KimJu O

AI & Signal Processing Researcher

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Research Interests

Bio-Signal	Non-contact bio-signal processing: UWB radar-based respiration/heart rate monitoring, anomaly detection.
Sensor Fusion	Multi-modal sensor fusion: Intelligent integration of thermal imaging, radar, and acoustic sensors.
Vision	Computer Vision: Camera calibration, depth estimation, thermal image processing.
Deep Learning	Signal processing-based Deep Learning: Feature extraction and classification of time-series sensor data.

Education

2020.03–2025.08 **Master of Engineering**, *Keimyung University*, Computer Engineering (AI)
Advisor: Prof. Deok-Woo Lee
Thesis: Deep Learning-Based Abnormal Respiration Signal Detection Using Ultra-Wideband Radar Sensors

Experience

2025.02–Present **Lead Researcher**, *JS SYSTEM*, R&D Division

- **APEX ML: Distributed AutoML Platform (2025.03 – Present)**
  - **[Overview & Objectives]** GPU-optimized, self-evolving AutoML platform for Prescriptive Analytics beyond simple prediction.
  - **[Vision]** Designed 3-phase automated pipeline (Explore-Optimize-Evolve) to maximize NVIDIA RTX 4090 efficiency.
  - **[Research Implementation]** Integrated 80+ SOTA tabular algorithms (TabM, TabR, GANs, etc.) via Algorithm Factory pattern.
  - **[Technical Contributions]**
    - Solely designed and implemented an End-to-End distributed ML pipeline for large-scale data.
    - Architected parallel processing via Ray, significantly improving data throughput.
    - Eliminated I/O and GPU bottlenecks using CUDA Stream and AsyncIO asynchronous pipelines.
    - Implemented real-time cluster monitoring (Prometheus/Grafana) and Failover systems.
  - **[Architectural Excellence]** Established a robust architecture reference for large-scale async processing and resource management.
  - *Tech: Ray, PyTorch, CUDA Stream, Optuna, FastAPI, Kubernetes, Docker, MLflow*
- **AI-Powered Acoustic Vision System (2025.07 – Present)**
  - **[Overview & Objectives]** Sound visualization and failure diagnosis system to replace high-cost acoustic cameras with low-cost AI software.
  - **[Signal & Vision Fusion]** Proposed **ROI Beamforming** (YOLOv8 + MiDaS) to optimize computation and visualize sound sources as heatmaps.
  - **[Technical Contributions]**
    - Implemented vision-audio fusion tracking (Kalman Filter) and beamforming (DAS, MVDR, MUSIC).
    - Designed AE-based anomaly detection and built training pipelines for DCASE challenges.
    - Established real-time inference optimization for edge devices (Jetson) via ONNX and TensorRT.
  - **[Technical Scalability]** Proprietary Reference Architecture currently advancing towards real-time enterprise-grade performance.
  - *Tech: PyTorch, Librosa, OpenCV, YOLOv8, MiDaS, ONNX Runtime, TensorRT*

2023.02–2024.03 **Researcher**, *Seongwoo Instruments*, R&D Department

- **Superconducting Seismic Wave Detection System (2023)**
  - **[Overview]** Real-time micro-seismic monitoring via international collaboration with UMD Physics Lab.
  - **[International Exchange]** Field experiments at the **University of Maryland (UMD)**, USA.
    - 1st Visit: 2023.04.05 – 2023.06.20 / 2nd Visit: 2023.09.28 – 2024.01.05
  - **[Technical Contributions]**
    - Designed digital filters for extreme sensitivity superconducting sensors (40% SNR improvement).
    - Developed SVM and Random Forest-based seismic-vs-noise classification models (92% accuracy).
    - Built high-capacity real-time data streaming pipeline and hybrid MATLAB-Python framework.
  - *Tech: Python, MATLAB, Scikit-learn, Digital Signal Processing, Noise Reduction*

2020.03–2021.12 **Commissioned Researcher**, *DGIST*, R&D Division

- **Non-overlap Multi-view Camera Calibration**
  - **[Overview]** Researched geometric integration for non-overlapping multi-view camera systems for wide-area security.
  - **[Technical Contributions]** Modeled extrinsic parameter estimation and robust edge detection for thermal cameras.
  - **[Research Value]** Secured core technology for data registration in multi-sensor networks with blind spots.
  - *Tech: Python, MATLAB, OpenCV, Computer Vision Geometry*

Academic Projects

2020–2022 **NRF Project**, *Keimyung University*

- **Deep Learning-Based Depth Camera Calibration**
  - **[Overview]** DNN-based distortion correction to overcome traditional geometric model limits for UAV/AMR recognition.
  - **[Technical Contributions]** Designed DNN architecture and built training pipelines with real-world weather/lighting datasets.
  - *Tech: Python, PyTorch, OpenCV, Deep Learning for Vision*

Publications

International Journals (SCI/SCIE)

1. **Ju O Kim**, D. Lee, "Calibrating a Three-Viewpoints Thermal Camera with Few Correspondences," *Journal of Signal Processing Systems*, vol. 96, no. 3, 2024. [Springer]
2. **Ju O Kim**, D. Lee, "Detection of Abnormal Respiration from Multiple-Input Respiratory Signals," *SENSORS*, 2020. [MDPI]

Domestic Publications (Selected)

3. J. Kim, D. Lee, "Thermal Camera Calibration using Improved Probability Maps," *KAIS*, 2021.
4. J. Kim, D. Lee, "Edge and Corner Detection for Multiple Thermal Camera Calibration," *ICROS*, 2020.
5. 6 additional domestic publications on UWB Radar signal processing and camera calibration.

Technical Skills

Signal Processing	FFT, Wavelet, Beamforming (MVDR/DAS/MUSIC), Kalman Filter, Z-Domain
Computer Vision	Calibration, Thermal Imaging, Depth Estimation, Edge/Corner Detection
Deep Learning	CNN, LSTM, Attention, Autoencoder, Time-series Classification

Infrastructure	Docker, Ray, MLflow, Kubernetes, Prometheus, Grafana, Git