

Joohyung Lee

ML Researcher, AITRICS (Seoul, South Korea)

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RESEARCH SUMMARY

- My research asks what regularities modern learning systems, including foundation and world models, should respect, and how to enforce them at scale without sacrificing utility. I develop **structure-respecting representation learning**: translating analytic priors (symmetry, acquisition physics, temporal dynamics) into scalable self-supervised objectives and layer-local regularizers for **robust generalization under shift**. PhD direction: **complement** analytic symmetries with learned spatiotemporal symmetries and semantic/physical plausibility constraints.
- **Research keywords**: self-supervised representation learning; geometric/equivariant deep learning; robustness & distribution shift; spatiotemporal representation learning; constraint-based learning for generative and world models.

EDUCATION

Texas A&M University <i>M.S. in Electrical Engineering</i>	College Station, TX, USA <i>Aug 2014</i>
The University of Texas at Dallas <i>B.S. in Electrical Engineering</i>	Richardson, TX, USA <i>Aug 2012</i>

RESEARCH & INDUSTRY EXPERIENCE

AITRICS <i>ML Researcher</i>	Seoul, South Korea <i>May 2022 – Present</i>
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- **Geometric / structure-respecting self-supervised learning**: proposed *Soft Equivariance Regularization (SER)*, a plug-in regularizer that decouples **invariance at the final embedding** from **equivariance constraints on intermediate spatial feature maps**; improved ImageNet-1k linear-eval Top-1 by +0.84 with negligible overhead (*ICLR 2026* (accepted); first author) [1].
- **Temporal regularities for multimodal clinical forecasting**: Proposed a world model-style pretraining framework for irregular, partially observed EHR trajectories (*ICLR 2023 TML4H Workshop*, Best Paper Honorable Mention, corresponding author; *ICLR 2026 TSALM Workshop*, co-first author). Devised an attention bias for set-embedding (*ICLR 2026 TSALM Workshop*, first author) and a shared time-embedding with modality attention to align asynchronous modalities (*MLHC 2023 Spotlight*; co-first author; corresponding author) [3, 6, 7, 5].
- **Acquisition-induced nuisance variation**: introduced a lightweight debiasing objective for weakly supervised learning on whole-slide images, suppressing acquisition-induced nuisance variation (*ICASSP 2024*; first author) [2].

Korea Electronics Technology Institute (KETI) <i>Senior Researcher</i>	Seongnam-si, South Korea <i>Dec 2020 – May 2022</i>
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- Developed ML pipelines for on-device face recognition and 3D point-cloud perception for autonomous-driving systems.

KAIST, Robotics & Computer Vision Lab <i>Researcher</i>	Daejeon, South Korea <i>Mar 2020 – Dec 2020</i>
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- Proposed late-fusion 3D model respecting anisotropic imaging geometry of MRI (*MICCAI 2022*, first author) [4].

National Cancer Center <i>Visiting Researcher (part-time, compensated appointment; concurrent with AITRICS)</i> <i>Researcher</i>	Gyeonggi-do, South Korea <i>Aug 2022 – Dec 2025</i> <i>Oct 2016 – Mar 2020</i>
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- Studied robustness and uncertainty of deep segmentation under limited supervision; introduced a variance-reduction strategy for rectal-cancer segmentation (*IEEE Access* 2019) [8].

Laboratory for Optical Diagnosis & Imaging, Texas A&M University <i>Student Researcher</i>	College Station, TX, USA <i>Mar 2013 – Jun 2014</i>
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- Developed ML for *in vivo* fluorescence lifetime imaging for oral-cancer detection (*Photochem. Photobiol.*; co-first) [10].

TEACHING & MENTORING

Texas A&M University, Department of Electrical Engineering <i>Grader (Signals and Systems)</i>	College Station, TX, USA <i>Jan 2014 – Apr 2014</i>
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- Created grading rubrics and evaluated coding assignments, written homework, and exams.

GEM Center, The University of Texas at Dallas <i>Math Tutor</i>	Richardson, TX, USA <i>Jan 2011 – May 2011</i>
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- Provided one-on-one tutoring in undergraduate mathematics and physics.

