# Auxiliary Means to Improve Motion Guidance Memorability in Extended Reality

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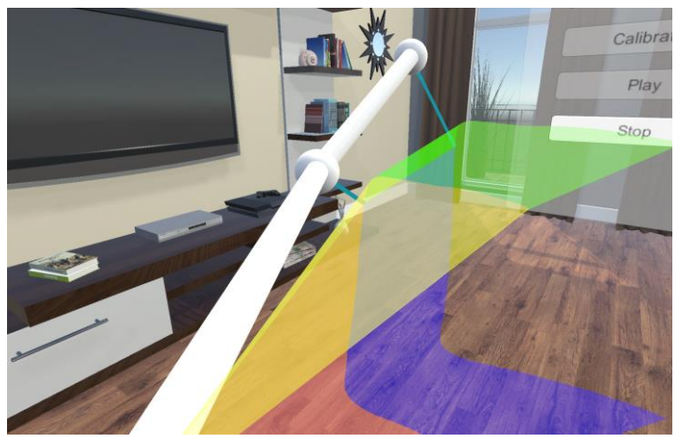
## Motivation & Contributions

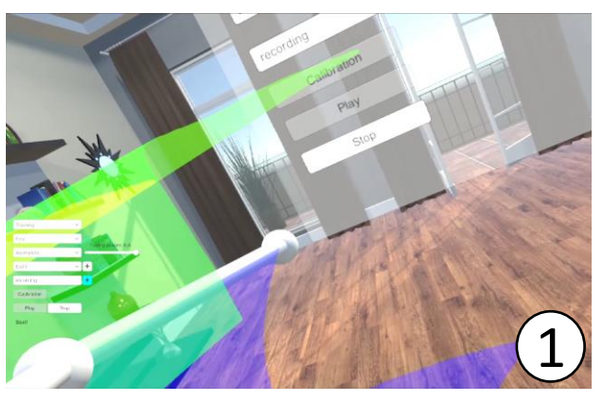
Users can practice 3D motions in the virtual environment, but how can they truly learn a new motor skill? What can be used to improve the memorability of motion guidance?

We propose 4 different auxiliary techniques for basic VR-based motion guidance systems and explore their effect on the memorability of motion guidance.

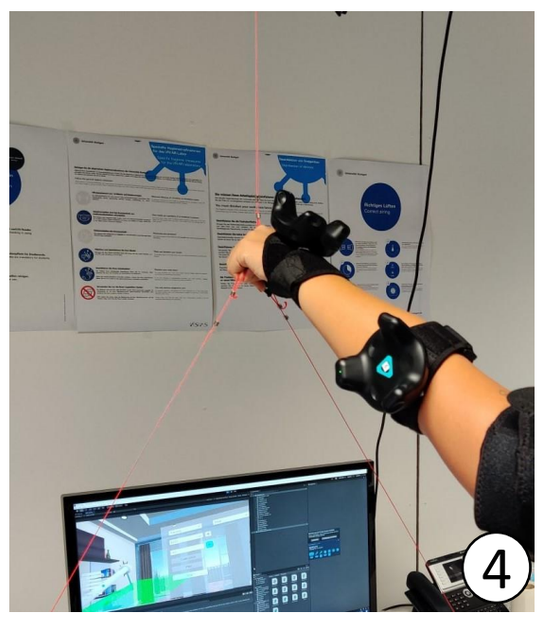



Baseline Motion Guidance [1]

