Hyojoon Park

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Introduction

My research focuses on the synergistic application of machine learning to enhance physics-based animations and advance medical imaging analysis. I am passionate about developing cutting-edge AI models across diverse domains, including computer graphics, physics-based simulations, computer vision, VR/AR, and healthcare.

Currently, my research primarily focuses on developing solutions for deep learning-based 3D 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]
  - Achieves high-resolution facial animation 115x faster (18.46 FPS) than traditional method (0.16 FPS) 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 collagen fiber centerline masks with controllable properties, including orientation, alignment, density, waviness, and length variations.
  - 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 motion capture system using a multi-camera calibration method and a specially designed low-cost suit, enabling the accurate capture of detailed 3D deformations in moving human bodies.
  - I developed and deployed the multi-camera calibration framework enhanced by machine learning-based anomaly corner detection.
  - Uses deep neural networks and geometric algorithms for accurate corner detection, labeling, and 3D reconstruction.

- **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.

- **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.
- **Dental Simulator with Increased Z-width of Haptic Rendering**
  Hyojoon Park*, Myungsin Kim, and Dongjun Lee*
  AsiaHaptics, 2018 [paper][video]
  - Introduces a dental simulator with haptic feedback capable of rendering stiff virtual teeth using commercially available 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.
- **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*.