Eunsu **Baek**

APPLE PH.D FELLOWSHIP · FEMALE · EMBODIED AI / ADAPTIVE SENSING FOR DNNs

Building 942, Room 416, 1, Gwanak-ro, Gwanak-gu, Seoul, 08826, Republic of Korea

✉ beshu9407.snu.ac.kr | ⌂ edw2n.github.io | ◎ edw2n | ⬚ eunsubaek | 🎓 Eunsu Baek

Summary

Ph.D. student at the **Graduate School of Data Science, Seoul National University**, focusing on **Robust Computer Vision**, **Reliable AI**, and **Embodied AI**. My research pioneers **sensing-centric approaches** to robustness (*Adaptive Sensing for DNNs*)—enhancing AI systems not only through training, but by optimizing **data acquisition** and **system-level design**. I led the development of **ImageNet-ES** (202K real-world, covariate-shifted images) and **Lens**, the first adaptive sensing framework for vision models. My work has been published in **top-tier venues** (CVPR, ICLR, UbiComp, ESWA), showcased in **award-winning demos** (Mobisys), and released as **open-source contributions** (*e.g.*, OpenOOD). With experience in full-stack **AI system prototyping**, **dataset engineering**, and **wearable AI applications**, I have **mentored over 7 students** in projects across sensing, vision, and interaction. My long-term goal is to build **trustworthy, embodied AI systems** that learn to perceive and act adaptively in the real world—toward scalable, human-aligned intelligence.

Education

Seoul National University · *Seoul, Republic of Korea*

PH.D. IN DATA SCIENCE · *Mar. 2022 – Present*

- Research in adaptive sensing for DNNs, embodied AI, domain generalization, and OOD detection at AIoT Lab (Advisor: Prof. Hyung-sin Kim)

Seoul National University · *Seoul, Republic of Korea*

M.S IN COMPUTER SCIENCE AND ENGINEERING · *Mar. 2020 – Feb. 2022*

- Research in Visualization & Visual Analytics and Human-Computer Interaction at HCI Lab (Advisor: Prof. Jinwook Seo)
- Master's Thesis: *"MRViz: Visualization System for Analyzing Reliability of CNN-based Deep Learning Models"*

Sookmyung Women's University · *Seoul, Republic of Korea*

B.S. IN MATHEMATICS (DOUBLE MAJOR IN COMPUTER SCIENCE) · *Mar. 2013 – Feb. 2018*

- Capstone Project: *"URKey: A Biometric Master Key for Secure and Unified Password Management"*

Research Experience

AIoT Lab at SNU (Advisor: Hyung-sin Kim) · *Seoul, Republic of Korea*

PH. D. STUDENT · *Jul. 2022 – Present*

- **Team leader of Adaptive sensing for DNNs** — Improved robustness to covariate shifts by *optimizing sensor parameters* in a novel paradigm.
- **Lead author & developer of ImageNet-ES (Luminous & Diverse)** — Built a controllable testbed (**ES-Studio**), collected 202K/192K covariate-shifted images in environment & sensor domains; revealed limits of training-based robustness; validated camera sensing as an effective remedy.
- **Lead author & developer of Lens** — *The first sensing framework* adapting to model and scene for robust prediction under real-world noise.
- **Co-author MIRROR** — Designed system & user scenarios for a *generalizable on-device VTO*; contributed to manuscript writing and visuals.
- **Co-author of ColonOOD** — Developed CAD pipeline and co-wrote manuscript on a *polyp diagnosis system* with OOD and uncertainty modeling.
- **Co-authored proposals & served as a core researcher in national projects** — *Surveillance AI, Embodied AI, XR interaction* (NRF/IITP).
- **Mentored 7 students** in adaptive sensing, robustness benchmarking, generative models, virtual try-on (VTO) applications, and industrial vision.
- **Committee member of GSDS VLM dataset challenge** — Contributing to dataset creation and competition logistics.

HCI Lab at SNU (Advisor: Jinwook Seo) · *Seoul, Republic of Korea*

M.S. STUDENT & RESEARCH INTERN · *Oct. 2019 – Feb. 2022*

- **Lead author & developer of MRViz** — Visual analytics system for CNN reliability; user studies & adversarial case analysis for robustness insights.
- **Lead author & developer of NutriSeeON** — Vision-based assistive app with wearables enabling blind-friendly interaction for grocery shopping.
- **Involved in IITP-funded collaborative projects** — *XAI-based neuro-signal analysis (ECG)* and *FPGA-accelerated visualization*.
- **Collaborator of Tangible Illusion** — Ran user studies validating a VR system simulating gravity.

HCS Lab at SNU (Advisor: Young-ki Lee) · *Seoul, Republic of Korea*

RESEARCH INTERN · *May. 2019 - Sep. 2019*

- **Main author & developer of SilverStone** — Developed *homomorphic encryption* with layer-wise computation for offloaded DNN inference.

