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Title of Thesis: Design and Development of a system to modulate perceptive acoustic effects

ABSTRACT

Acoustic is the key facet in sound related experiments on human subject. Acoustic Source Perception is capability of human to classify incoming sensory information from the surroundings. Perception of acoustic source accurately has advantages for performance of work by human. Perception plays an important role in performance of human under various environmental conditions. Introduction of noise affects the Acoustic Source Perception (ASP) and also decrease the concentration of human subject for a particular task. The acoustic perception differs with low and high frequencies. In low frequencies, the localization of the source is made through perception of phase difference of acoustic sounds and in high frequencies; the localization of the source is made through perception of amplitude difference on the ear level.

In the thesis a graphical user based application of MATLAB is designed to generate the acoustic effect in order to perform experiments related to acoustics. With accessibility of sound cards, advanced processor in this era gives compactness to the user for generating acoustic effects which can be listened through speakers and headset. The main purpose is to create acoustic environment for various experiment related to perception. Further, design of sound generator using MULTISIM with its hardware implementation is done with electronic components. Acoustic Source perception experiments are also performed using this hardware setup. Furthermore, listening tests are performed on simulation based test setup to analyze the sound perception by various subjects. A suitable interface of electronic circuit has been developed for a prototype sound generator. This device consists of an input sound source, amplifier unit, and high frequency speaker module and protection circuit. The output sound level is in the range of 96-103 dB at various frequencies. This prototype worked accurately till 12.1 kHz but with increase in frequency increases the noise components. This prototype is additionally modified

with two channel sound generator and it gives output of 107dB at 14.7 kHz. The device is extremely useful in the range of 98-107 dB SPL. Finally, the compact acoustic source generator is developed which can generate sound in the range of 2-25 kHz. The acoustic source consists of integrated circuitry and speaker module to generate the variable frequency sound. The integrated circuit and speaker module is enclosed in wooden cabinet. The developed acoustic source can be utilized for performing various acoustic experiments. The significant part of this thesis is assessment of acoustic source perception in horizontal plane. The experiment on sound perception was performed on human subjects. For experiments to be performed in horizontal plane eleven Bluetooth enabled speaker (BES) tagged 1 to 11 numbers were placed evenly at 30 degree in a circular outline and input to BES was controlled with the help of computer. Two set of acoustic source perception experiments were designed for this study. In first experiment, buzz sound was used as acoustic source with low fixed frequency (LFF) and High fixed frequency (HFF). The experiments were performed for both LFF and HFF. Initially, set of LFF experiment was performed. The data recorded from the two set of experiments was compared and analyzed. The results show the perception of acoustic source in horizontal plane is affected by the addition of white noise to the LFF and HFF. Furthermore, assessment of acoustic source perception under noise and its comparative analysis is done. Various set of experiments are designed where exposure of acoustic source with fixed frequency on a number of subjects is done. A noise signal is added to the acoustic source to create a noisy condition. Response of the subjects is taken in a tabulated form for the score of the quality of acoustic source. This experiment is designed to analyze the score of sound perception by various subjects. Experimental analysis is shown for the response provided by the subject for sound perception at various frequencies. In one of the research work, effect of aircraft acoustics on human perception is analyzed by using population based questionnaire survey methodology which is conducted at nearby residents of aviation acoustic prone areas. The comparative analysis of acoustic noise during plane takeoff and landing is accomplished for cargo and fighter aircraft. The analysis shows that fighter aircraft produce more noise as compared to cargo aircrafts and may lead to several problems related to hearing and sound perception.