VR Haptic Controllers
Multi-Purpose Handheld Haptics
Beyond Vibro-Tactors

Hrvoje Benko

Currently @

Work conducted @
Visuals ➤➤➤ Haptics

Audio

Epic's Robo Recall
VR Controllers – vibrotactile only

- Oculus Touch
- HTC Vive
- Sony PSVR
Two Realities of Haptics in VR Today

Mainstream Use
Vibrotactile only, low encumbrance

Research Use
High forces, high encumbrance
Actuated Gloves – individual feedback to each finger/low comfort/low resolution

CyberTouch

CyberGrasp - 1997

Rutgers Master II-ND - 2002

Delph et al. Soft Exo-Skeletal Arm - 2013

Dexmo Robotics - 2016

Perez et al. Haptics Symposium 2016
Haptic Robotic Arms – high force/restricted mobility/low resolution

SeansAble Phantom Omni

Van der Linde et al. HapticMaster 2002

Araujo et al. SnakeCharmer TEI 2016

Novint Falcon

Haption Virtuose 6D

UCLA Bionics Lab
Tactile Arrays – higher resolution/stationary/2.5D at best


Follmer et al. InFORM. UIST 2013

Kyung et al. Ubi-Pen IEEE CG&A 2009

Poupyrev et al. Lumen Siggraph Etech 2004
Why such discrepancy between haptic research and product?

None of the research prototypes have demonstrated significant utility without a significant drawback.

VR Controllers are:

• Easy to hold for a variety of people with different hand sizes.
• Easily acquired, dropped, and tracked.
• A platform for additional buttons and joysticks.
• In a tool form factor.
Tools:

Familiar objects
Amplify our abilities
Become extensions of our body

Tool-use induces morphological updating of the body schema
L Cardinali, F Frassinetti, C Brozzoli, C Urquizar, et. al. - Current Biology, 2009
An opportunity: VR Haptic Controllers

Extend the tool form factor of VR handheld controllers with higher fidelity haptics.
What kinds of VR Haptic Controllers do we need?
5 Ideas for VR Haptic Controllers Toolbox
Ungrounded haptic devices with force feedback rendering.
Reactive Grip by Tactical Haptics

NormalTouch and TextureTouch

3D shape output on the handheld controller form factor

NormalTouch and TextureTouch

High-fidelity 3D Haptic Shape Rendering on Handheld Virtual Reality Controllers

Hrvoje Benko, Christian Holz, Mike Sinclair, Eyal Ofek
Microsoft Research
2016
Multi-purpose haptic devices that adapt to the user’s context of use.
Goal

One VR Haptic Controller device that integrates multiple haptic rendering capabilities and adaptively selects which one to use based on the user’s grip and the environmental context.
CLAW:
A Multifunctional Handheld Haptic Controller for Grasping, Touching, and Triggering in Virtual Reality

User-customizable haptic devices.
Haptic Revolver

Haptic Revolver

#4

Haptic rendering *between* devices.
#5

*Reuse* existing objects as haptic tools.
Passive Haptics Rocks!
But, passive haptics approach doesn’t scale!
Haptic Retargeting

Body Warping

physical cube

virtual cube

The Rendered Body Shifts to The Right
World Warping

The World Also Rotates
(At Different Rate)
Putting it all together...
Haptic retargeting allows physical props to be reused for haptics by leveraging the dominance of vision to retarget people's hand motions.

A single prop can be repurposed to allow movement and stacking of a virtual space with a multitude of virtual objects.
5 Ideas for VR Haptic Controller Toolbox

1. Provide *force feedback* rendering on *ungrounded* devices.
2. Design *multi-purpose* haptic devices that *adapt* to the context of use.
3. Design *user-customizable* haptic controllers.
4. Don’t ignore haptics *between* devices.
5. Enable *reuse* of existing objects as haptic tools.
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