Representative Coursework Projects

Crowd2Crowd (C2C) — Bidirectional dataset platform for custom requests with automatic QC · *2023*
Led & built full-stack development of dataset marketplace with bidirectional match & automated quality control. [github] [slides][video] · *SNU GSDS*

NaviBl — Navigation System for Blinds *(1st Place Award)* · *2022*
Led & Built AI-driven auditory guidance system for real-time crosswalk navigation on Coral board. [slides] [video] · *Google Coral Competition*

TamrAtlas — Visual Explorer of Instagram Trends in Jeju · *2021*
Led full-stack D3/React development on 200K crawled posts; built custom UI for search & trend exploration. [github] [slides] [video1] · *SNU CSE*

NutriSeeON — Virtual eyes to shop healthy groceries · *2020*
Led & built vision-based Android app with wearable haptic-auditory feedback for blind-friendly grocery shopping. [github] [video] · *SNU CSE*

Publications

CONFERENCES & JOURNALS (textsuperscript*Co-first authors, †Corresponding authors)

[J.2] *ColonOOD: A Complete Pipeline for Optical Diagnosis of Colorectal Polyps Integrating Out-of-Distribution Detection and Uncertainty Quantification*
Sehyun Park[*], Dongheon Lee[*], Ji Young Lee, Jaeyoung Chun, Ji Young Chang, <u>Eunsu Baek</u>, Eun Hyo Jin, and Hyung-Sin Kim[†]
ESWA, Vol. 295, Jan. 2026 (IF **Top 7%** in Operations Research) [pdf]

[C.2] *Adaptive Camera Sensor for Vision Model* [Lens]
<u>Eunsu Baek</u>, Taesik Gong[†], Hyung-sin Kim[†]
International Conference on Learning Representations 2025 (ICLR'25) , Singapore [pdf] [poster], [github]

[C.1] *Unexplored Faces of Robustness and Out-of-Distribution: Covariate Shifts in Environment and Sensor Domain* [ImageNet-ES]
<u>Eunsu Baek</u>, Keondo Park, Jiyoon Kim, Hyung-sin Kim[†]
IEEE/CVF Computer Vision and Pattern Recognition Conference 2024 (CVPR'24), Seattle WA, USA [pdf] [video] [github]

[J.1] *MIRROR: Towards Generalizable On-Device Video Virtual Try-On for Mobile Shopping*
Dong-sik Kang, <u>Eunsu Baek</u>, Sungwook Son, Youngki Lee, Taesik Gong, Hyung-sin Kim[†]
PACM IMWUT, Vol. 7, No. 4, Dec 2023; presented at UbiComp 2024, Melbourne [pdf] [video1] [video2]

DEMOS

[D.1] *On-Device Video Virtual Try-On for Mobile Shopping* (People's Choice Demo Runner-up Award)
Dongha Ahn, Dong-sik Kang, <u>Eunsu Baek</u>, Hyung-sin Kim[†]
ACM International Conference on Mobile Systems, Applications, and Services 2024 (Mobisys'24) , Tokyo, Japan [pdf] [video]

ONGOING MANUSCRIPTS

[O.3] *Perception Test for Vision Models: A Unified and Generalizable OOD Detector*
<u>Eunsu Baek</u>, Jiyoon Kim, Keondo Park, Sojung Kim, Taesik Gong, Hyung-Sin Kim[†]
to be submitted to ICLR 2026

[O.2] *Simulating Environment and Sensor Domain Perturbations via Generative Image Translation*
Jiyoon Kim, <u>Eunsu Baek</u>, Hyung-Sin Kim[†]
to be submitted to WACV 2026

[O.1] *AI Should Sense Better, Not Just Scale Bigger: Adaptive Sensing as a Paradigm Shift*
<u>Eunsu Baek</u>, Keondo Park, Jeonggil Ko, Min-hwan Oh, Taesik Gong, Hyung-Sin Kim[†]
Under review at to NeurIPS 2025 [pdf]

Honors & Awards

2024	**Best Paper Award**, ImageNet-ES (CVPR 2024) — $755	*SNU BK21+*
	People's Choice Demo Runner-up, On-Device VTO Demo	*Mobisys 2024*
	Travel Grant, Conference Attendance Support — $400	*CVPR 2024*
2023–2024	**Medical AI Scholarship**, — $3,805 / semester	*SNU AIMED*
2023	**1st Place (212 teams) at Samsung AI Challenge**, Camera-Invariant Domain Adaptation — $7,611	*SAIT*
2022	**1st Place at Coral Competition**, NaviBl: Navigation for Blinds [slides], [video] — $1,522	*Google & SNU*
	GSDS Development Fund, Software Globalization Support — $7,611	*SNU GSDS*
2017	**Outstanding Award**, Debate Competition: "AI Apocalypse"	*SMWU*
2016	**Leadership Scholarship**, President, College of Natural Sciences; Emergency Council (GSC vacant) — $3,805 / semester	*SMWU*
2015–2018	**Samsung SW Scholarship**, Academic Excellence in CS — $266 (×5)	*Samsung*
	Academic Excellence, 1st in 21 major courses (GPA 4.07/4.3) — $2,891 (×3)	*SMWU*
2014	**Club Innovation Award**, Captain, Natural Science Research Society — $380	*SMWU*

