

Research Overview

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Korea Haptics Community Workshop

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Haptics and Virtual Reality Laboratory
POSTECH

POSTECH Haptics and VR Lab

History

- Prof. Chan-Mo Park: Founded the VR Lab.
- Prof. Gerard Jounghyun Kim: Led the lab in 1995-2006.
- Prof. Seungmoon Choi: Joined the lab in 2005, and renamed it to the HVR Lab in 2007.

Current Members

- 9 Doctoral students

<http://hvr.postech.ac.kr>

Research Areas

Haptics

Human Haptics

Computer Haptics

Machine Haptics

Applications

Virtual Reality

HCI

Robotics

Haptizing Surface Topography with Varying Stiffness Based on Force Constancy

- **Overview**

- Haptic rendering of collocated, continuously varying surface topography and stiffness.
- Based on the theory of force constancy [ACM TAP 2008].

- **Team**

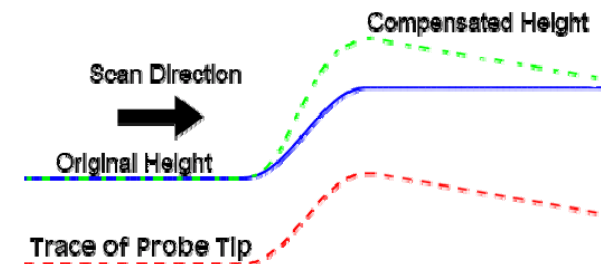
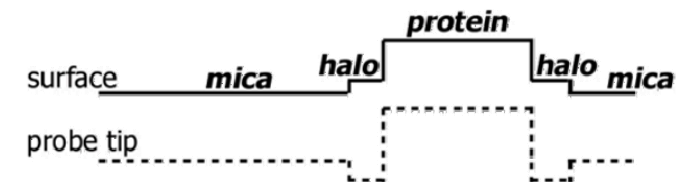
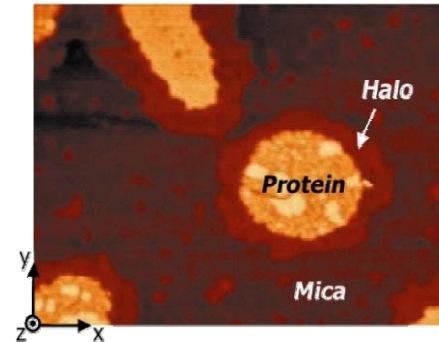
- Jaeyoung Cheon, Inwuk Hwang, Gabjong Han, and Seungmoon Choi

- **Progress**

- Feasibility of applying the force constancy theory to haptic rendering of surface topography with varying stiffness [ICAT 2006]
- Role of surface normal rendering on the perception of surface topography [WHC 2007]
- Surface topography compensation algorithm with adequate error cancellation [HS 2008]

- **Future Work**

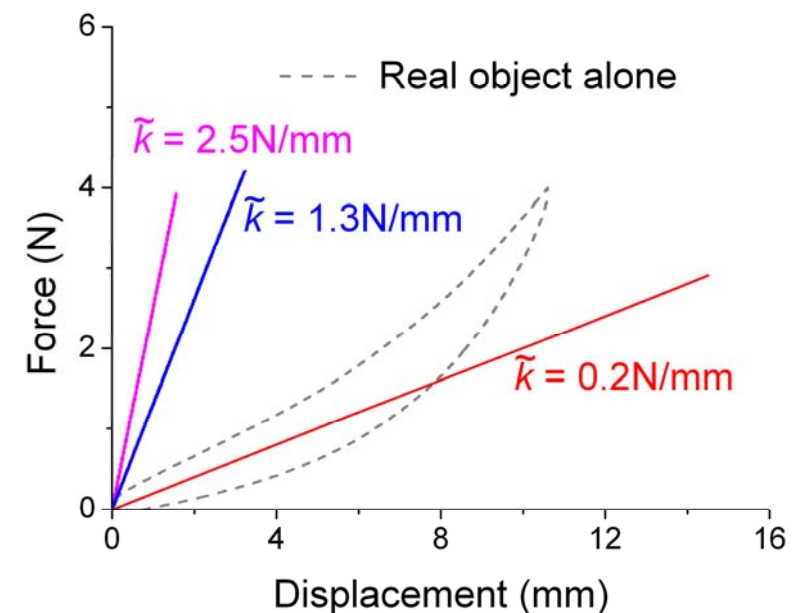
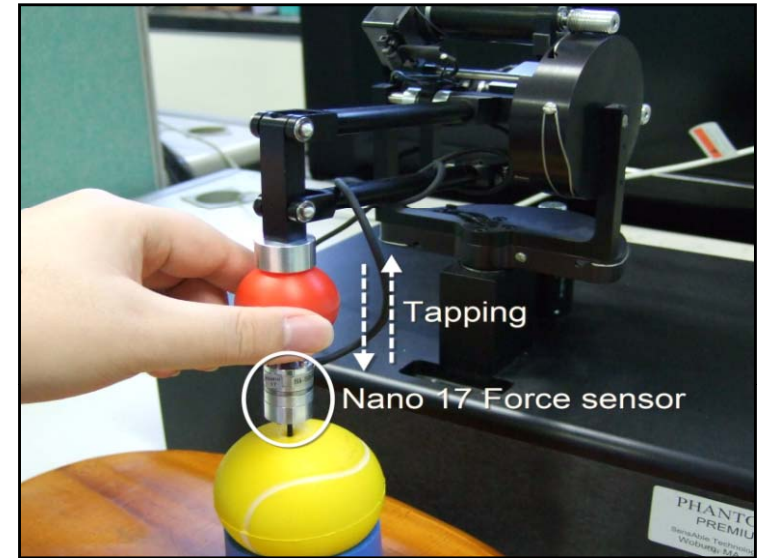
- Adaptation to 3D mesh



