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Standalone Demonstration : Sound and Texture Synthesizer

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Music production on traditional instruments creates vibrations that are perceived via hearing and touch. This is particularly true when producing music on a violin where the vibrations transmitted to the chin helps the musician to hone-in the tone quality. In contrast, modern music synthesizers create high quality sounds without including relevant haptic content. We present the implementation of a haptic sound synthesizer which creates sounds and vibration patterns in real time rendered both acoustically through headphones and haptically through an ultrasonic surface display. The aim of our device is to further investigate the interactions between synthetic haptic textures and sounds.

DESCRIPTION

THE SYNTHESIZER OF INTERACTION SOUNDS

The sound synthesizer is based on perceptually relevant sound morphologies associated with the recognition of objects (structural invariants) and actions (transformational invariants) in line with the ecological approach to perception proposed by Gibson [3]. The identification of invariant sound structures led to an *Action-Object Paradigm* for sound synthesis in which sounds are described as the consequence of an action (like knocking, rubbing or scratching) on an object, defined by its shape (width, thickness, curvature...), and material (metal, wood, glass, ...). The synthesizer interface is presented Fig.2. The action is modeled by a low-pass filtered noise simulating successive impacts and the object by a resonator, implemented through a resonant filter bank. A perceptual mapping enables continuous transitions between the different categories of actions and objects [2].



Figure 1: The ultrasonic haptic touchscreen.

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THE ULTRASONIC HAPTIC SURFACE

The haptic surface device Fig.1 is based on ultrasonic friction modulation. A glass plate is made to vibrate at a resonant mode and the vibrations cause the finger to slightly levitate from the plate. The near-field acoustic levitation of the finger dramatically reduces the friction between the finger and the screen [9]. Modulating the amplitude of the ultrasonic vibration allows for a controlled modulation of the friction force applied to the finger. Patterning friction as a function of position and velocity of the finger can thereby create the illusion of touching shapes and textures [1].

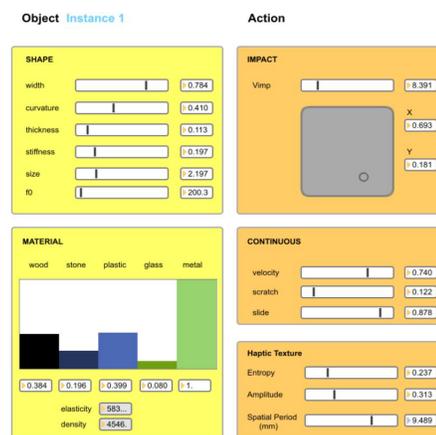


Figure 2: Interface of the interactive sound synthesizer

AUDIO AND TACTILE INTERACTION

Previous research has shown that audition can influence touch while exploring a texture, and the present demonstration aims to exploit such cross-modal interactions to produce realistic and interesting stimuli. Modifications of the spectral density or high-frequency damping of the interaction-produced sound might alter our perception of roughness. This is known as the *Parchment-skin Illusion* [7]. This effect has been rigorously demonstrated on exploration of abrasive papers [4]. It is also possible to influence our scaling of roughness by listening to synthetic sounds instead of recorded, touch-produced sounds [6], but audio and tactile stimuli must be congruent both in intensity [8] and from a spatial point of view [5].

On-site requirements : table and power plugs.

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