

Haptic Feedback in Room-Scale VR

Masterstudium:
Visual Computing

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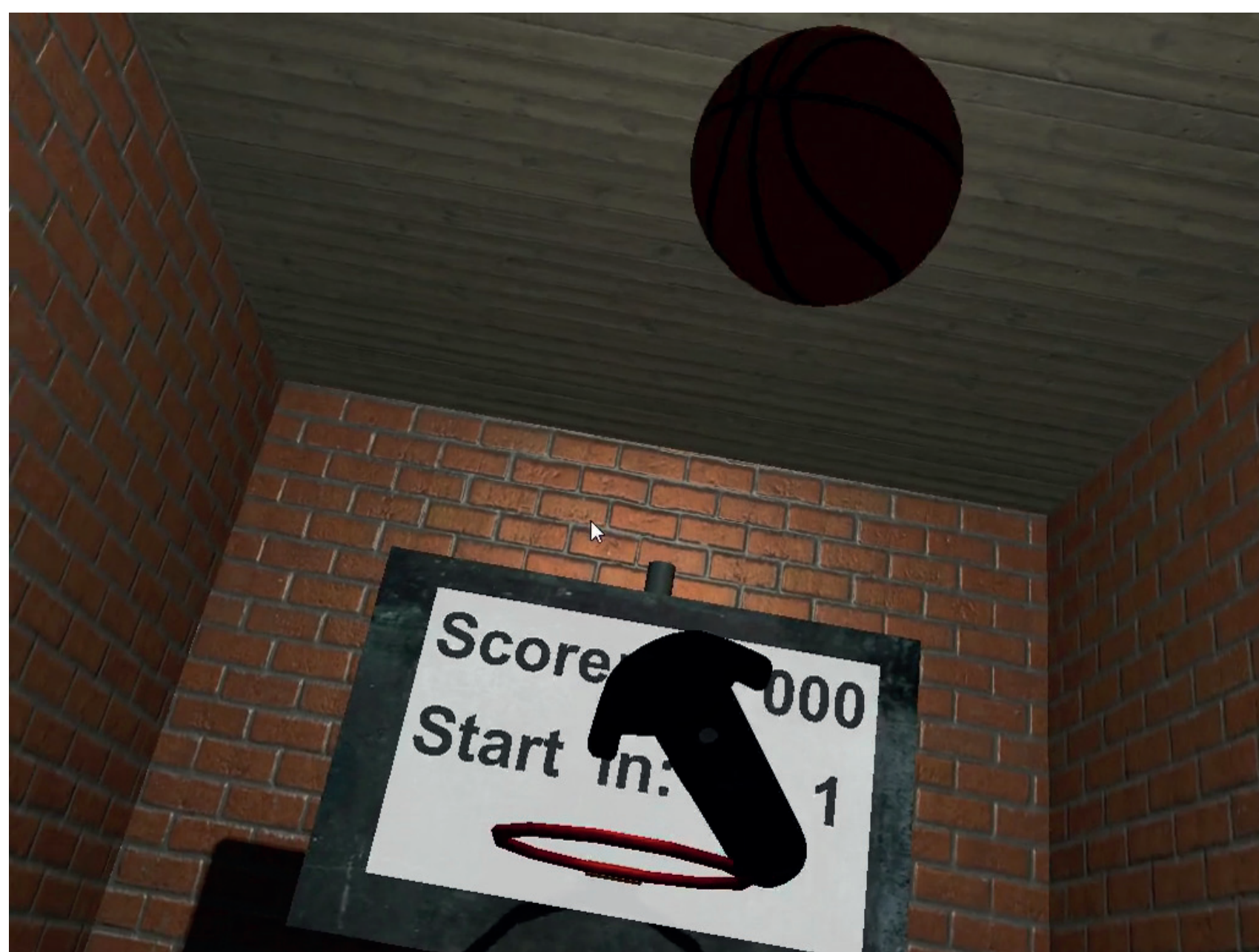
Introduction

Virtual reality (VR) is finally becoming a mainstream medium. Current systems like the HTC Vive offer accurate tracking of the HMD and controllers, which allows for highly immersive interactions with the virtual environment. The interactions can be further enhanced by adding feedback.