TCA with Height Restoration

Haptic Augmented Reality

- **Overview**
 - Modulating the haptic properties of a real object with the addition of virtual haptic feedback for haptic AR
 - e.g. soft sponge \rightarrow stiffer rubber
- **Team**
 - Seokhee Jeon, Jongphil Kim, and Seungmoon Choi
- **Progress**
 - Stiffness modulation using the closed-loop framework with a force sensor [EH, 2008].
- **Future work**
 - Passivity Analysis
 - Contact transient modulation
 - Friction and texture modulation
 - Haptic AR Toolkit



Haptic Pottery Modeling

- **Overview**

- Haptic modeling of virtual pottery

- **Team**

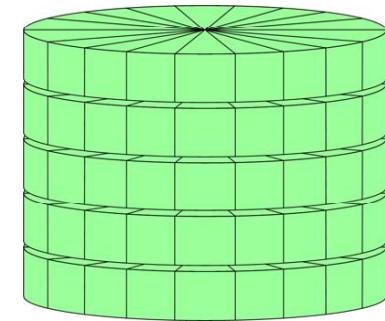
- Jaebong Lee and Seungmoon Choi

- **Progress**

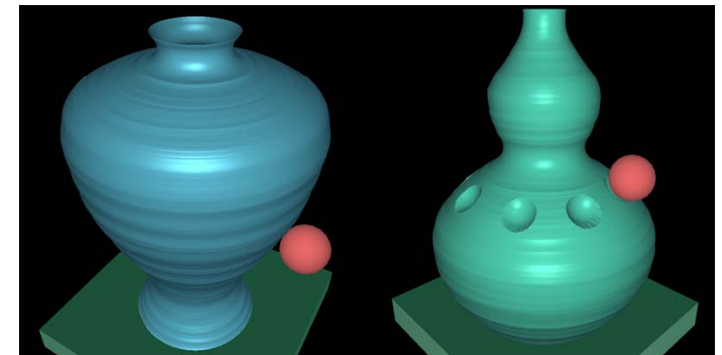
- Circular Sector Element Method [EH, 2008]
 - Allows effective modeling system of virtual pottery.
 - Based on the cylindrical symmetry of pottery.
- A model composed of 144,000 elements could be stably simulated in real-time.

- **Future Work**

- Improving algorithms for more realistic simulation.
- Planning to conduct an usability study.



Structure of the CSEM



Pottery Models

Friction Rendering

- **Overview**

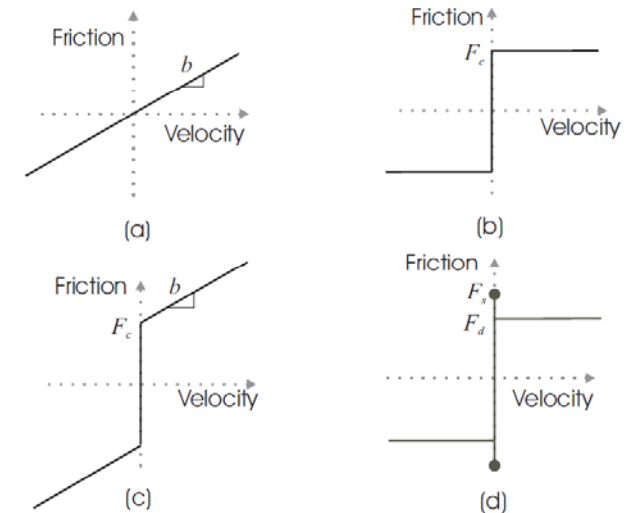
- What factors affects friction?
- Find a relation between the parameter spaces of friction rendering and perception
- Find appropriate friction rendering technique in 3 DoF haptic rendering

