

## RESEARCH INTERESTS

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My research focuses on developing robust robot intelligence that can perceive and navigate the dynamic world in challenging conditions, with a specific interest in self-supervised learning of 3D geometry and sensor fusion. I am interested in the following areas, but also open to other explorable/challenging domains.

- **3D Geometric Understanding In-the-Wild**
  - Self-supervised 3D Geometry (Depth, optical flow, scene flow, odometry, object pose, SLAM)
  - 3D Geometry in Adverse Conditions (rainy, snowy, dusty, over-exposed, low-lighted conditions)
  - Continual Learning for 3D Geometry
- **Scalable Representation Learning**
  - Learning from Self-supervision (Image, Video, Motion, Action)
  - Learning from Multi-modal sensor data (RGB, NIR, LWIR cameras, LiDAR, Radar)
- **Robust Visual Perception**
  - Reinforcement Learning for Adaptive Robot Vision
  - Multi-modal Sensor Fusion for Geometric/Semantic Perception

## RESEARCH EXPERIENCES

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**Korea Advanced Institute of Science and Technology** Korea  
Graduate Student Researcher, Robotics and Computer Vision Lab (Advisor: In So Kweon) 2017 - Present  
– Research topics: Self-supervised 3D Geometry, Sensor Fusion, Robot Vision, Deep Learning.

**Seoul National University of Science and Technology** Korea  
Research Intern, Embedded System Lab (Advisor: Byoung Wook Choi) 2015 - 2017  
– Research topics: Embedded Linux, Real-time Operating System, Real-time Ethernet, Robotics.

## EDUCATION

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**Korea Advanced Institute of Science and Technology** Korea  
Ph.D. in Electrical Engineering, Advisor: In So Kweon Sep.2019–Aug.2023 (Expected)  
– Thesis: “Self-supervised 3D Geometric Perception in Adverse Real-world Environments”

**Korea Advanced Institute of Science and Technology** Korea  
M.S. in Electrical Engineering, Advisor: In So Kweon, GPA: 3.81/4.30 Sep.2017–Aug.2019  
– Thesis: “Noise-Aware Camera Exposure Control for Robust Robot Vision”

**Seoul National University of Science and Technology** Korea  
B.S. in Electrical and Information Engineering, GPA: 4.20/4.50 Mar.2011–Feb.2017  
– Project: “Real-Time Ethernet Protocol based Omni Directional Mobile Robot”

## PUBLICATIONS

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- **14. Multi-spectrum Generalizable and Selectively-fusible Depth Estimation**
  - **Ukcheol Shin**, Kyunghyun Lee, In So Kweon
  - IEEE/CVF Conference on Computer Vision and Pattern Recognition (**CVPR**, under-review), 2023
  - Received **Samsung Humantech Paper Award (Honourable Mention)**

- **13. Deep Depth Estimation from Thermal Images**
  - **Ukcheol Shin**, Jinsun Park, In So Kweon
  - IEEE/CVF Conference on Computer Vision and Pattern Recognition (**CVPR**, under-review), 2023
- **12. Self-supervised Monocular Depth Estimation from Thermal Images via Adversarial Multi-spectral Adaptation**
  - **Ukcheol Shin**, Kwanyong Park, Byeong-Uk Lee, Kyunghyun Lee, In So Kweon
  - IEEE/CVF Winter Conference on Applications of Computer Vision (**WACV**) (**Oral**), 2023
  - Received **Best Student Paper Award** in WACV 2023
- **11. UDA-COPE: Unsupervised Domain Adaptation for Category-level Object Pose Estimation**
  - Taeyeop Lee, Byeong-Uk Lee, Inkyu Shin, Jaesung Choe, **Ukcheol Shin**, In So Kweon
  - IEEE/CVF Conference on Computer Vision and Pattern Recognition (**CVPR**), 2022
- **10. DRL-ISP: Multi-objective Deep Camera ISP with Deep Reinforcement Learning**
  - **Ukcheol Shin**, Kyunghyun Lee, In So Kweon
  - IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**) (**Oral**), 2022
- **9. Maximizing Self-supervision from Thermal Image for Effective Self-supervised Learning of Depth and Ego-motion**
  - **Ukcheol Shin**, Kyunghyun Lee, Byeong-Uk Lee, In So Kweon
  - IEEE Robotics and Automation Letters (**RA-L** and **IROS**) (**Oral**), 2022
- **8. MS-UDA: Multi-spectral Unsupervised Domain Adaptation for Thermal Image Semantic Segmentation**
  - Yeong-Hyeon Kim, **Ukcheol Shin**, Jinsun Park, In So Kweon
  - IEEE Robotics and Automation Letters (**RA-L**), 2021
- **7. Self-supervised Depth and Ego-motion Estimation for Monocular Thermal Video using Multi-spectral Consistency Loss**
  - **Ukcheol Shin**, Kyunghyun Lee, Seokju Lee, In So Kweon
  - IEEE Robotics and Automation Letters(**RA-L** and **ICRA**) (**Oral**), 2021
- **6. An Efficient Asynchronous Method for Integrating Evolutionary and Gradient-based Policy Search**
  - Kyunghyun Lee, Byeong-Uk Lee, **Ukcheol Shin**, In So Kweon
  - Neural Information Processing Systems (**NeurIPS**) (**Oral**), 2020
- **5. Vehicular Multi-camera Sensor System for Automated Visual Inspection of Electric Power Distribution Equipment**
  - Jinsun Park, **Ukcheol Shin**, Gyumin Shim, Kyungdon Joo, Francois Rameau, Junhyeok Kim, Dong-Geol Choi, In So Kweon
  - IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**) (**Oral**), 2019
- **4. Camera Exposure Control for Robust Robot Vision with Noise-aware Image Quality Assessment**
  - **Ukcheol Shin**, Jinsun Park, Gyumin Shim, Francois Rameau, In So Kweon
  - IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**) (**Oral**), 2019
- **3. Performance Evaluation of Real-time Mechanisms on Open Embedded Hardware Platforms**
  - **Ukcheol Shin**, Byoung Wook Choi
  - Journal of Institute of Control, Robotics, and Systems, 2017
- **2. Development and Control of an Omnidirectional Mobile Robot on an Ethercat Network**
  - Raimarius Delgado, **Ukcheol Shin**, Chang Hwi Hong, Byoung Wook Choi
  - International Journal of Applied Engineering Research (IJAER), 2016
- **1. Implementation and Performance Analysis of an Ethercat Master on the Latest Real-time Embedded Linux**
  - Raimarius Delgado, Chang Hwi Hong, **Ukcheol Shin**, Byoung Wook Choi
  - International Journal of Applied Engineering Research (IJAER), 2015