Selected Conference Publications

- [1] **Soft Equivariance Regularization for Invariant Self-Supervised Learning.**
Joohyung Lee, Changhun Kim, Hyunsu Kim, Kwanhyung Lee, Juho Lee.
ICLR 2026 (accepted). [pdf]
- [2] **Compact and De-Biased Negative Instance Embedding for Multi-Instance Learning on Whole-Slide Image Classification.**
Joohyung Lee, Heejeong Nam, Kwanhyung Lee, Sangchul Hahn.
ICASSP 2024. [pdf]
- [3] **Learning Missing Modal Electronic Health Records with Unified Multi-modal Data Embedding and Modality-Aware Attention.**
Kwanhyung Lee, Soojeong Lee, Sangchul Hahn, Heejung Hyun, Edward Choi, Byungeun Ahn, Joohyung Lee.
MLHC 2023. Spotlight. (Co-first author; Corresponding author). [pdf]
- [4] **Moving from 2D to 3D: Volumetric medical image classification for rectal cancer staging.**
Joohyung Lee, Jieun Oh, Inkyu Shin, You-sung Kim, Dae Kyung Sohn, Tae-sung Kim, In So Kweon.
MICCAI 2022. [pdf] [video]

Workshop

- [5] **Structure-Aware Set Transformers: Temporal and Variable-Type Attention Biases for Asynchronous Clinical Time Series.**
Joohyung Lee, Kwanhyung Lee, Changhun Kim, Eunho Yang.
ICLR 2026 Workshop on TSALM (accepted). [pdf]
- [6] **Status-Aware Self-Supervised Forecasting for Irregular Clinical Time Series.**
Kwanhyung Lee, Joohyung Lee, Jongheon Kim, Hanhsang Chul, Eunho Yang.
ICLR 2026 Workshop on TSALM (accepted; co-first author). [pdf]
- [7] **Self-Supervised Predictive Coding with Multimodal Fusion for Patient Deterioration Prediction in Fine-grained Time Resolution.**
Kwanhyung Lee, John Won, Heejung Hyun, Sangchul Hahn, Edward Choi, Joohyung Lee.
ICLR 2023 Workshop on Trustworthy ML for Healthcare. Oral presentation; **Best Paper Honorable Mention. (Corresponding author)**. [pdf]

Journal

- [8] **Reducing the Model Variance of Rectal Cancer Segmentation Network.**
Joohyung Lee, Ji Eun Oh, Min Ju Kim, Bo Yun Hur, Dae Kyung Sohn.
IEEE Access, 2019. [pdf]
- [9] **Tumor Identification in Colorectal Histology Images Using a Convolutional Neural Network.**
Hongjun Yoon, Joohyung Lee, Ji Eun Oh, Hong Rae Kim, Seonhye Lee, Hee Jin Chang, Dae Kyung Sohn.
Journal of Digital Imaging, 2018. [pdf]
- [10] **Objective Detection of Oral Carcinoma with Multispectral Fluorescence Lifetime Imaging *In Vivo*.**
Bilal H Malik, Joohyung Lee, Shuna Cheng, Rodrigo Cuenca, Joey M Jabbour, Yi-Shing Lisa Cheng, John M Wright, Beena Ahmed, Kristen C Maitland, Javier A Jo.
Photochemistry and Photobiology, 2016. (Co-first author). [pdf]

Manuscripts in Preparation

- [11] **Disentangling Distance and Angle in Relative Positional Encoding for Rotation- and Scale-Consistent Vision Transformers.**
in preparation.

HONORS & RECOGNITION

- **MLHC 2023**: Spotlight paper.
- **ICLR 2023 TML4H Workshop**: Best Paper Honorable Mention; Oral presentation.

REFERENCES

Prof. Eunho Yang (Research supervisor)

Associate Professor, Kim Jaechul Graduate School of AI, KAIST; Email: eunho@kaist.ac.kr

Prof. Juho Lee (Research collaborator)

Associate Professor, Kim Jaechul Graduate School of AI, KAIST; Email: juholee@kaist.ac.kr

Prof. Dae Kyung Sohn (Research supervisor)

Professor, Dept of Public Health & Artificial Intelligence, National Cancer Center; Email: gsgsbal@ncc.re.kr