- **Team**

- Gabjong Han and Seungmoon Choi

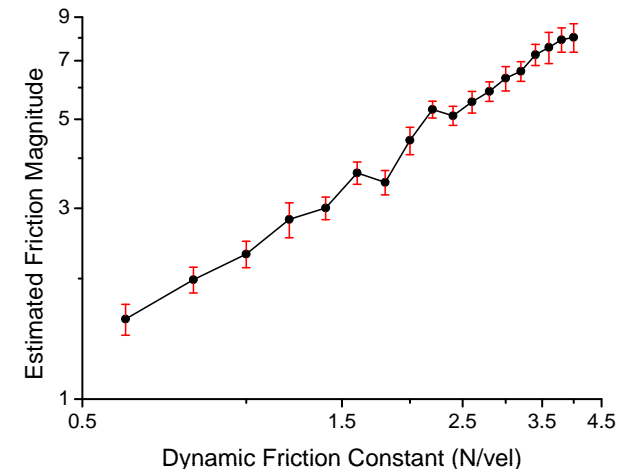
- **Progress**

- Implementation of different friction rendering techniques
- Pilot experiment of friction magnitude estimation over viscosity rendering



Various friction rendering model.

- a) Viscosity damping, b) the Coulomb model, c) Coulomb plus viscous model, and d) Coulomb with stiction.



Sample of estimated friction magnitude over viscous friction rendering constant. Red bar shows standard Error.

Physical and Perceptual Characteristics of Mobile Device Vibration

- **Overview**

- To unveil the physical and perceptual characteristics of mobile device vibrations driven with a vibration motor

- **Team**

- Jaehoon Jung, Jonghyun Ryu, and Seungmoon Choi

- **Progress**

- Measurement and analysis of physical vibration characteristics [HCII 2007][ACM TAP, submitted][Korea HCI 2008]
- Vibrotactile detection thresholds transmitted through a mobile device [HCII 2007][ACM TAP, submitted] [Korea HCI 2008]
- Perceived magnitudes of mobile phone vibrations [HCII 2007][ACM TAP, submitted] [Korea HCI 2008]
- Comparison of vibration perceived magnitudes perceived through a mobile device with different actuators [HS2008][IEEE ToH, in preparation]

Perceptually Transparent Vibration Rendering on a Mobile Device

- **Overview**

- For minimizing the interference of the device dynamics and the human perception for transmitting perceptually correct vibration effect
- By cascading a system function $f(x)$ with its inverse $f^{-1}(x)$ in order to constitute the identity system

- **Team**

- Jonghyun Ryu and Seungmoon Choi

- **Progress**

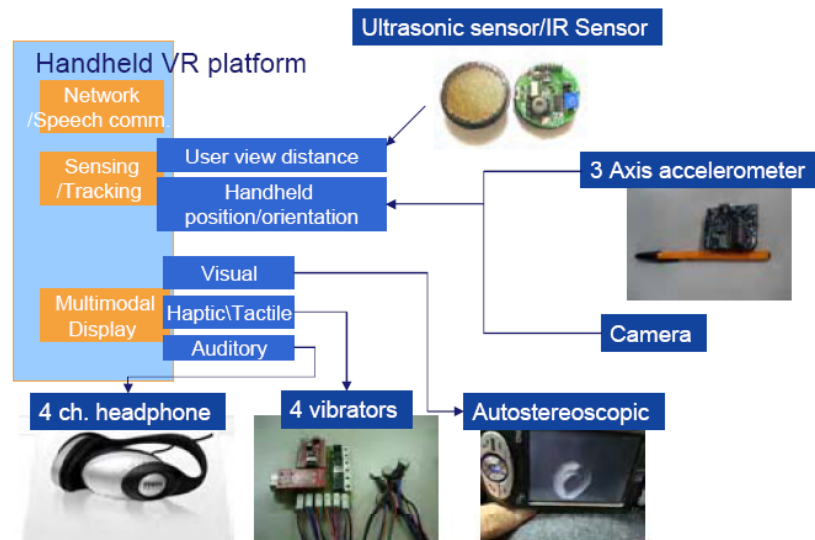
- Concept of perpetually transparent vibration rendering and a graphical vibration editor [IEEE ROMAN 2007]
- Investigation of pairwise discriminability under conditions with/without PTR [EH 2008]

