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Automatic and Perceptually Matched Sound-to-Haptic Conversion for Commercial VR Devices

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***Abstract*—We present a haptic signal conversion method that automatically transforms real-world sounds or recorded vibrations into realistic, wide-band haptic feedback for VR devices without requiring manual editing. By combining Intensity Segment Modulation (ISM) for high-frequency textures and a proxy presentation method for low-frequency sensations, our approach preserves the perceptual richness and temporal dynamics of the original signals. The feedback is presented using standard VR controllers and haptics SDKs, without specialized hardware or manual tuning. In the demonstration, participants will experience a VR environment and clearly recognize the enhanced naturalness, realism, and richness of haptic sensations achieved by our method. They can also compare haptic feedback generated by conventional methods, such as Meta Haptics Studio, with that produced by our perceptually faithful conversion method.**

***Index Terms*—Haptics, virtual reality**

(a) User wearing a VR headset. (b) Scene from the VR Demo

Fig. 1: Demonstration Overview.

I. Introduction

haptic feedback in VR remains relatively simple despite advances in other modalities. To enhance haptic realism in VR, tools have been developed that convert real-world sounds or recorded vibrations into actuator-drivable signals; however, achieving sufficient realism often requires manual editing and tuning. In this study, we propose a method that automatically converts real-world sound signals into haptic feedback for VR devices, preserving the original perceptual characteristics and enabling high-fidelity haptic experiences without manual adjustments.

II. Method

Our method combines two perceptually grounded techniques to enable wide-band haptic sensations without manual intervention. For high-frequency haptic information, we apply Intensity Segment Modulation (ISM) [1], which captures temporal fluctuations of perceived intensity from the original signal and generates amplitude-modulated signals to preserve high-frequency textures. Mapping ISM intensity to SDK parameters enables perceptually equivalent high-frequency feedback. For low-frequency components, we use a proxy presentation method that delivers short amplitude modulation wave at the peaks of the low-frequency waveform, reconstructing slow, oscillating sensations even with actuators unable to generate continuous low-frequency vibrations.This approach suppresses the perception of high carrier frequency while effectively reproducing the temporal characteristics of low-frequency haptic sensations. These techniques together enable realistic wide-band haptic feedback using only standard VR hardware.

III. Demos

In the demonstration, participants will experience a VR environment where haptic feedback is generated from real-world sounds, such as bubbling water. The signals are automatically converted by our method to preserve the perceptual characteristics of the original stimuli and are presented using the standard controllers and haptics SDK of the Meta Quest 3. Participants can directly compare the realism of haptics generated by our method and those by conventional systems such as Meta Haptics Studio.

References

[1] Yamaguchi, K., Konyo, M. and Tadokoro, S.: Sensory Equivalence Conversion of High-Frequency Vibrohaptic Signals using Intensity Segment Modulation Method for Enhancing Audiovisual Experience,IEEE Transactions on Haptics (2021).