The main contribution of this thesis is a user study analyzing grabbing and throwing with controllers, haptic and optical feedback, and the advantages of point-cloud editing in VR. The point-cloud editing led to further contributions: a faster rendering method, viewing with a pinch gesture and selecting with volumes.



Grabbing and Throwing with Controllers



Players can grab the ball and throw it into the basket. When a controller is close to a ball, the trigger can be pressed to grab.

The ball is thrown by releasing the trigger while moving the controller.

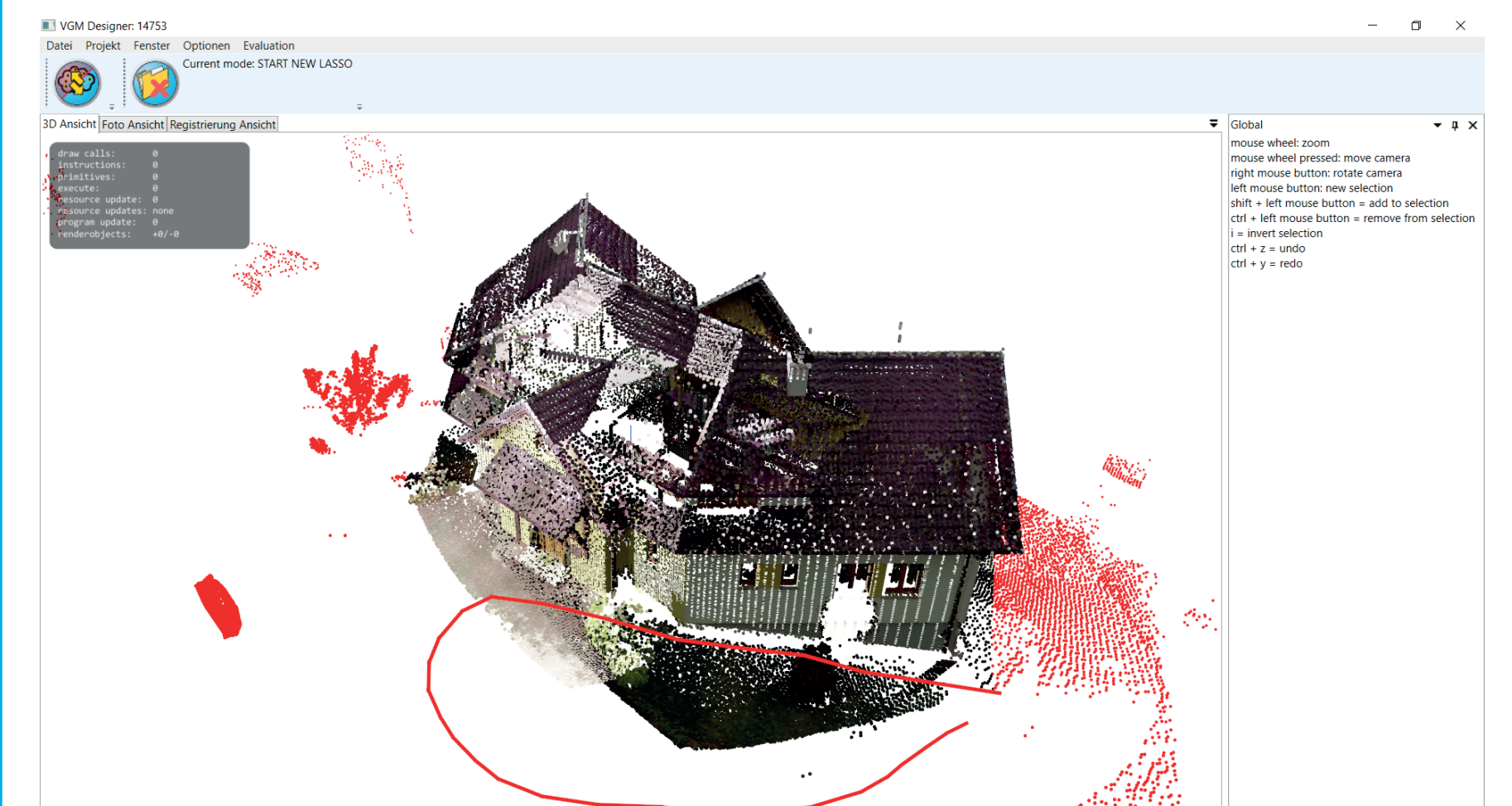
Optical and Haptic Feedback



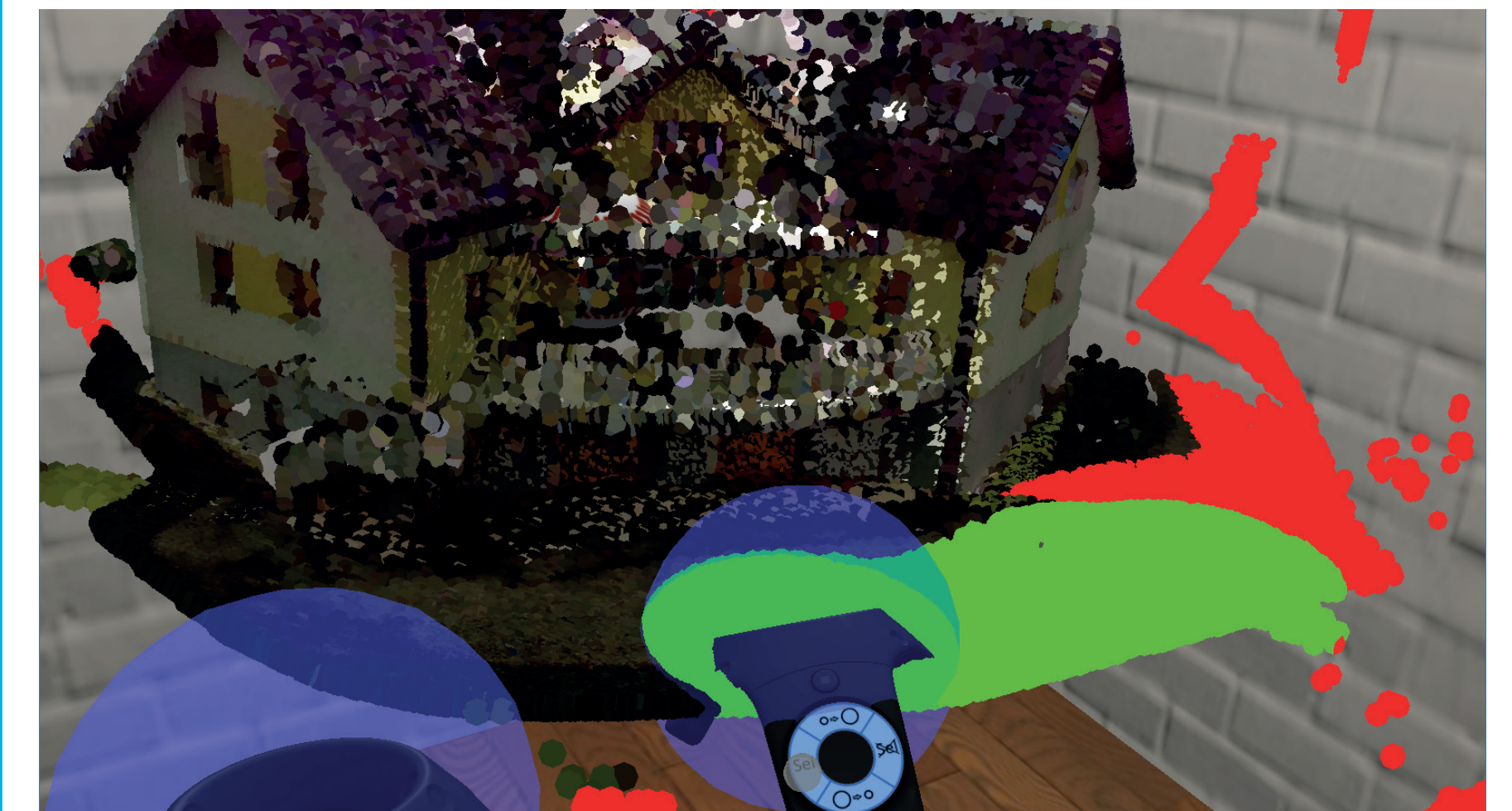
When a controller is close to a ball, the ball is highlighted (optical feedback) and the controller vibrates (haptic feedback).

