



# Hah Min Lew

AI RESEARCHER · KLLEON

Personal Website: [hahminlew.github.io](https://hahminlew.github.io)

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“Bridging AI research and scalable solutions for measurable real-world impact.”

## Professional Summary

AI Researcher with 2+ years at Klleon, specializing in Generative AI for digital humans. M.S. in Electrical Engineering and Computer Science, with expertise in Machine/Deep Learning, Signal/Image Processing, and Data Analysis.

Currently leading research in audio-driven 3DMM generation, enabling lifelike avatar movements and lip-sync. Exploring multimodal-driven 3DMM generation and leveraging Gaussian Splatting for photorealistic rendering.

Projects: Audio-driven 3DMM Generation • Multimodal 3DMM Generation • Photorealistic Human Head Rendering • Virtual Human Dialogue System

## Skills

<b>Programming</b>	Python, Bash, MATLAB, C, Java
<b>Frameworks</b>	PyTorch, TensorFlow, Keras, Scikit-learn, Pytorch3D
<b>CV &amp; Audio Tools</b>	OpenCV, FFmpeg, librosa
<b>DevOps</b>	Docker, Containerd, Git
<b>Back-end Basics</b>	Node.js
<b>Front-end Basics</b>	HTML, CSS, JavaScript
<b>Languages</b>	Korean, English

## Education

### DGIST (Daegu Gyeongbuk Institute of Science and Technology)

Daegu, South Korea

M.S. IN ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Mar. 2019 - Aug. 2021

- GPA: 4.06/4.3, Advisor: Prof. Jae Youn Hwang

### DGIST (Daegu Gyeongbuk Institute of Science and Technology)

Daegu, South Korea

B.E. IN SCHOOL OF UNDERGRADUATE STUDIES

Mar. 2014 - Feb. 2019

- Best Project Award

## Experience

### Klleon AI Research

Seoul, South Korea

AI RESEARCHER

Aug. 2022 - Present

- Researching audio- and text-driven 3DMM generation for virtual avatars with natural human-like expressions and movements.
- Developed photorealistic head rendering model using Gaussian Splatting, outperforming 5 state-of-the-art models. ( $MSE \downarrow 59.96\%$ ,  $PSNR \uparrow 4.41dB$ ,  $SSIM \uparrow 3.85\%$ ,  $LPIPS \downarrow 38.16\%$ )
- Developed a Head Swap AI model with 212.7x speedup, reducing annual GPU costs by 99.53% (from \$2.2M to \$10.5K), enabling a \$97K contract.
- Built large-scale multimodal data pipelines (4.86M+ frames from in-the-wild videos).
- Integrated external APIs (NVIDIA Audio2Face, OpenAI ChatGPT, TTS) into a streaming avatar system, achieving 25-28 FPS performance.

### Multimodal Biomedical Imaging and System Lab, DGIST

Daegu, South Korea

GRADUATE RESEARCHER

Mar. 2019 - Aug. 2022

- Achievements: 6 SCIE publications, 7 international conferences, 9 projects, 4 patents, and 2 awards.
- Designed machine learning-based anomaly detection systems and generative models for biomedical imaging, focusing on multimodal, class-imbalance, and multi-task learning.
- Developed hardware-software integrated systems for application-specific use cases.
- Collaborative research with medical doctors from hospitals, including SNUH, SNUDH, and Yonsei Severance.

### LANTERN

Daegu, South Korea

CO-FOUNDER

Nov. 2016 - Jul. 2017

- Founded a data-driven personalized tutor matching service company in collaboration with Class101.
- Designed a matching database system and established tutor evaluation metrics for personalized recommendations.

## Multimodal 3DMM for Realistic Facial Expressions and Motion

Seoul, South Korea

PROJECT LEAD

Dec. 2024 - Present

- Developing a multimodal 3D Morphable Model (3DMM) framework for lifelike facial expressions and motion driven by audio-text inputs.
- Used skills: Python, PyTorch, Git.

