Haptic and Auditory Feedback on Immersive Media in Virtual Reality

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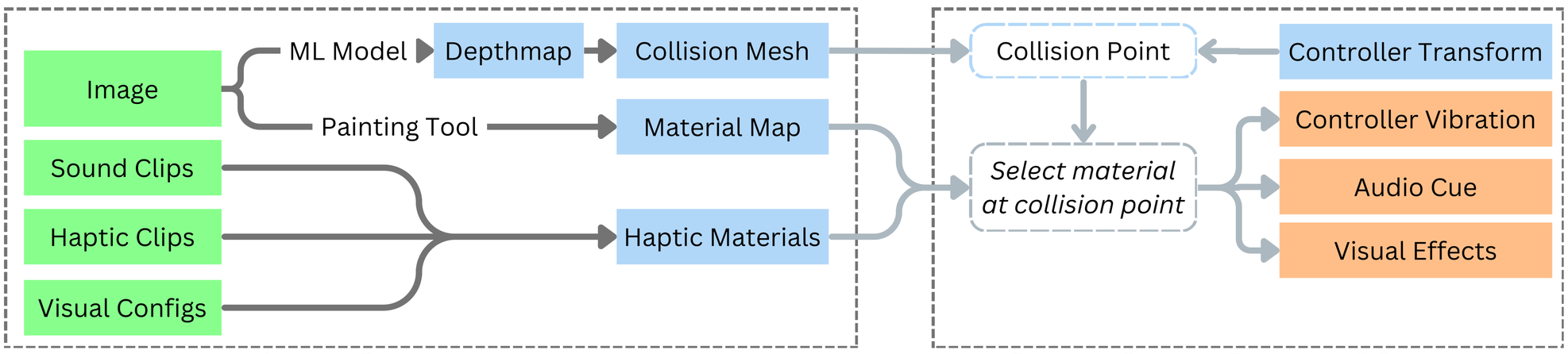


Overview of our processing pipeline and runtime approach

1. Motivation

Modern immersive VR image viewers:

- Support 2D / 3D, 180°, 360° and panoramas
- Add particle FX & audio to increase immersion
- Do not support interactive (pseudo-)haptic feedback

Our contribution:

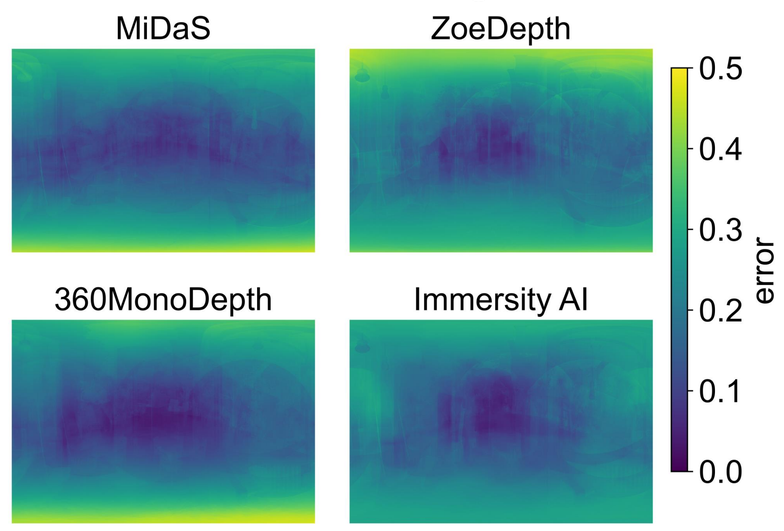
- Add interactive feedback to spherical images
- User study shows increase in presence

2. Methodology

- Extension to VR media app *immerGallery*
- Controller represented by virtual hand
- Display monoscopic image as textured 3D mesh
- Collision of hand and 3D mesh
  → Sample material map, play back feedback

Depthmap generation using existing ML model
→ Errors in polar regions

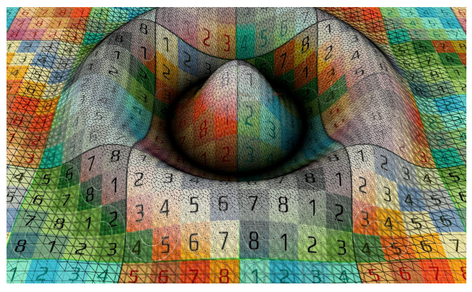
- Error correction and 3D mesh generation



