A Vibrotactile Music System Based on Sensory Substitution

by

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ABSTRACT

The pursuit of developing adequate artificial receptor systems that are based on sensory substitution techniques calls for increased research on the human senhsitivity to perceive audio information through vibrotactile stimuli. This thesis introduces an experiment, which investigates the human ability to distinguish differences in vibrotactile signals that are generated by musical algorithms and presented through a haptic display, the "SenseAble1.0". In a double-blind study, 7 test participants were asked to identify differences in vibrotactile signals during specific interactive tasks. To ensure reliable masking, the subjects were asked to wear headphones presenting pink noise, so that no artifacts coming from the vibrotactile display were audible under any circumstances. In the first sub-section of the experiment, the absolute sensing threshold (AST) of the individuals was established, normalized to the SenseAble1.0 prototype. In the following sub-sections, the ability to discriminate abstract stimuli such as interval size and pitch direction was examined. In addition, the experiment investigated whether there was a retaining effect noticeable with subjects who received a "tactile training" versus those who did not. Results show variability between individuals, especially in the absolute sensation level and threshold of perception. High performance accuracy was found in the interval tests, which was enhanced through training. However, strong adaptation effects (desensitization) were present and set limiting conditions for the available test and training time.

The subjective testing part of the experiment mainly focused on a practical approach, which included performing live with the SenseAble1.0 as a vibrotactile music system. These performances illustrated to what extent a musical communication between ensemble members and a hearing impaired musician is possible with the current SenseAble prototype. It also served as a basis for researching and designing a future prototype with enhanced spatial resolution properties for perceiving vibrotactile stimuli.