## Real-time Expressive 3D Chat Avatar System

Seoul, South Korea

PROJECT LEAD

Apr. 2024 - Dec. 2024

- Integrated NVIDIA Audio2Face, OpenAI ChatGPT, and TTS APIs into a streaming avatar dialogue system with 25-28 FPS performance.
- Designed an emotion message queue protocol to enable natural emotional transitions and realistic facial expressions in avatars.
- Optimized Numpy-to-Tensor conversion and computations for live streaming, achieving a 13.5% speed improvement.
- Used skills: Python, PyTorch, Docker, Containerd, Git.

## High-performance Real-time Head Swapping System

Seoul, South Korea

PROJECT LEAD

Aug. 2022 - Apr. 2024

- Led the development of a state-of-the-art head swapping framework, including data preprocessing pipelines, multi-GPU training, and efficient inference mechanisms.
- Built a high-quality dataset from 15,354 videos of 3,592 identities, processing 2.6M frames.
- Achieved a 212.7x inference speedup (from 10s/frame to 47ms/frame), reducing GPU resource requirements by 99.53%.
  - Reduced annual GPU costs from \$2.2M+ (assuming 213 AWS EC2 g4dn.4xlarge instances) to approximately \$10.5K (using a single instance).
  - Enabled negligible costs for a \$97K/year client contract.
- Achieved significant performance improvements over the SOTA method:
  - Metrics: PSNR  $\uparrow$ 55.5%, LPIPS  $\downarrow$ 91.8%, L1  $\downarrow$ 88.8%, SSIM  $\uparrow$ 21.8%
  - Inference speed: 60.57 FPS ( $\uparrow$ 53.6%)
  - Computational efficiency: Parameters 8.92M ( $\downarrow$ 63.4%), MACs  $\downarrow$ 33.0%
- Used skills: Python, PyTorch, Docker, Git, JavaScript, HTML, CSS.

## Custom Dataset Creation and Text-to-Image Model Finetuning

Seoul, South Korea

PROJECT LEAD

Oct. 2023 - Nov. 2023

- Built an end-to-end pipeline for fashion product dataset creation, integrating ML-based image captioning and text-to-image model finetuning.
- Open-sourced the pipeline on GitHub and the trained models and dataset on Hugging Face.
  - Dataset: Total 26,224 downloads.
  - Models: Total 2,095 downloads. (as of December 17, 2024.)
- Used skills: Python, PyTorch, Git.
- Repositories: [GitHub], [Dataset], [Model].

## Optimized Biomedical Monitoring System with a Time-efficient Algorithm

Daegu, South Korea

PROJECT LEAD

Mar. 2019 - Mar. 2021

- Achieved an average error rate of  $\pm 1.77\%$ , outperforming commercial products with errors of  $\pm 1-5\%$ .
- Developed a cost-efficient time-series processing algorithm with a time complexity of  $O(N \log N)$ .
- Integrated hardware and software for real-time biomedical monitoring.
- Used skills: MATLAB, LabView, VHDL.

## AI-powered Smartphone Imaging for Early Dental Caries Detection

Daegu, South Korea

PROJECT LEAD

Apr. 2020 - Feb. 2022

- Developed an ML-based smartphone image analysis system achieving 0.952 recall and 0.953 precision in early dental caries detection.
- Utilized convolutional neural networks (CNNs) to optimize classification performance for multimodal imaging data.
- Used skills: Python, TensorFlow.

## ML-based Smartphone Imaging for Otitis Media Diagnosis

Daegu, South Korea

PROJECT MEMBER

Feb. 2020 - Jan. 2022

- Constructed multimodal human clinical datasets (4.98B+ pixels) and optimized image classification models for clinical validation.
- Enhanced diagnostic accuracy with a multi-layer perceptron (MLP) model achieving 80% accuracy, outperforming expert clinicians at 73%.
- Used skills: Python, TensorFlow, Scikit-learn.

