Live demonstration : mixed reality 3D in-air ultrasound applications

Live Demonstration: Mixed Reality 3D In-Air Ultrasound Applications

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***Abstract*—In-air ultrasound has become a common sensing modality for several convenient applications in our daily life found in consumer, industrial or automotive electronics. Using transducer arrays and beamforming algorithms, 3D information of reflectors in an environment can also established and visualized. Due to the physical limitations of ultrasound this representation is much sparser than we are used to when compared to visual sensors. By combining a virtual reality headset with a small ultrasound sensor that features a microphone array and a broadband ultrasound emitter, we can create a mixed reality representation of the world wherein we visualize ultrasonic reflections as an overlay onto the optical images captured by the cameras of the VR headset.**

Keywords—virtual reality, sensor arrays, sensor data fusion

I. DEMONSTRATION SETUP

Over the years, we have continued improving our embedded real-time 3D imaging ultrasound sonar sensor [1] and demonstrated its potential for various applications in previous award-winning live demonstrations at the IEEE Sensors conference [2, 3]. In this edition we propose on demonstrating a first-person mixed or virtual reality view of in-air ultrasound. This demo combines an HTC Vive Pro 2 Virtual Reality (VR) headset with our miniaturized µRTIS [4] (Micro Real-Time Imaging Sonar) which can showcase both the sensor's 2D as 3D sensing capabilities. To create the visualization of the sensor data, the data is processed in real-time and fed into a Unity environment. This environment allows for creating a stereoscopic image that is projected on the respective displays of the VR headset. A Mixed Reality (MR) view of the world is accomplished by using the embedded cameras of the headset and creating an overlay of the acoustic 3D visualization onto the optical image.

II. VISITOR EXPERIENCE

In this live demonstration exhibit, visitors will be able to interact with the combined sensor setup, and experience how the environment looks like through 3D acoustic sensing in mixed reality. Visitors will be able get a better grasp on both the possibilities and the limitations of acoustic sensors for various applications through this experience. Furthermore, by using our own 3D in-air ultrasonic sensor and placing specific ultrasonic emitting reflectors in the world, the visitor can experience the advantages that the ultrasonic sensing modality can provide over others for phenomena not visible to the human senses and better understand how these bio-inspired sensors help other species such as bats to perceive the world around them.

Figure 1: the combined sensor setup comprised of a) an HTC Vive Pro 2 VR headset with embedded optical cameras and b) the µRTIS ultrasound sensor featuring a dense microphone array and a broadband ultrasonic emitter.

III. CONCLUSIONS

While we as humans are acustomed to seeing the world in the visible spectrum, using our µRTIS sensor we can create acoustic images of our surroundings using beamforming techniques. This demonstration can present the surroundings through acoustic images in real-time in a Virtual or Mixed Reality visualization in combination with the headset's embedded cameras. These sparse acoustic representations of reality can help the visitor better comprehend the concept and design choices of acoustic sensors and demonstrate the possibilities, constraints and the limitations for them in various new and existing applications.

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