- **Future Work**

- Absolute identification
- Application to the design of tactons

Handheld VR

- **Overview**
 - Demonstrate the feasibility of handheld virtual reality
 - Develop handheld VR applications
- **Team**
 - Sunghoon Park, Seungmoon Choi, and Gerard J. KIm
- **Progress**
 - Mobile image browser using the 'handheld VR platform' [ISUVR 2007]
 - Usability study (On-going)



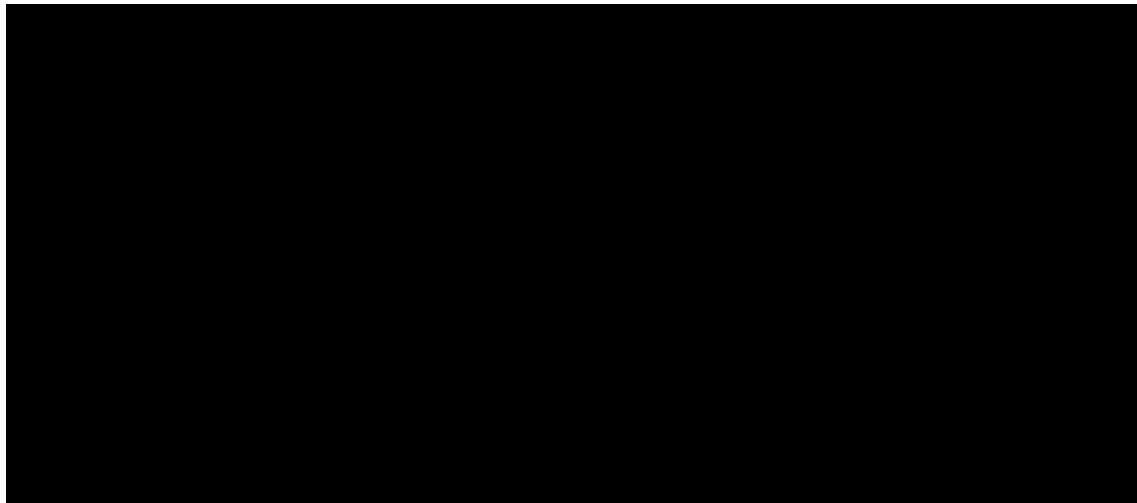
Handheld VR Platform



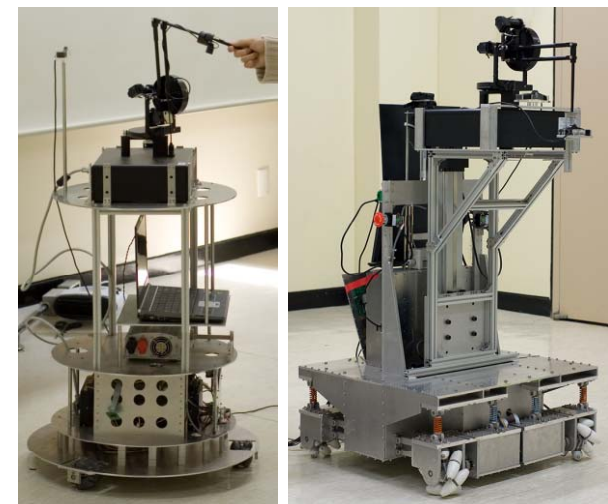
Application : Mobile Image Browser using Motion Tracking

PoMHI (POSTECH Mobile Haptic Interface)

- **Overview**
 - We aim to develop a new MHI for CAVE™.
- **Team**
 - Co-project with the POSTECH R&A Lab (Prof. Jin-Soo Lee)
- **Progress**
 - PoMHI v0.5 [URAI 2007].
 - PoMHI v0.9 is under development.
 - Four omni-directional wheels with dampers
 - Potential-field based motion planning
 - Workspace extension in height direction



PoMHI v0.5 demonstration



PoMHI v0.5 (left) and v0.9 (right)

And More...

- **Real-Time Visual Saliency Tracking and Its Application to Virtual Reality (Sungkil Lee)**
- **Motion-based remote control for interactive environments (Supported by KT)**
- **Designing passive touch information display for driving information system in automobiles (Supported by NGV)**
- **Shaker Project (with Purdue)**