

# Hyojoon Park

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## Introduction

My research focuses on the synergistic application of **machine learning** to **computer graphics** and **computer vision**, particularly to enhance **physics-based simulations** and advance **medical image analysis**. In addition, I am passionate about developing cutting-edge AI models across diverse domains, including **3D reconstruction**, **image/video processing**, **VR/AR**, and **haptics**.

Currently, my research primarily focuses on developing solutions for deep learning-based **4D image/video compression**.

## Education

### University of Wisconsin-Madison

Wisconsin, USA

Ph.D. Candidate in Computer Sciences

Sep. 2021 - current

- **Research area:** Synergistic application of machine learning in physics-based simulation for computer graphics and medical image
- **Advisor:** Professor Eftychios Sifakis

### Seoul National University

Seoul, Korea

M.S. in Mechanical Engineering

Mar. 2017 - Feb. 2019

- **Research area:** Rendering and transparent control of high-performance haptic system
- **Thesis:** Dental Simulator with Increased Z-width of Haptic Rendering (presented in AsiaHaptics 2018)
- Selected for [Outstanding MS Thesis Presentation Award](#) [[M.S. thesis presentation](#)]
- **Advisor:** Professor Dongjun Lee

### Korea University

Seoul, Korea

B.S. in Mechanical Engineering

Mar. 2010 - Feb. 2017

- Military service: Jun. 2011 - Mar. 2013

### Technical University of Munich (TUM)

Munich, Germany

B.S. Exchange Student in Mechanical Engineering

Spring 2014

## Publications

### • Near-realtime Facial Animation by Deep 3D Simulation Super-Resolution

**Hyojoon Park**, Sangeetha Grama Srinivasan, Matthew Cong, Doyub Kim, Byungsoo Kim, Jonathan Swartz, Ken Museth, Eftychios Sifakis  
ACM Transactions on Graphics, 2024 (Presented at SIGGRAPH ASIA 2024) [[paper](#)] [[github](#)]

- 3D simulation super-resolution achieving high-resolution facial animation 115x faster (at 18 FPS) than traditional method while maintaining similar quality.
- Novel deep learning architecture (including point-cloud upsampling with arbitrary and non-integer upsampling ratios) to enhance low-resolution simulations and generalize to unseen expressions.

### • Collagen Fiber Centerline Tracking in Fibrotic Tissue via Deep Neural Networks with Variational Autoencoder-based Synthetic Training Data Generation

**Hyojoon Park\***, Bin Li\*, Yuming Liu, Michael S. Nelson, Helen M. Wilson, Eftychios Sifakis, and Kevin W. Eliceiri (\*equal contributions)

Medical Image Analysis, 2023 [[paper](#)][[github](#)]

- Introduces a novel property-controllable variational autoencoder, DuoVAE, designed to generate synthetic data with desired properties.
- Facilitates the creation of diverse synthetic datasets, addressing the challenge of limited annotated data for training deep learning models.

### • Capturing Detailed Deformations of Moving Human Bodies

He Chen, **Hyojoon Park**, Kutay Macit, and Ladislav Kavan

SIGGRAPH, 2021 [[paper](#)][[multi-camera calibration codes](#)]

- Introduces a novel markerless motion capture system in a multi-camera setup using a specially designed low-cost suit, enabling the accurate capture of detailed 3D deformations in moving human bodies.
- Uses deep neural networks and geometric algorithms for accurate corner detection, labeling, and 3D reconstruction.
- I developed and deployed the multi-camera calibration framework enhanced by machine learning-based anomaly corner detection.

### • Adaptive Precision-Enhancing Hand Rendering for Wearable Fingertip Tracking Devices

**Hyojoon Park** and Jung-Min Park

IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2020 [[paper](#)][[video](#)]

- Introduces 3D hand rendering framework in VR for wearable fingertip tracking devices, focusing on reconstructing realistic hand poses using only fingertip positions.
- Key contributions include motion retargeting and new hinge constraints for real-time inverse kinematics to enhance visual plausibility and precision.

- **Dental Simulator with Increased Z-width of Haptic Rendering**

*Hyojoon Park, Myungsin Kim, and Dongjun Lee*

AsiaHaptics, 2018 [[paper](#)][[video](#)]

- Introduces a VR dental simulator with haptic feedback capable of rendering very stiff virtual teeth using low-cost haptic devices.
- Employs a passive midpoint integrator (PMI) and virtual coupling with passive decomposition to significantly increase the maximum achievable stiffness (Z-width).

- **Rigid-body Collaborative Manipulation among Remote Users with Wearable Cutaneous Haptic Interfaces**

*Myungsin Kim, WonHa Lee, Hyojoon Park, Junghan Kwon, Yong-Lae Park, and Dongjun Lee*

AsiaHaptics, 2018 [[paper](#)][[video](#)]

- Introduces a remote multiuser collaboration system via wearable cutaneous haptic interfaces, leveraging passivity-based simulations for stable and realistic interactions.

- **Stretchable Skin-Like Cooling/Heating Device for Reconstruction of Artificial Thermal Sensation in Virtual Reality**

*Jinwoo Lee, Heayoun Sul, Wonha Lee, Kyung Rok Pyun, Inho Ha, Dongkwan Kim, Hyojoon Park, Hyeonjin Eom, Yeosang Yoon, Jinwook Jung, Dongjun Lee, and Seung Hwan Ko*

Advanced Functional Materials, 2020 [[paper](#)]

- Introduces a stretchable, bi-functional skin-like thermo-haptic (STH) device for VR, capable of precise cold and hot sensations with a single structure and 230% stretchability.

