

# Junha Ryu

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## Research Interests

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- My current research interests include **energy-efficient System-on-Chip design**, especially focused on **AI-powered AR/VR and 3D vision systems**. Over the past 4 years, I have participated in the design of 3 silicon chips related to artificial intelligence.
- **Research Topics (w/ Related Publication)**
  - ✓ **Neural Graphics Acceleration:** ISSCC'23, ASSCC'23, ISSCC'24
  - ✓ **3D Vision System:** ISSCC'22
  - ✓ **AR/VR System-on-Chip:** IEDM'21
  - ✓ **DNN Accelerator:** JSSC'21, HPCA'23

## Education

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KAIST, Daejeon, Republic of Korea	Mar. 2022 - Present
Ph.D. Candidate in School of Electrical Engineering	
Advisor: Professor Hoi-Jun Yoo (IEEE Fellow)	
KAIST, Daejeon, Republic of Korea	Mar. 2020 – Feb. 2022
M.S. in School of Electrical Engineering	
Thesis: <i>A CIS-based Action Recognition SoC with Self-Adjustable Frame Resolution for Always-on IoT Devices</i>	
Advisor: Professor Hoi-Jun Yoo (IEEE Fellow)	
KAIST, Daejeon, Republic of Korea	Mar. 2015 – Feb. 2020
B.S. in School of Electrical Engineering	

## Honors and Awards

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- **Bronze Award**, 29<sup>th</sup> Samsung Humantech Paper Award (2023.02) – 2<sup>nd</sup> Author
- **Bronze Award**, 28<sup>th</sup> Samsung Humantech Paper Award (2022.02) – 4<sup>th</sup> Author
- National Science and Engineering Undergraduate Scholarship (2017-2018)

## Publications

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(C: Conference, J: Journal, P: Preprint)

[C-14]

**A 8.81 TFLOPS/W Deep-Reinforcement-Learning Accelerator with Delta-Based Weight Sharing and Block-Mantissa Reconfigurable Pe Array**

Sanghyuk An, [Junha Ryu](#), Gwangtae Park, and Hoi-Jun Yoo

*IEEE International Symposium on Circuits and Systems (ISCAS)*, 2024

[C-13]

**NeuGPU: A 18.5 mJ/Iter Neural-Graphics Processing Unit for Instant-Modeling and Real-Time Rendering with Segmented-Hashing Architecture**

[Junha Ryu](#), Hankyul Kwon, Wonhoon Park, Zhiyong Li, Beomseok Kwon, Donghyeon Han, Dongseok Im, Sangyeob Kim, Hyungnam Joo, Hoi-Jun Yoo

*IEEE International Solid-State Circuits Conference (ISSCC)*, 2024 (Accepted)

[C-12]

**A 33.58 FPS Embedding based Real-time Neural Rendering Accelerator with Switchable Computation Skipping Architecture on Edge Device**

Jongjun Park, Donghyeon Han, [Junha Ryu](#), Dongseok Im, Gwangtae Park, and Hoi-jun Yoo

*IEEE Asian Solid-State Circuits Conference (ASSCC)*, 2023

[C-11]

**A 5.99 TFLOPS/W Heterogeneous CIM-NPU Architecture for an Energy Efficient Floating-Point DNN Acceleration**

Wonhoon Park, [Junha Ryu](#), Sangjin Kim, Soyeon Um, Wooyoung Jo, Sangyeob Kim, Hoi-Jun Yoo

*IEEE International Symposium on Circuits and Systems (ISCAS)*, 2023

[C-10]

**A 15.9 mW 96.5 fps Memory-Efficient 3D Reconstruction Processor with Dilation-based TSDF Fusion and Block-Projection Cache System**

Hankyul Kwon, Gwangtae Park, [Junha Ryu](#), Wooyoung Jo, Hoi-Jun Yoo

*IEEE International Symposium on Circuits and Systems (ISCAS)*, 2023

[C-9]