Teaching Experience

COURSEWORK

Summer 2025	**Head Instructor**, 7-week Project Mentoring Program, Data Analysis Boot Camp	*HYUNDAI MOTORS*
2024–2025	**Head Lab Instructor**, On-device AI Program (4 semesters)	*SAMSUNG*
Summer 2024	**Head Lab Instructor**, Advanced Expert Course in Big Data, Fintech, and AI	*SNU KDT*
Winter 2023	**Lab Instructor**, Ambient AI Boot Camp [video]	*SNU GSDS*
Fall 2022	**Head Lab Instructor**, Ambient AI Platforms and Practice (M3239.005900) [video]	*SNU GSDS*
Fall 2021	**Lab Instructor**, Digital Computer Concept and Practice (035.001)	*SNU CSE*
Fall 2019	**Lab Instructor**, Computer Programming (M1522.000600)	*SNU CSE*

MENTORED STUDENTS

2025 – Present	**Jun-Won Park (Lead Manager, KIA)**, E2E Vehicle Inspection Pipeline (No Unlabeled Data)	
2025 – Present	**Jin-Hwan Kim (Manager, KIA)**, Out-of-Distribution Data Generation for Vehicle Inspection	
2025 – Present	**Rian Kim (Undergrad, SNU)**, Adaptive Sensing for DNNs	
2025 – Present	**Claire Shin (Undergrad, Princeton)**, Adaptive Sensing for DNNs	
2023 – Present	**Jiyoon Kim (Master, SNU)**, Real perturbation simulation	
2024	**Dong-ha Ahn (Undergrad, SNU)**, Adaptive Sensing for DNNs, Virtual Try-On	
2023	**Mingyun Seo (Undergrad, SNU)**, Adaptive Sensing for DNNs	

Talks & Presentations

KCC 2025 Top Conference Session — *Jul. 2025*
Adaptive Camera Sensor for Vision Models — *Jeju, South Korea*

ICLR 2025 Poster Presentation — *Apr. 2025*
Adaptive Camera Sensor for Vision Models — *Singapore*

ResearchTrend Connect Invited Talk — *Mar. 2025*
Vision-Language Meetup: Sensing for DNNs — *Online*

KIISE Winter Invited Poster Presentation — *Feb. 2025*
Unexplored Faces of Robustness and Out-of-Distribution: Covariate Shifts in Environment and Sensor Domains (CVPR 2024) — *Jecheon, South Korea*

Ubicomp 2024 Oral Presentation — *Sep. 2024*
MIRROR: Towards Generalizable On-Device Video Virtual Try-On for Mobile Shopping. — *Melbourne, Australia*

Trustworthy AI Workshop Invited Talk — *Sep. 2024*
MIRROR: Towards Generalizable On-Device Video Virtual Try-On for Mobile Shopping. — *Melbourne, Australia*

KCCV 2024 Invited Poster Presentation — *Aug. 2024*
Unexplored Faces of Robustness and Out-of-Distribution: Covariate Shifts in Environment and Sensor Domains (CVPR 2024) — *Busan, South Korea*

CVPR 2024 Poster Presentation — *Jun. 2024*
Unexplored Faces of Robustness and Out-of-Distribution: Covariate Shifts in Environment and Sensor Domains (CVPR 2024) — *Seattle, USA*

Mobisys 2024 Demo Presentation (Runner-up Award) — *Jun. 2024*
On-Device Video Virtual Try-On for Mobile Shopping — *Tokyo, Japan*

Academic & Open-source Contributions

2025 – Present	**Committee of GSDS Dataset Challenge for Language Models**, Organizing dataset creation and competition logistics.	
2025	**Invited Reviewer**, Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT).	
2025	**ImageNet-ES Diverse Release**, ImageNet-ES variant of non-luminous scenes under diverse environment settings (192K)	
2024	**ImageNet-ES Integration to OpenOOD Framework**, Contribute to provide standardized OOD evaluation. [openOOD]	
2024	**ImageNet-ES Release**, Sensor control & Robustness benchmark with 202K perturbed images in ES domain [gitHub]	

Skills

Programming	Python, C/C++/C#, JavaScript, Java, SQL, R, Mathematica
AI / ML	Computer Vision, Edge AI, Generative Models, Diffusion, VLMs, XAI, Representation & Transfer Learning, RL
Systems & Prototyping	Linux, Android, Jetson, Coral, Arduino, BLE, FPGA, Unity; Testbed Construction, Rapid Prototyping
Frameworks & Tools	PyTorch, TensorFlow, Flask, React, Vue, D3, OpenOOD, MongoDB, Neo4J, BigQuery
Research & Analysis	Data Visualization (D3, Vega, Matplotlib), Model Debugging, User Studies, Dataset Curation, Signal Processing
Math Foundations	Linear Algebra, Real Analysis, Cryptography, Differential Equations
Languages	Korean, English