- **Wearable Cutaneous Haptic Interface with Soft Sensors and IMUs**

*Yongjun Lee, Myungsin Kim, Yongseok Lee, Hyojoon Park, and Dongjun Lee*

Korea Robotics Society Annual Conference, 2018

- **Design and Performance Evaluation of Wearable Haptic Interfaces**

*WonHa Lee, Myungsin Kim, Hyojoon Park, and Dongjun Lee*

International Conference on Control, Automation and Systems, 2018

## Work Experience

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### NVIDIA

Graduate Research Intern

*Santa Clara, CA, USA*

*May 2024 - Aug. 2024*

### University of Utah

Graduate Research Assistant

*Salt Lake City, UT, USA*

*Sep. 2019 - May 2021*

- Developed a multi-camera calibration framework augmented with machine learning-based anomaly detection for checkerboard corner detections, contributing to a publication at SIGGRAPH 2021. [[github](#)] [[paper](#)]

### Korea Institute of Science and Technology (KIST)

Intern Researcher

*Seoul, Korea*

*Mar. 2019 - Aug. 2019*

- Developed a VR hand rendering framework for wearable fingertip tracking devices, designed to effectively enhance grasping accuracy (published in IROS 2020). [[paper](#)] [[video](#)]

### Republic of Korea Army (ROKA)

Military Service

*Seoul, Korea*

*Jun. 2011 - Mar. 2013*

- Served 21 months as a military English interpreter.

### Korea Advanced Institute of Science and Technology (KAIST)

Instructor for KAIST New Education

*Seoul, Korea*

*Sep. 2014 - Feb. 2015*

- Taught "Arduino-based Exploration Robot" and "Developing Android Service App" classes to middle and high school students.

## Teaching Assistant

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Computer Graphics (CS559) *University of Wisconsin-Madison*

*Spring 2022*

Computer Graphics (CS559) *University of Wisconsin-Madison*

*Fall 2021*

Interactive Computer Graphics (CS6610) *University of Utah*

*Spring 2021*

Computer Graphics (CS4600) *University of Utah*

*Fall 2020*

System Analysis in Mechanical Engineering *Seoul National University*

*Spring 2018*

## Achievements

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### AWARD

[Outstanding MS Thesis Presentation Award](#)

*Seoul National University*

Topic: Dental Simulator with Increased Z-width of Haptic Rendering; access the [[video](#)] and [[slides](#)]

*Dec. 2018*

Award of Excellence

*Korea University*

English-Mediated Course Tutor: Writing

*Fall 2013*

## SCHOLARSHIP

Merit-based Scholarship *Seoul National University*

*Spring 2018*

National Scholarship *Korea University*

*Fall 2016*

Future Scholarship *Korea University*

*Spring 2016*

## Other Experience

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Guest Presenter at [NAVER LABS Seminar](#)

*Seongnam, Korea*

Topic: Dental Simulator with Increased Z-width of Haptic Rendering

*Dec. 2018*

### Independent Mobile Application Development

Loop Timer MacOS [\[project page\]](#)

*2021 - current*

- Repeatable timer app that resides in the menu bar, floats above other windows, provides notifications, supports infinite repetitions, and offers customization options for size, color, and multiple timer items.
- Created this app after experiencing deteriorating eyesight from prolonged monitor use, aiming to encourage regular eye rests.
- Developed using *Swift*.

Quick Clipboard MacOS [\[project page\]](#)

*2021 - current*

- Tool to add frequently used texts to the clipboard, enabling quick copy-paste functionality via keyboard shortcuts.
- Created this app to streamline workflows after frequently typing lengthy and repetitive command-line codes.
- Developed using *Swift*.

Korean Subway iOS, Android [\[facebook\]](#) [\[instagram\]](#)

*2017 - discontinued*

- First Korean subway app, covering all five cities, featuring satellite-based maps with real-time arrival and departure information.
- Created this app to better understand distances and geographical locations while traveling on subways that operate underground.
- Developed using *KDijkstra's shortest path algorithm, Kd-Tree data structure, Swift, Java, PHP-cURL, SQLite, AWS, Photoshop, Illustrator*.

KUSchedule iOS, Android [\[archive page\]](#)

*2015 - discontinued*

- Server-based lecture timetable app that auto-generates schedules from a single login, designed for Korea University students.
- Created this app to simplify obtaining lecture schedules with consistent visualization and easy generation, eliminating the need to manually input all lecture information.
- Developed using *AES-256 encryption, Objective-C, Java, PHP-cURL, DOM parser/regex, Photoshop, Illustrator*.

Space Shoot RPG iOS, Android [\[facebook\]](#) [\[archive page\]](#)

*2016 - discontinued*

- Arcade-RPG game where players choose between warrior and magician-type jets, leveling up and unlocking new skills to defend against intruding enemies.
- Created this app to practice and refine object-oriented programming skills.
- Developed using *C/C++, Cocos2d-x, SQLite, Photoshop, Illustrator*.

Falling Moon iOS, Android [\[archive page\]](#)

*2016 - discontinued*

- Physics-based arcade game where players tap to shoot Earths at falling Moons.
- Plays an additive ping-pong sound, triggered whenever an Earth hits a Moon, making the gameplay more enjoyable.
- Developed using *C/C++, Cocos2d-x's physics engine, Photoshop, Illustrator*.

Group Alarm iOS, Android [\[archive page\]](#)

*2015 - discontinued*

- Socket-based multi-user alarm app enabling real-time chat and synchronized global alarms, allowing users to support each other in waking up successfully.
- Created this app to gain hands-on experience in implementing a chatting framework using UDP and to develop my first web app compatible with multiple mobile platforms, including iOS and Android.
- Developed using *Node.js, UDP, Javascript, jQuery, Ajax, HTML, CSS, MySQL, Cordova, AWS, Photoshop, Illustrator*.