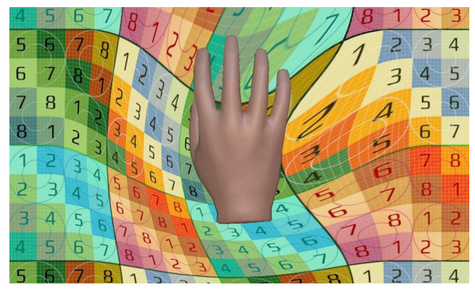
Absolute error of depth estimation models

Material map separates image by surfaces into haptic materials. Each material has:

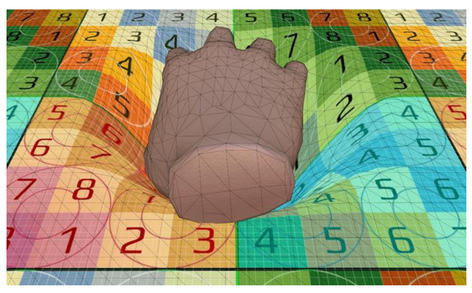
- Haptic clip (frequency, amplitude sequence)
- Audio effect
- Visual effects



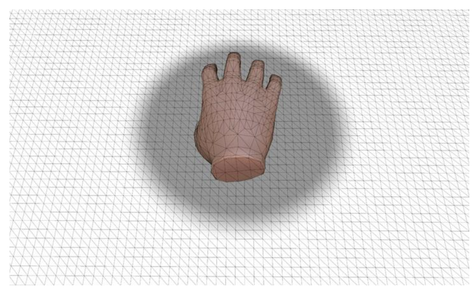
Sine Wave → 🌊 Fluids



UV Distort → 👕 Cloths

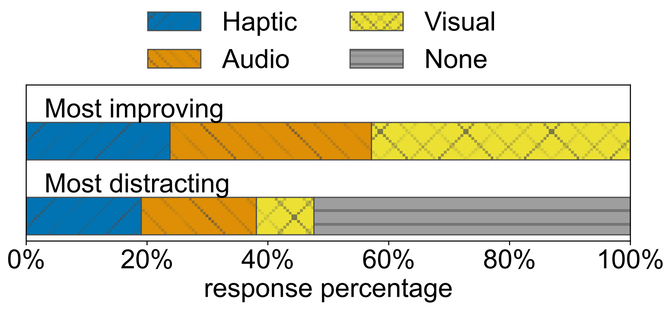


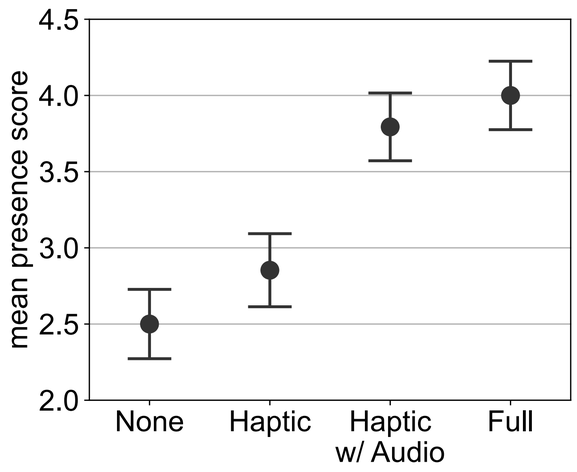
Offset→ 🛏️ Compression



Fake AO→ ✋ Shadow

3. Discussion





Left: Feedback voted most impacting the experience
Right: Mean presence scores by feedback configurations

Presence measured in VR with IPQ on scale 0 – 6:

- Haptic feedback only slightly increases presence
- Haptic with audio significantly increases presence
- All techniques combined result in highest presence

Similar results in post-questionnaire. Techniques rated by participants on impacting the experience:

- >50% find no technique decreasing
- Haptic least often improving, for 20% decreasing
  🗣 “Not enough variance between surfaces.”
- Audio more often improving, for 20% decreasing
  🗣 “No variance depending on interaction type / speed.”
- Visual feedback most improving, for <10% decreasing
  🗣 “Not very noticeable.”

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https://immerVR.com

https://www.informatik.uni-wuerzburg.de/games