Inyoung Oh

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Fusing semantic and geometric cues for reliable, metric 3D spatial perception.

Research Focus

My research makes learned and semantic 3D *metric, consistent, and structured* by fusing it with explicit geometry, recovering reliable spatial structure exactly where data-driven models are least faithful: at object boundaries, sharp discontinuities, and absolute scale.

- Scene-intrinsic geometric cues (surface normals, sharp boundaries, ground planes) as transferable structure injected into learned and semantic 3D
- Metric, consistent 3D from a single image: bridging 2D and 3D through scene geometry, where learned depth and multi-view reconstruction fall short
- Geometric representations that generalize across sensors and domains (CAD, LiDAR, indoor/outdoor scans, monocular)

Education

Ph.D., Mechanical and Robotics Engineering, Gwangju Institute of Science and Technology (GIST) **Feb 2026**

Dissertation: *Normal Vector Estimation, and Semantic Segmentation of 3D Point Clouds using Deep Learning and Geometric Analysis*

M.S., Mechatronics, GIST **Feb 2018**

Thesis: *Sphere and Cylinder Detection in Kinect Point Clouds using RANSAC and the 2D Hough Transform*

B.S., Mechatronics, Chungnam National University **Feb 2016**

Research Experience

Postdoctoral Fellow, Visual Intelligence Group, KIST | Advisor: Dr. Junghyun Cho **Feb 2026–Present**

- Reframed relocalization from a moving camera (placing it and nearby people in metric 3D from RGB alone) as a **geometric 2D–3D bridge**: on an up-to-scale map, metric placement reduces to a ray–ground intersection set by one geometric quantity, the ground-plane normal, independent of pose and reconstruction method.
- Bypassing monocular depth's principled limits, this estimator recovers metric position **7.7–100**× better than strong monocular-depth and recent VGGT-style feed-forward baselines (even given GT pose) across indoor and outdoor capture, isolating capture geometry, not any model or dataset, as the cause (manuscript in preparation [P1]).
- This puts my doctoral geometry at the crux: estimating scene-intrinsic structure (surface normals, sharp and planar discontinuities, robust to sparsity and noise) is exactly what my descriptors deliver, carried from point clouds into image-grounded 3D.

Research Assistant, Modeling and Simulation Lab, GIST | Advisor: Prof. Kwang Hee Ko **Feb 2016–Feb 2026**

Established the geometric half of this fusion: explicit scene-intrinsic cues (surface normals, sharp features), injected into learned models, that transfer across sensors, sampling density, and noise.

Sharp Feature Detection & Geometric Descriptors

- **SFD-Net** (ECCV 2026): an architecture-agnostic descriptor that detects sharp features as surface-normal discontinuities. Prepended to three independent backbones *without modification*, it raises Average F1 by +4–7 pp (the descriptor, not backbone-specific tuning, drives the gains) and transfers *zero-shot* from 10K-point synthetic CAD to real-world scans more than an order of magnitude larger (∼36×); SOTA Average F1 on ABC across all four noise conditions. [C1]
- Grounding the descriptor theoretically via directional statistics, replacing heuristic scale selection with a training-free geometric prior that stays informative precisely at discontinuities (in preparation). [P2]

Normal Vector Estimation

- A multi-scale normal estimator resolving neighborhood-scale ambiguity under non-uniform sampling via attention-based scale weighting and Chamfer-distance noise-aware supervision; SOTA on the PCPNet primitive subset (noise-free RMSE 1.821°, 6.53M parameters). [J1]

Semantic Segmentation (Outdoor & Indoor)

- Injected intensity-assisted normal cues into RandLA-Net via a Normal Local Feature Aggregation module, yielding +4.0 pp mIoU on outdoor LiDAR (SemanticKITTI, 53.9→57.9) with pronounced gains on safety-critical classes (Bicycle +21.4 pp, Motorcycle +15.2 pp, Pedestrian +4.0 pp). [J3]
- Extended refined normals and multi-scale geometric features into boundary-aware indoor segmentation on S3DIS, achieving +6.3% mIoU over the PushBoundary baseline (Ph.D. thesis).