The ball at the basket shows which one of the four balls is required to score. The ball is grabbed with the trigger.

Point-Cloud Editing



On desktop: control view with orbiting camera, select points with lassos



In VR: control point cloud with pinch gesture, select points with volumes

Grabbing works nicely because the trigger state encodes the intention of grabbing.

Throwing does not work nicely because the ball needs to be released willingly, which is not natural for basketball.

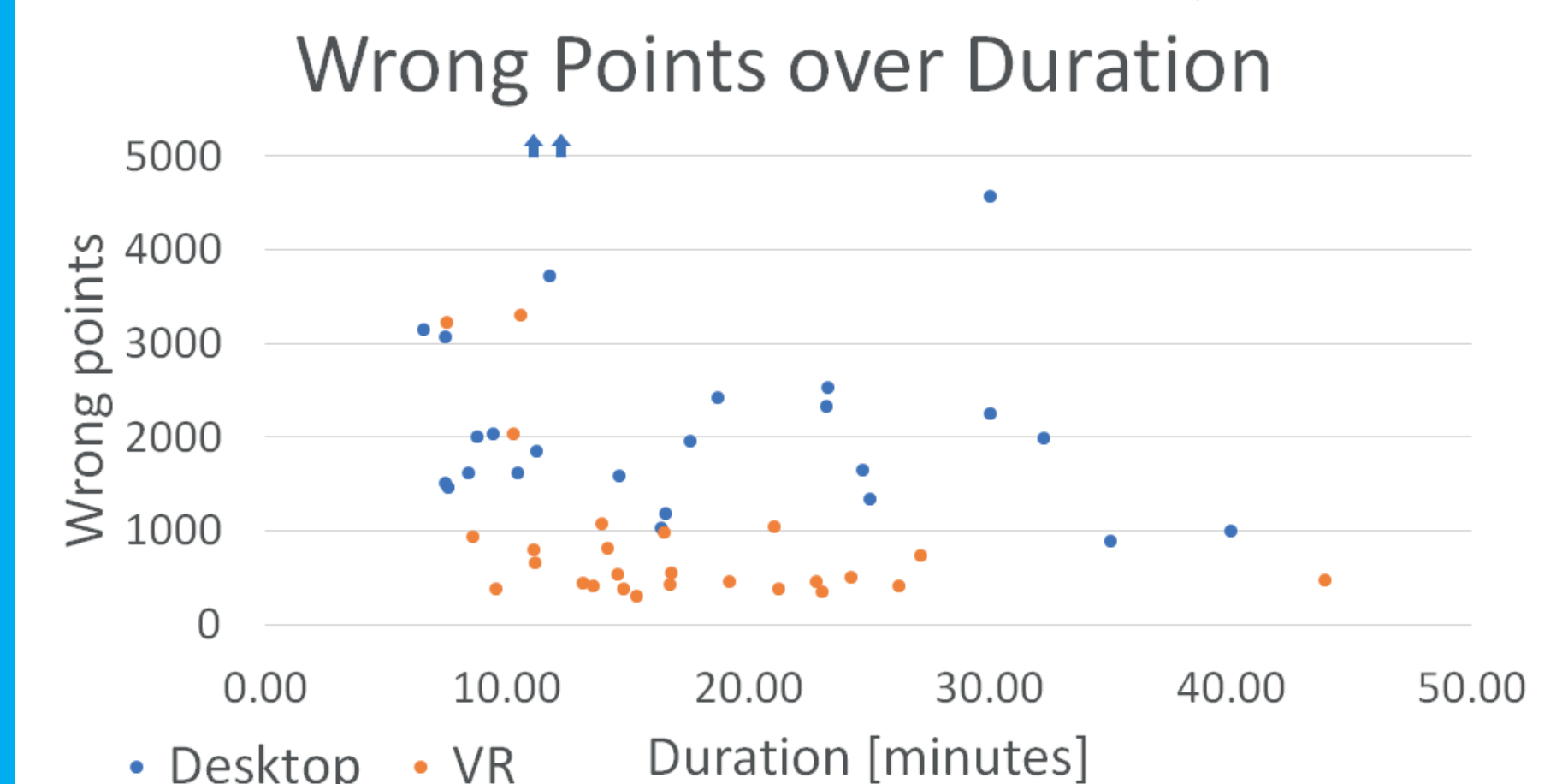
Therefore, another metaphor should be used to release the grab.