## ADDITIONAL PROJECTS

### Image-to-Image Translation for High-resolution Gastrointestinal Imaging PROJECT LEAD

Feb. 2021 - Sep. 2023

### Multitask Learning-based Network for Rotator Cuff Tear Segmentation PROJECT MEMBER

Dec. 2021 - Dec. 2022

### Low-voltage CMUT-based Ultrasound Imaging for Medibots PROJECT MEMBER

Sep. 2020 - Dec. 2022

### 2021 Laboratory-specialized Start-up Leader University Project PROJECT MEMBER

Aug. 2021 - Jan. 2022

### Smart Monitoring System for Hip Implants PROJECT MEMBER

Feb. 2019 - May. 2021

### Technical Commercialization Activity Support for Bio Society Leadership PROJECT MEMBER

May. 2020 - Dec. 2020

### Multimodal Data Registration and Analysis for Tumor Detection PROJECT MEMBER

Mar. 2019 - Oct. 2020

### Ultrasonic Capsule Endoscopy PROJECT MEMBER

Jun. 2019 - Jun. 2020

## Publications

<b>GeoAvatar: Adaptive Geometrical Gaussian Splatting for 3D Head Avatar</b> S. MOON*, <b>HAH MIN LEW*</b> , S. LEE, J. KANG, AND G. PARK.	<i>First Author</i> <i>Under Review</i>
<b>Towards High-fidelity Head Blending with Chroma Keying for Industrial Applications</b> <b>HAH MIN LEW*</b> , S. YOO*, H. KANG*, AND G. PARK. <i>WACV 2025</i>	<i>First Author</i> <i>Feb. 2025</i>
<b>Deep Learning-based Synthetic High-Resolution In-Depth Imaging Using an Attachable Dual-element Endoscopic Ultrasound Probe</b> <b>HAH MIN LEW*</b> , J. S. KIM*, M. H. LEE, J. PARK, S. YOUN, H. M. KIM, J. KIM, AND J. Y. HWANG. <i>ARXIV PREPRINT</i>	<i>First Author</i> <i>Sep. 2023</i>
<b>CSS-Net: Classification and Substitution for Segmentation of Rotator Cuff Tear</b> K. LEE, <b>HAH MIN LEW</b> , M. H. LEE, M. KANG, J. KIM, AND J. Y. HWANG. <i>ACCV 2022</i>	<i>Co-Author</i> <i>Dec. 2022</i>
<b>Deep Learning-based Framework for Fast and Accurate Acoustic Hologram Generation</b> M. H. LEE, <b>HAH MIN LEW</b> , S. YOUN, T. KIM, AND J. Y. HWANG. <i>IEEE TUFFC</i> (IF: 3.267)	<i>Co-Author</i> <i>Nov. 2022</i>
<b>Multi-task and Few-shot Learning-based Fully Automatic Deep Learning Platform for Mobile Diagnosis of Skin Diseases</b> K. LEE, T. C. CAVALCANTI, S. KIM, <b>HAH MIN LEW</b> , D. H. LEE, AND J. Y. HWANG. <i>IEEE JBHI</i> (IF: 7.021)	<i>Co-Author</i> <i>Jul. 2022</i>
<b>Speckle Reduction via Deep Content-Aware Image Prior for Precise Breast Tumor Segmentation in an Ultrasound Image</b> H. LEE, M. H. LEE, S. YOUN, K. LEE, <b>HAH MIN LEW</b> , AND J. Y. HWANG. <i>IEEE TUFFC</i> (IF: 3.267)	<i>Co-Author</i> <i>Jul. 2022</i>
<b>Intelligent Smartphone-based Multimode Imaging Otoscope for the Mobile Diagnosis of Otitis Media</b> T. C. CAVALCANTI, <b>HAH MIN LEW</b> , K. LEE, S. LEE, M. K. PARK, AND J. Y. HWANG. <i>BIOMEDICAL OPTICS EXPRESS</i> (IF: 3.562)	<i>Co-Author</i> <i>Nov. 2021</i>
<b>Ultrasonic Blood Flowmeter with a Novel Xero Algorithm for a Mechanical Circulatory Support System</b> <b>HAH MIN LEW</b> , H. SHIN, M. H. LEE, S. YOUN, H. C. KIM, AND J. Y. HWANG. <i>ULTRASONICS</i> (IF: 4.062)	<i>First Author</i> <i>Aug. 2021</i>
<b>Forward-Looking Multimodal Endoscopic System Based on Optical Multispectral and High-Frequency Ultrasound Imaging Techniques for Tumor Detection</b> J. KIM, <b>HAH MIN LEW</b> , J. KIM, S. YOUN, H. A. FARUQUE, A. N. SEO, S. Y. PARK, J. H. CHANG, E. KIM, AND J. Y. HWANG. <i>IEEE TMI</i> (IF: 11.037)	<i>Co-Author</i> <i>Oct. 2020</i>

