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 facial animations** and **medical image analysis**. In addition, I am passionate about developing cutting-edge frameworks across diverse domains, including **3D reconstruction** of the human face, body, and hands; **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 that renders highly stiff haptic feedback, achieving up to 10x greater maximum stiffness (Z-width) from virtual teeth using commercially available haptic devices.

- **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

NVIDIA   *Santa Clara, CA, USA*
Graduate Research Intern   *May 2024 - Aug. 2024*

University of Utah   *Salt Lake City, UT, USA*
Graduate Research Assistant   *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)   *Seoul, Korea*
Intern Researcher   *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)   *Seoul, Korea*
Military Service   *Jun. 2011 - Mar. 2013*
- Served 21 months as a military English interpreter.

Korea Advanced Institute of Science and Technology (KAIST) *Seoul, Korea*
Instructor for KAIST New Education   *Sep. 2014 - Feb. 2015*
- Taught "Arduino-based Exploration Robot" and "Developing Android Service App" classes to middle and high school students.

Teaching Assistant

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

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

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*.