Any feedback significantly increases the grabbing accuracy and how well events can be predicted.

There is almost no significant effect on task load and usability.

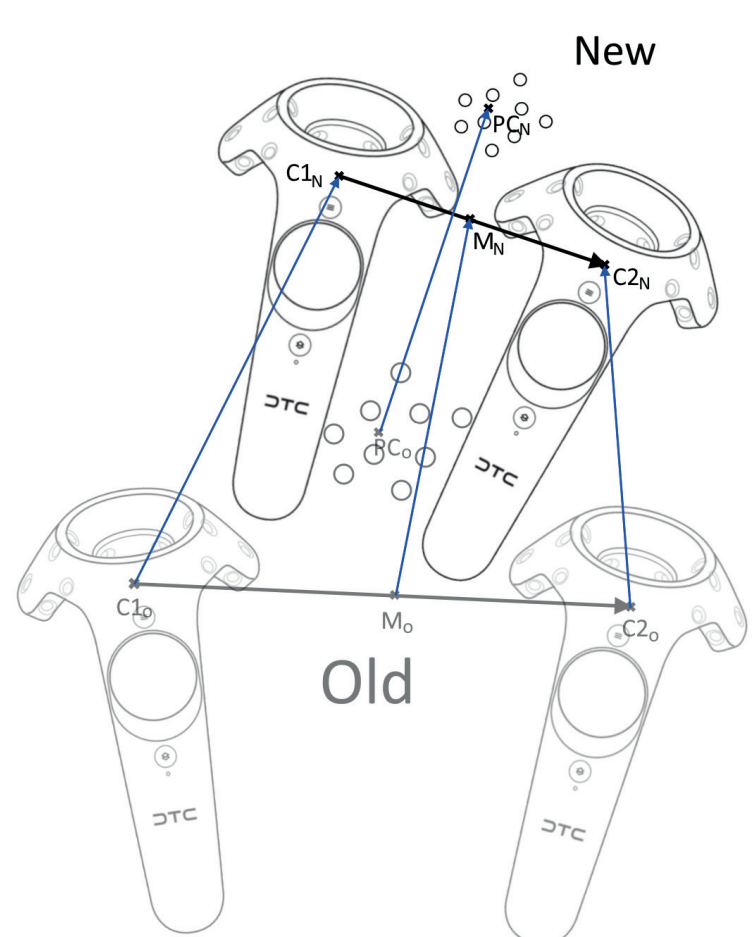
The effect of optical, haptic, and both feedback types is similar.