## SKILLS

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- **Programming Language:** C, C++, Python, Matlab
- **ML/CV/RO Library:** Pytorch, OpenCV, ROS
- **Embedded Linux:** Linux Programming, Device Driver, Real-time Operating System, Embedded System.
- **Deep Learning:** 3D Geometry, Self-supervised Learning, Domain Adaptation, Reinforcement Learning
- **Sensors:** RGB Camera, NIR Camera, Thermal Camera, Motor, Wheel Encoder, IMU, LiDAR

## ACADEMIC ACTIVITIES

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- Journal Reviewer 2021–Current  
*IEEE Transactions on Cybernetics, IEEE Robotics and Automation Letters (RA-L), Neural Processing Letters*
- Conference Reviewer 2021–Current  
*NeurIPS, ICML, ICLR, AAAI, CVPR, ICCV, WACV, ICRA, IROS*

## AWARDS AND HONORS

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- Honorable Mention, 29th HumanTech Paper Award, Samsung Electronics Co., Ltd (\$2000). Feb 2023
- Best Student Paper Award, IEEE/CVF Winter Conference on Applications of Computer Vision (WACV) Jan 2023

## RESEARCH PROJECTS

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- **AI System for Traffic and Hit-and-Run Accidents with Multi-Band Images** (2022 - Current)
  - Organization: Korea Advanced Institute of Science and Technology (KAIST), Miru Systems Company.
  - Objective: Develop multi-band sensor system (Visible, NIR, LWIR) and video analysis algorithms (object detection, super-resolution, video summarization, anomaly detection) for traffic and hit-and-run accidents.
- **Real-time Masking/Unmasking System for Personal Information in Public CCTV Services** (2021 - Current)
  - Organization: Korea Advanced Institute of Science and Technology (KAIST), Hanbat National University, Miru Systems Company, Hanulsoft Company, Datamaker Company, Deajeon Transportation Corporation, Telecommunications Technology Association (TTA).
  - Objective: Develop real-time personal information (human faces, license plates) masking and unmasking algorithm with deep stenography algorithm. Also, develop real-time streaming embedded devices (Jetson Nano) with the developed algorithms.
- **SWIR Camera based Navigation for UAV in Indoor Environments** (2021 - Current)
  - Organization: Korea Advanced Institute of Science and Technology (KAIST), University of Picardy Jules Verne (UPJV), University of Burgundy.
  - Objective: Aim to develop deep neural network based Structure-from-Motion or SLAM algorithms for SWIR camera.
  - Related to the publications ([7], [9], [12]).
- **Automated Visual Inspection System for Electric Power Distribution Equipment** (2017 - 2021)
  - Organization: Five Labs in Korea Advanced Institute of Science and Technology (KAIST), Korea Electric Power Corporation (KEPCO), NexChal Company.
  - Objective: Develop vehicular multi-camera sensor system (8 color cameras, 2 thermal cameras, 6 motors, 1 GPS/IMU), its control algorithm, and perception models (detection, segmentation) for automated visual inspection from a moving vehicle. Also, integrate all developed hardware and software with Robot Operating System (ROS) platform in vehicle platform.

- Related to the publications ([4], [5]).
- **Real-Time Embedded Linux and Device Driver Development for Mobile Robot** (2016 - 2017)
  - Organization: Seoul National University of Science and Technology, Korea Institute of Science and Technology.
  - Objective: Develop real-time device driver development for sensors (Motor, encoder, LRF, IMU) and I2C based control system.
  - Related to the publications ([1], [2], [3]).
- **Real-Time Ethernet Protocol Development for Low-power Embedded System** (2015 - 2016)
  - Organization: Seoul National University of Science and Technology, Korea Institute of Science and Technology.
  - Objective: Develop real-time embedded system (Xenomai) and real-time ethernet protocol (EtherCAT) for real-time distributed motor control.
  - Related to the publications ([1], [2], [3]).