6-DoF Pose Estimation & MR Systems

- Designed RoI-PCA color-space augmentation to decouple object appearance from background variation, im-

proving 5cm5deg accuracy by +10.77pp on LINEMOD; integrated into a real-time, markerless multi-device MR remote collaboration system (MR glasses + projector–camera), without depth sensors. [J2]

Geometric Primitive Recognition

- Proposed a parameter-free pipeline-recognition method from unorganized point clouds (curvature-driven classification + sphere-RANSAC centerline recovery), recovering topology-consistent structure from raw scans without user-specified priors for radius, orientation, or connectivity. [J4]

Publications

Published / Accepted

[C1] **Inyoung Oh**; K.H. Ko. "SFD-Net: Sharp Feature Detection Network Based on Local Geometric Features." *European Conference on Computer Vision (ECCV)*, **2026**. *(accepted)*

[J1] **Inyoung Oh**; J. Song; M. Kim; D. Yun; K.H. Ko. "Attention-Guided Multi-Scale Point Cloud Normal Estimation with Noise-Aware Training." *Int. J. Image and Graphics*, **2026**. *(accepted)*

[J2] **Inyoung Oh**; G. Jang; J. Song; M. Son; D. Kim; J. Yun; K.H. Ko. "A Mixed Reality-based Remote Collaboration Framework Using Improved Pose Estimation." *Computers in Industry*, 174, 104414, **2026**.

[J3] M. Kim; **Inyoung Oh**; D. Yun; K.H. Ko. "Improved Semantic Segmentation Network Using Normal Vector Guidance for LiDAR Point Clouds." *J. Computational Design and Engineering*, 10(6), 2332–2344, **2023**.

[J4] **Inyoung Oh**; K.H. Ko. "Automated Recognition of 3D Pipelines from Point Clouds." *The Visual Computer*, 37(6), 1385–1400, **2021**.

In Preparation

[P1] **Inyoung Oh** et al. "Metric Relocalization in Up-to-Scale Maps via Ground-Plane Geometry."

[P2] **Inyoung Oh** et al. "A Directional Statistics Approach to Geometric Sharpness Estimation in 3D Point Clouds."

Patent

K.H. Ko; **Inyoung Oh**. "Automated System for Detecting 3D Pipeline." KR 2010-2135828 B1 (Registered), **July 2020**.

Awards & Scholarships

Best Poster Award (×6), Korean Society for Computational Design and Engineering (CDE)	**2020–2025**
CDE DX Encouragement Award, Korean CDE Society	**2022**
Outstanding PhD Student RA Scholarship (×5), GIST	**2018–2025**
GIST Full Scholarship (Government-funded, Doctoral & Master's)	**2016–2026**

Presentations

Inyoung Oh; K.H. Ko. "Automatic Detection of Cylindrical Objects from Unorganized Point Cloud." *EuroVR* (poster), London, UK. **2018**

Inyoung Oh; K.H. Ko. "A RANSAC-based Method for Detection of Multiple Spheres from a Point Cloud." *Computer Graphics International* (poster), Yokohama, Japan. **2017**

Teaching & Mentorship

Mentorship, Modeling and Simulation Lab, GIST: mentored M. Kim from undergraduate intern through graduate studies; mentee published a first-author journal paper (*JCDE*, 2023). Also guided additional interns and supervised a bachelor's thesis. **2018–2026**

Teaching Assistant, Engineering Analysis, GIST: recitations, assessment design, Python/MATLAB/C++ instruction. **2017, 2020**

Professional Service

Reviewer, *Journal of Computational Design and Engineering* (JCDE)

Technical Skills

Languages & Frameworks: Python, PyTorch, C++, MATLAB, Open3D, PCL, Unity3D
Sensors & Devices: Velodyne/Ouster LiDAR, Kinect v2, Azure Kinect, MR smart glasses

References

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