator for Embedded Processor with GUI.**

Gwan Beom Hwang, Kwon Neung Cho, Chang Yeop Han, **Hyun Woo Oh**, Young Hyun Yoon, Seung Eun Lee.

Micromachines, Vol. 12, No. 2, Jan. **2021**.

A RISC-V Processor Supporting AMBA AXI Protocol for Embedded Systems <ul style="list-style-type: none">• Designer: Won Sik Jeong, Sun Beom Kwon, Hyun Woo Oh, Jeongeun Kim• Technology: Samsung 28nm RFCMOS (1-poly 8-metal)• Role: RTL Verification	Jul. 2022
Robot-Specific Processor for Autonomous Driving <ul style="list-style-type: none">• Designer: Youngwoo Jeong, Yue Ri Jeong, Hyun Woo Oh, Kwang Hyun Go• Technology: Samsung 28nm RFCMOS (1-poly 8-metal)• Role: System Verification Assistant	Jul. 2022
In-Vehicle Network Processor based on Cortex-Mo <ul style="list-style-type: none">• Designer: Kwon Neung Cho, Jeong Eun Kim, Hyun Woo Oh• Technology: TSMC 180nm RFCMOS (1-poly 6-metal)• Role: System Verification SW Dev., RTL Verification, Pre/Post-Layout Simulation	Mar. 2022
A Programmable Embedded AI Processor with Cortex-Mo <ul style="list-style-type: none">• Designer: Kwon Neung Cho, Young Woo Jeong, Hyun Woo Oh, Chang Yeop Han• Technology: Samsung 28nm RFCMOS (1-poly 8-metal)• Role: RTL Subblock Design	Jul. 2021
32-bit Processor with Posit Arithmetic Coprocessor for Embedded Systems <ul style="list-style-type: none">• Designer: Hyun Woo Oh, Jeong Eun Kim, Do Young Choi, Kwang Hyun Go• Technology: Samsung 28nm RFCMOS (1-poly 8-metal)• Role: RTL Design & Verification, ASIC Design Front-end/Back-end, Firmware Development, PCB Design & Chip Test	Jul. 2021
Implementation of Lossless Decompression Accelerator Based on Inflate Algorithm <ul style="list-style-type: none">• Designer: Gwan Beom Hwang, Do Young Choi, Hyun Woo Oh, Chang Yeop Han• Technology: Samsung 65nm RFCMOS (1-poly 8-metal)• Role: System Verification SW Dev., PCB Design & Chip Test	Sep. 2020
Communication System with Simple and Fast Communication Error Check Code Based on CRC <ul style="list-style-type: none">• Designer: Chang Yeo Hanp, Kwon Neung Cho, Hyun Woo Oh• Technology: Magnachip Hynix 0.18um CMOS• Role: RTL Subblock Design	Jun. 2020

PROFESSIONAL SERVICES

Reviewer, IEEE Access

2023