
Design Recommendations for Motion-Based Bicycle Simulators

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Abstract:

Bicycle simulators are increasingly built-in laboratories to be used for research purposes. Still, their motion dynamics are highly complex, and riders account for most of the mass of the overall system. Consequently, bicycle simulators suffer motion sickness and perceived realism, resulting from inconsistencies between the expected and experienced multisensory perceptions. To improve this situation, we have built a motion-based bicycle simulator. In this work, we present the results of different user studies investigating the potential of motion-based bicycle simulators. All conducted experiments utilize the same methodology, where we measure simulator sickness, presence/perceived realism, and cycling performance. In particular, we looked at different tilting modes (strong tilt based on a physics model and parameterized weak tilt with less aggressive onset), pitch modes (mirroring elevation profiles and acceleration/deceleration), as well as a comparison between Virtual Reality (VR) head-mounted displays and TV screens. Our work concludes with a thorough discussion of the results of all studies, and our findings can inform the design of future bicycle simulators.



Figure 1: TU Wien Motion-Based VR Bicycle Simulator