Better performance and usability in VR

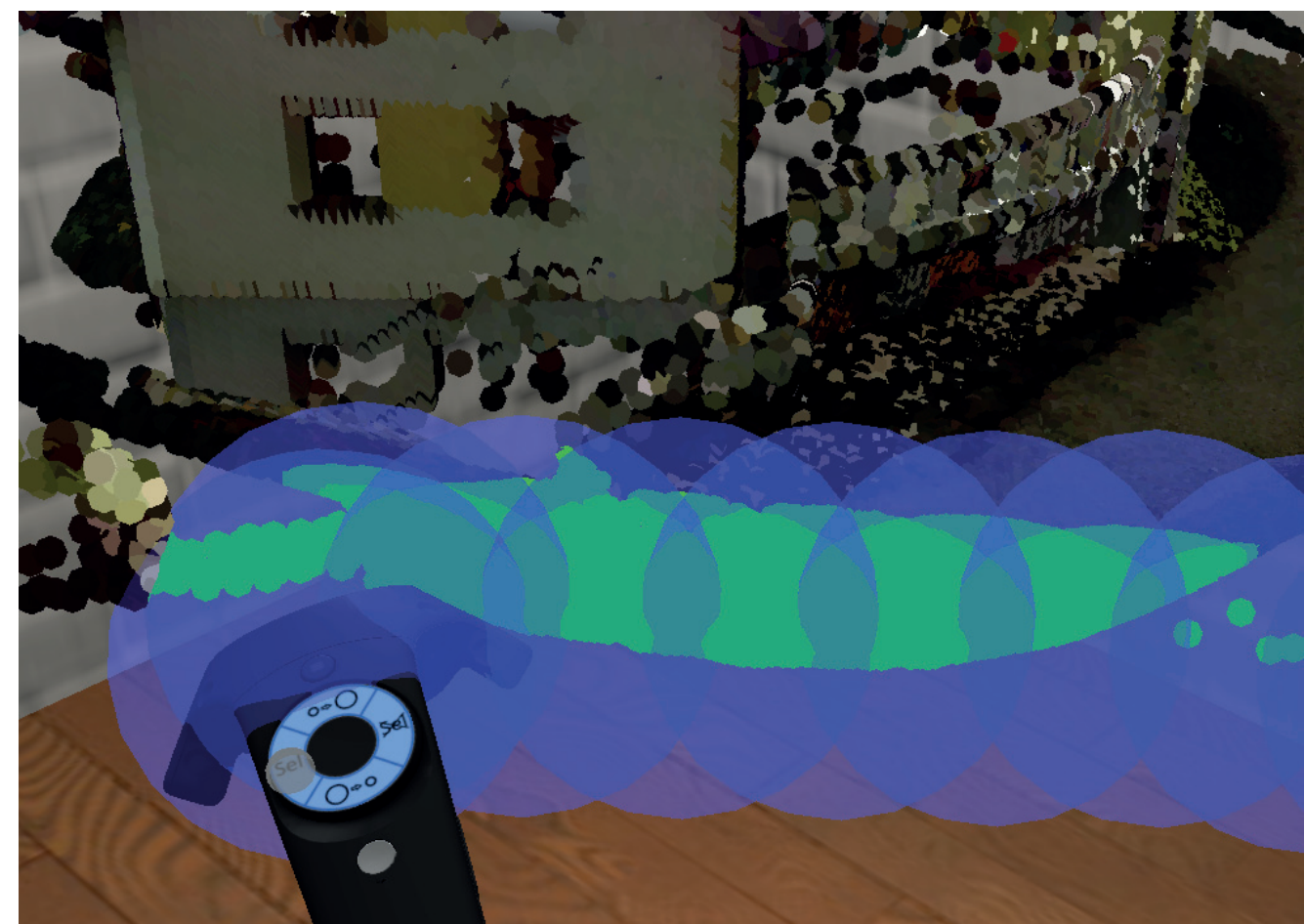


Innovations for Point-Cloud Editing in VR

Bi-Manual Pinch Gesture to transform point clouds



Point selection with volumes and selection visualization in real time