**A Low-power Neural 3D Rendering Processor with Bio-inspired Visual Perception Core and Hybrid DNN Acceleration**

Donghyeon Han, [Junha Ryu](#), Sangyeob Kim, Sangjin Kim, Jongjun Park, Hoi-Jun Yoo

*IEEE Symposium in Low-Power and High-Speed Chips (COOL CHIPS)*, 2023

[C-8]

**Sibia: Signed Bit-slice Architecture for Dense DNN Acceleration with Slice-level Sparsity Exploitation**

Dongseok Im, Gwangtae Park, Zhiyong Li, [Junha Ryu](#), Hoi-Jun Yoo

*IEEE International Symposium on High-Performance Computer Architecture (HPCA)*, 2023

[C-7]

**MetaVRain: A 133mW Real-Time Hyper-Realistic 3D-NeRF Processor with 1D-2D Hybrid-Neural Engines for Metaverse on Mobile Devices**

Donghyeon Han, [Junha Ryu](#), Sangyeob Kim, Sangjin Kim, Hoi-Jun Yoo

*IEEE International Solid-State Circuits Conference (ISSCC)*, 2023

[C-6]

**DSPU: A 281.6 mW Real-Time Deep Learning-Based Dense RGB-D Data Acquisition with Sensor Fusion and 3D Perception System-on-Chip**

Dongseok Im, Gwangtae Park, Zhiyong Li, [Junha Ryu](#), Sanghoon Kang, Donghyeon Han, Jinsu Lee, Wonhoon Park,

Hankyul Kwon, and Hoi-Jun Yoo  
*IEEE Hot Chips Symposium (HCS)*, 2022

[C-5]

**A Low-power and Real-time 3D Object Recognition Processor with Dense RGB-D Data Acquisition in Mobile Platforms**

Dongseok Im, Gwangtae Park, [Junha Ryu](#), Zhiyong Li, Sanghoon Kang, Donghyeon Han, Jinsu Lee, Hoi-Jun Yoo  
*IEEE Symposium in Low-Power and High-Speed Chips (COOL CHIPS)*, 2022

[C-4]

**DSPU: A 281.6 mW real-time depth signal processing unit for deep learning-based dense RGB-D data acquisition with depth fusion and 3D bounding box extraction in mobile platforms**

Dongseok Im, Gwangtae Park, Zhiyong Li, [Junha Ryu](#), Sanghoon Kang, Donghyeon Han, Jinsu Lee, Hoi-Jun Yoo  
*IEEE International Solid-State Circuits Conference (ISSCC)*, 2022

[C-3]

**AI SoCs for AR/VR user-interaction (Invited)**

[Junha Ryu](#), Dongseok Im, Hoi-Jun Yoo  
*IEEE International Electron Devices Meeting (IEDM)*, 2021

[C-2]

**A 0.82  $\mu$ W CIS-Based Action Recognition SoC With Self-Adjustable Frame Resolution for Always-on IoT Devices**

[Junha Ryu](#), Gwangtae Park, Dongseok Im, Ji-Hoon Kim, Hoi-Jun Yoo  
*IEEE International Symposium on Circuits and Systems (ISCAS)*, 2021

[C-1]

**GANPU: A Versatile Many-Core Processor for Training GAN on Mobile Devices with Speculative Dual-Sparsity Exploitation**

Sanghoon Kang, Donghyeon Han, Juhyoung Lee, Dongseok Im, Sangyeob Kim, Soyeon Kim, [Junha Ryu](#), and Hoi-Jun Yoo  
*IEEE Hot Chips Symposium (HCS)*, 2020

[J-7]

**A 8.81 TFLOPS/W Deep-Reinforcement-Learning Accelerator with Delta-based Weight Sharing and Block-Mantissa Reconfigurable PE Array**

Sanghyuk An, [Junha Ryu](#), Gwangtae Park, and Hoi-Jun Yoo  
*IEEE Transactions on Circuits and Systems II: Express Briefs (TCAS-II)*, 2024

