### detecting prediction errors during haptic interaction

Lukas Gehrke, Sezen Akman, Pedro Lopes, Albert Chen, Tim Chen, Avinash Singh, Chin-Teng Lin and Klaus Gramann





### 1. motivation





# 2. related work

rendering haptic realism



#### SMA pads [Merrett et al., '11]



- REVEL
- [Bau et al., '12]



on-the-nail vibro[Ando et al., '02]





CyberTouch [Virtual Technologies, '90]



#### 3DOF fingerpad [Kim et al., '16]





#### questionnaires requires:

- 1. stopping the experience
- 2. reflecting on it
- 3. judging it
- 4. get back to immersion







# 3. our approach





## 4. experiment







### Mismatch (25%)



### 5. results

1. ERPs in match (visuals & haptics in sync)



#### 2. ERPs in mismatch (visuals & haptics in sync)









**EEG pipeline:** how did we process the EEG signal?

#### **EEG pipeline** raw . MMM MALANM MmMm MW Arm MM MW Mm Mm. filtered time-locked w. ۰, epoched MW MMMMMM MAMANIM averaged



#### **EEG pipeline**



# 6. outlook



towards a multimodal approach



### while we currently do this **offline**, we envision **realtime assessment** in VR

## 7. conclusion



#### Sensory information ≠ expectation



### **ERPs** during **prediction errors** to assess haptic mismatches



#### potential as a **complimentary presence experience** metric



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