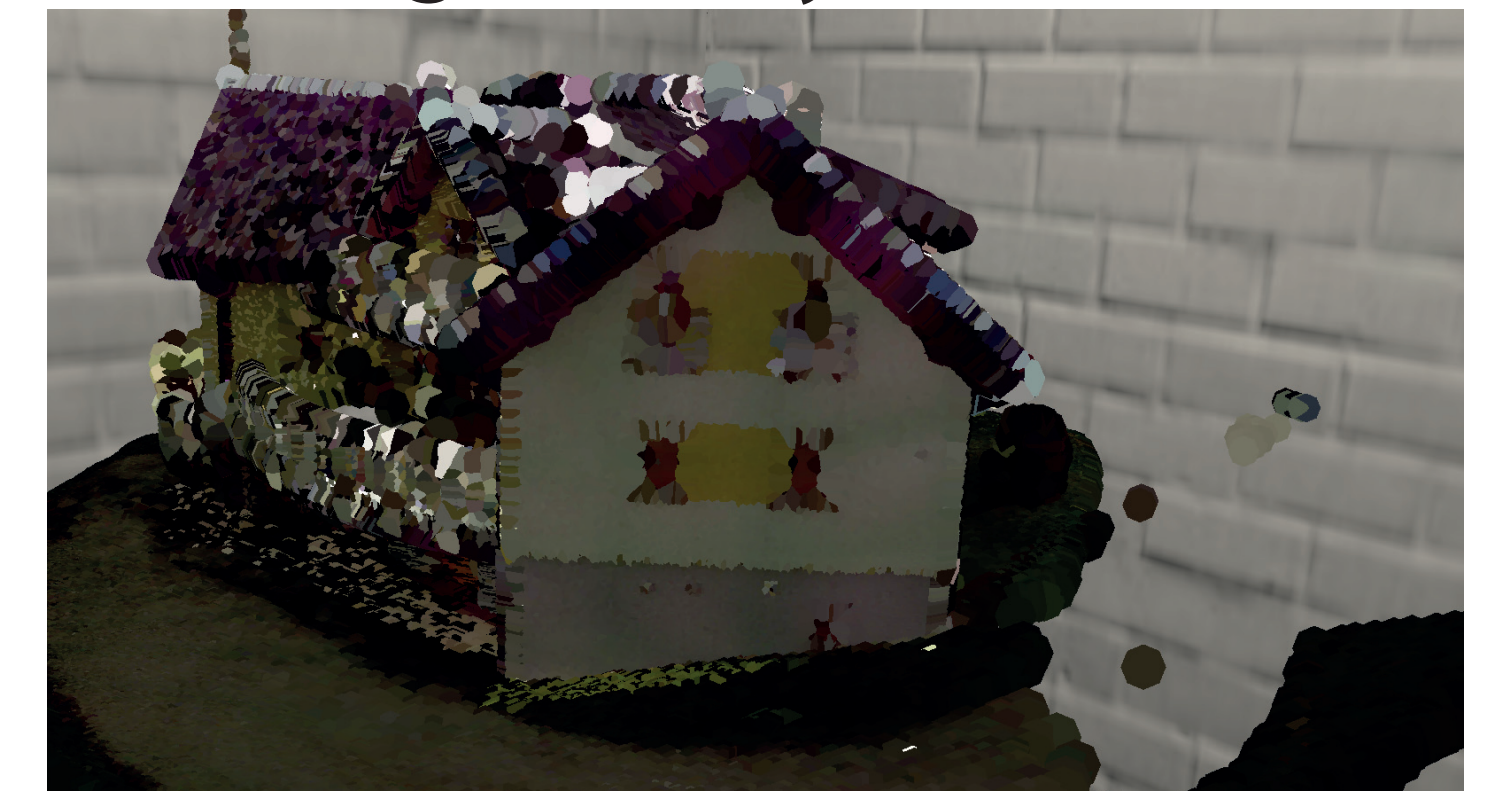
Rendering with shape creation for point primitives

Load in fragment shader (like [1])



13.5 ms

Load in geometry shader (new)



1.9 ms

[1] "High-quality point based rendering using fast single pass interpolation", Schuetz M., Wimmer M.