Summary 2:

AR Feels "Softer" than VR: Haptic Perception of Stiffness in Augmented versus Virtual Reality

To study the difference in haptic perception of stiffness of a virtual object in AR and VR, a group of 12 users compared the stiffness between two pistons displayed using Microsoft HoloLens, rendered in AR and VR. Peripheral vision was obstructed using a mask so the same field of vision would be maintained for both. When users move the curser to the piston (lined up with a haptic force feedback device in real life) and exerts force onto it, the device simulates the opposing spring force to render the stiffness. Users are asked to judge which piston is stiffer. Other factors such as the response time, the displacement, the force the users exerted, and the users' perceived differences between the environments were also considered. Results showed that users thought VR piston to be stiffer 60% of the time and exerted more force on VR piston. Interestingly, users reported that they were they did not think the type of display influenced their haptic perception and found very little differences between the environments. Although there was no difference in displacement caused (both pushed till end), users generated more opposing force in VR, suggesting that users may have let go and pushed down repeatedly for more times. This indicated different subconscious ways of interacting in VR and AR.

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abstract={Does it feel the same when you touch an object in Augmented Reality (AR) or in Virtual Reality (VR)? In this paper we study and compare the haptic perception of stiffness of a virtual object in two situations: (1) a purely virtual environment versus (2) a real and augmented environment. We have designed an experimental setup based on a Microsoft HoloLens and a haptic force-feedback device, enabling to press a virtual piston, and compare its stiffness successively in either Augmented Reality (the virtual piston is surrounded by several real objects all located inside a cardboard box) or in Virtual Reality (the same virtual piston is displayed in a fully virtual scene composed of the same other objects). We have conducted a psychophysical experiment with 12 participants. Our results show a surprising bias in perception between the two conditions. The virtual piston is on average perceived stiffer in the VR condition compared to the AR condition. For instance, when the piston had the same stiffness in AR and VR, participants would select the VR piston as the stiffer one in 60% of cases. This suggests a psychological effect as if

objects in AR would feel ”softer” than in pure VR. Taken together, our results open new perspectives on perception in AR versus VR, and pave the way to future studies aiming at characterizing potential perceptual biases.},
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