Abstract

Passive haptic feedback for virtual reality (VR) leverages physical props to provide haptic feedback and can achieve immersive sensations but suffers from scalability issues. To tackle these, two independent concepts have been proposed by previous research:

1. **Dynamic Passive Haptic Feedback (DPHF)**: A hardware-based concept leveraging actuated props that change their physical state and passive haptic sensation, and
2. **Haptic Retargeting (HR)**: A software-based concept redirecting the user’s hand during interaction, leveraging manipulations of the real-to-virtual mapping.

While past research on both techniques reported promising results, up to now, these concepts remained isolated. This paper advocates the combined use of Dynamic Passive Haptic Feedback and Haptic Retargeting for rendering enhanced ranges of haptic effects.

Prop-Based Haptics for VR:

1. **virtual**
2. **real**
3. **Center of Mass**

2 Central Challenges: similarity & colocation

### 1st Thought Experiment: Haptic Similarity

**Scenario:**
A user lifts up a virtual rod represented by a colocated rod-shaped proxy. The VR system renders a weight shift.

**Sketched below:**
The max. achievable shift effects of DPHF, Haptic Retargeting, and their combination.

**Take-Away:** Combining DPHF + Haptic Retargeting yields increased effect ranges.

### 2nd Thought Experiment: Colocation

**Scenario:**
A user lifts up a virtual rod represented by a dislocated rod-shaped proxy. The VR system compensates for the dislocation by preventing noticeable weight shift.

**Sketched below:**
The max. unnoticeable dislocation of DPHF, Haptic Retargeting, and their combination.

**Take-Away:** Combining DPHF + Haptic Retargeting allows for greater dislocation to go unnoticed.

Conclusion

Our thought experiments show that DPHF + HR can in certain scenarios provide more flexibility and design freedom by allowing props to represent more virtual objects, and compensating for larger dislocations, than DPHF and HR individually can. Future work will gather practical insights in corresponding user experiments.

References