[J-6]

**A Low-power AI-based 3D Rendering Processor with Hybrid DNN Computing**

Donghyeon Han, [Junha Ryu](#), Sangyeob Kim, Sangjin Kim, Jongjun Park, Hoi-Jun Yoo  
*IEEE Micro*, 2023

[J-5]

**MetaVRain: A Mobile Neural 3-D Rendering Processor With Bundle-Frame-Familiarity-Based NeRF Acceleration and Hybrid DNN Computing**

Donghyeon Han, [Junha Ryu](#), Sangyeob Kim, Sangjin Kim, Jongjun Park, Hoi-Jun Yoo  
*IEEE Journal of Solid-State Circuits (JSSC)*, 2023

[J-4]

**A Mobile 3D Object Recognition Processor with Deep Learning-based Monocular Depth Estimation**

Dongseok Im, Gwangtae Park, Zhiyong Li, [Junha Ryu](#), Sanghoon Kang, Donghyeon Han, Jinsu Lee, Wonhoon Park, Hankyul Kwon, Hoi-Jun Yoo

*IEEE Micro*, 2023

[J-3]

**DSPU: An Efficient Deep Learning-Based Dense RGB-D Data Acquisition With Sensor Fusion and 3-D Perception SoC**

Dongseok Im, Gwangtae Park, [Junha Ryu](#), Zhiyong Li, Sanghoon Kang, Donghyeon Han, Jinsu Lee, Wonhoon Park, Hankyul Kwon, Hoi-Jun Yoo

*IEEE Journal of Solid-State Circuits (JSSC)*, 2022

[J-2]

**GANPU: An energy-efficient multi-DNN training processor for GANs with speculative dual-sparsity exploitation**

Sanghoon Kang, Donghyeon Han, Juhyoung Lee, Dongseok Im, Sangyeob Kim, Soyeon Kim, [Junha Ryu](#), and Hoi-Jun Yoo

*IEEE Journal of Solid-State Circuits (JSSC)*, 2021

[J-1]

**A 0.82  $\mu$ W CIS-Based Action Recognition SoC With Self-Adjustable Frame Resolution for Always-on IoT Devices**

[Junha Ryu](#), Gwangtae Park, Dongseok Im, Ji-Hoon Kim, Hoi-Jun Yoo

*IEEE Transactions on Circuits and Systems II: Express Briefs (TCAS-II)*, 2021

[P-1]

**Extension of direct feedback alignment to convolutional and recurrent neural network for bio-plausible deep learning**

Donghyeon Han, Gwangtae Park, [Junha Ryu](#), and Hoi-Jun Yoo

*arXiv preprint*, 2020

## Invited Talks

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Google, San Diego, CA (Host: Kangmin Lee)

Feb. 2024

“NeuGPU: A 18.5 mJ/Iter Neural-Graphics Processing Unit for Instant-Modeling and Real-Time Rendering with Segmented-Hashing Architecture”

Apple Inc., Cupertino, CA (Host: Youchang Kim)

Feb. 2024

“NeuGPU: A 18.5 mJ/Iter Neural-Graphics Processing Unit for Instant-Modeling and Real-Time Rendering with Segmented-Hashing Architecture”

## Activities

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Student Representative, Semiconductor System Lab, KAIST

Jul. 2023 - Present

Research Intern, Semiconductor System Lab, KAIST

Dec. 2018 – Feb. 2020

Visiting Student, Technical University of Denmark (DTU), Lyngby, Denmark

Feb. 2018 – Aug. 2018

## Teaching Experience

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Teaching Assistant, Introduction to Electronics Design Lab (EE305), KAIST, Fall 2021

Teaching Assistant, EE Co-op Program (Samsung DRAM Design Team), KAIST, Summer 2021

**Teaching Assistant**, Electronics Design Lab <Circuit and System> (EE405), KAIST, Spring 2021

**Teaching Assistant**, Introduction to Electronics Design Lab (EE305), KAIST, Fall 2020