## System Design



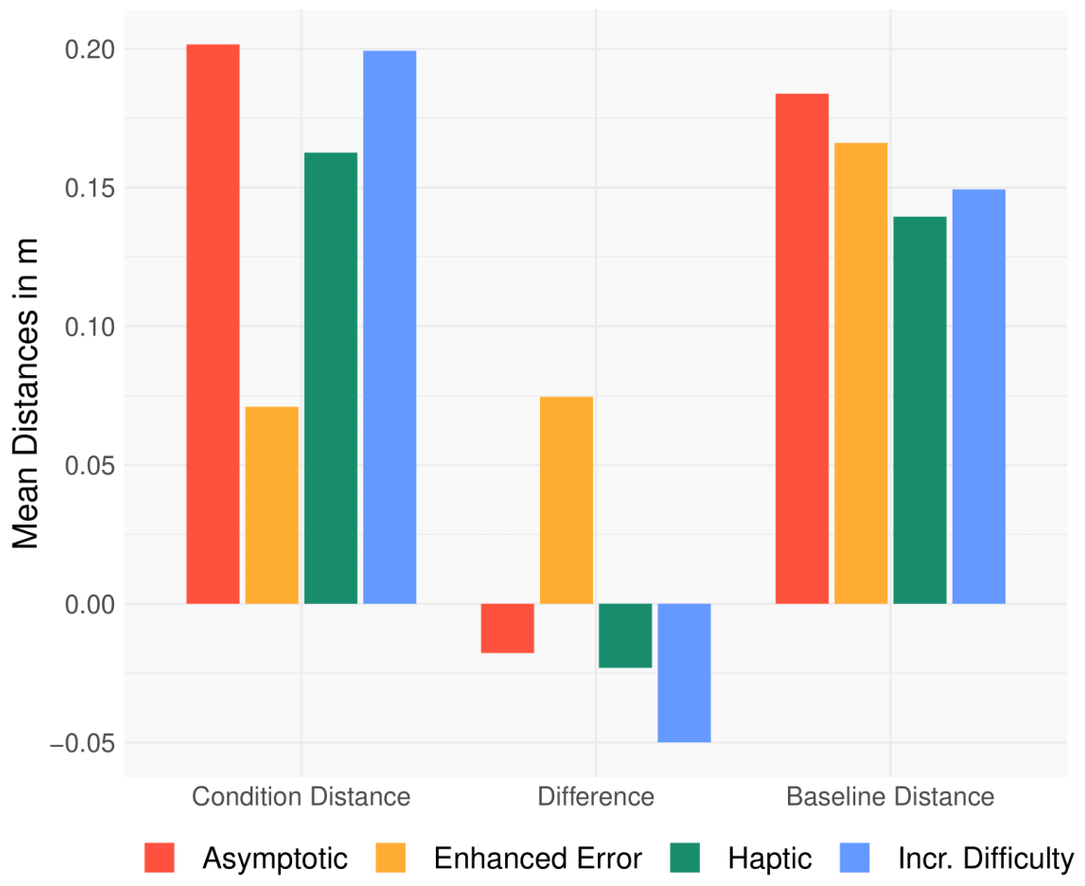



① **Asymptotic Path,** which gradually leads the arm back to the path when it deviates.
② **Increasing Difficulty,** which raises the transparency of instructions during training.
③ **Haptic Constraint [2]**, which limited the deviation of the user's arm from the path.
④ **Enhanced Error Feedback**, which highlights the arm deviation during training.

## Preliminary Study

**Participants**: 15 ♀ + 17 ♂, in 4 groups
**Repeated Measured in each group:**
Baseline motion guidance vs.
one of the 4 proposed auxiliary techniques
**Procedure**: within-subject in different groups
① 10 movement repetitions with baseline or auxiliary techniques in the training phase.
② after the training phase, one more repetition without any instructions as the examination.
**Measures:**
NASA Task Load Index, System Usability Scale (SUS), Deviation Distance, Movement reproduction in the examination phase




## Results:

- No findings on task load
- *Haptic constraint* evoked a significantly lower system usability than the baseline (p=0.046).
- The *Asymptotic Path* visualization performed worst regarding the movement reproduction but felt not as tedious to the participants
- The *Increasing Difficulty* was rated as most helpful, and successfully reproduced by 5 out of 8 participants.
- *Enhanced Error Feedback* outperformed the other techniques regarding the reproduction capabilities (7 of 8) and the movement error distance (p=0.001).

## Reference:

[1] X. Yu, K. Angerbauer, P. Mohr, D. Kalkofen, and M. Sedlmair. Perspective matters: Design implications for motion guidance in mixed reality. In 2020 IEEE International Symposium on Mixed and Augmented Reality (ISMAR), pp. 577–587.

[2] A. Achberger, F. Aust, D. Pohlandt, K. Vidackovic, and M. Sedlmair. Strive: String-based force feedback for automotive engineering. In The 34th Annual ACM Symposium on User Interface Software and Technology, pp. 841–853, 2021.

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