## Patents

<b>BLADDER MONITORING APPARATUS AND METHOD FOR CONTROLLING BLADDER MONITORING APPARATUS</b> J. Y. HWANG, M. H. LEE, <b>HAH MIN LEW</b> (US17-516850, KR10-0145463)	<i>Application</i> <i>Nov. 2021</i>
<b>ULTRASONIC BLOOD FLOW MEASURING APPARATUS AND METHOD THEREOF</b> J. Y. HWANG, <b>HAH MIN LEW</b> , H. C. KIM (KR10-2021-0062321)	<i>Application</i> <i>May 2021</i>
<b>MOBILE OTOSCOPE SYSTEM</b> J. Y. HWANG, T. C. CAVALCANTI, <b>HAH MIN LEW</b> (KR10-2021-0049885)	<i>Application</i> <i>Apr. 2021</i>
<b>THREE-DIMENSIONAL DIAGNOSTIC SYSTEM</b> J. Y. HWANG, J. KIM, <b>HAH MIN LEW</b> , K. LEE (PCT-KR2020-015460, KR10-2019-0141198)	<i>Application</i> <i>Nov. 2020</i>

## Awards & Scholarships

### AWARDS

2021	<b>Outstanding Poster Award</b> , 2021 Student Conference at DGIST	<i>Daegu, South Korea</i>
2021	<b>Best Paper Award</b> , 2021 Spring Conference at KOSOMBE	<i>Remote, South Korea</i>
2017	<b>Best Project Award</b> , 2016 Undergraduate Group Research Project (UGRP) Program at DGIST	<i>Daegu, South Korea</i>

### SCHOLARSHIPS

2022	<b>Full Government Scholarships</b> , Full tuition exemptions and school expenses support in M.S.	<i>Daegu, South Korea</i>
2021	<b>Full Government Scholarships</b> , Full tuition exemptions and school expenses support in M.S.	<i>Daegu, South Korea</i>
2020	<b>Full Government Scholarships</b> , Full tuition exemptions and school expenses support in M.S.	<i>Daegu, South Korea</i>
2019	<b>Full Government Scholarships</b> , Full tuition exemptions and school expenses support in M.S.	<i>Daegu, South Korea</i>
2018	<b>Full Government Scholarships</b> , Full tuition exemptions and school expenses support in B.E.	<i>Daegu, South Korea</i>
2016	<b>Full Government Scholarships</b> , Full tuition exemptions and school expenses support in B.E.	<i>Daegu, South Korea</i>
2015	<b>Full Government Scholarships</b> , Full tuition exemptions and school expenses support in B.E.	<i>Daegu, South Korea</i>
2014	<b>Full Government Scholarships</b> , Full tuition exemptions and school expenses support in B.E.	<i>Daegu, South Korea</i>