

# Obstacle sensation augmented by enhancing low frequency component for horror game sound

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## ABSTRACT

Horror computer games provide users with a mental stimulation that the real world cannot. Current horror games can provide the user with a visible ghost and stereo background sound to thrill the user. Inspired by obstacle sense- blind people localizing only with hearing, a novel method to augment existence is proposed. Obstacle sense is caused mainly by coloration by reflected sound and the attenuation by shielding. By focusing on the attenuation, we found an effective sense can be created by decreasing high frequency component and increasing low frequency component simultaneously. Experiments were conducted to evaluate our proposal.

**KEYWORDS:** Augmented reality, game background sound, horror game, obstacle sensation.

## 1 INTRODUCTION

Computer games combine the aesthetic and the social aspects in a way the old mass media, such as movies, and novels do not. Horror computer games are one of the most popular categories.

To elicit the emotional reactions of the upcoming frightening events and a more euphoric atmosphere, the fact of obstacle sense inspired us. Human can perceive the existence and the position of non-sound object aurally without visual information. This ability is known as “obstacle sense”. The factors of this perception may include the impression due to the change of acoustic field caused by the reflected sound [1]; the reduction in volume due to absorption-attenuation is another factor [2] (Figure 1).

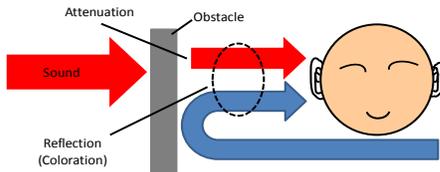


Figure 1. Schematic explanation of obstacle sense.

Our purpose is to “augment” the euphoric atmosphere of horror game background sound based on the principles of obstacle sense. Keeping with our proposal, attenuation caused by relatively smaller objective is set as a fast candidate. The attenuation is mainly observed by high frequency component since it tends to transmit straight and reflect, while the low frequency sound tends to diffract [3]. Two possibilities were assumed. First, drastic decrease of the high frequency component might create a more effective obstacle sense. Second, if human sense the obstacle by comparing the high and low frequencies, a more effective sense can be created by not only decreasing high frequency component, but also “increasing” low frequency component. By conducting

the first preliminary trial, the result showed that the second possibility created a more effective obstacle sense.

## 2 EXPERIMENTS AND RESULTS

Two specific experiments were conducted. The first experiment compared the situation under different cut-off frequencies of low pass filter without volume difference. The sound stimulus was pink noise. The direction and subjective certainty of an obstacle (1~5) were asked to evaluate the effect. The results showed that as the cut-off frequency of low pass filter decreased, the obstacle sense perceived by subjects became stronger (Table 1).

Table 1. Results of experiment 1

Cut-off frequency( Hz)	Rates of correctness	Obstacle sensation certainty
400	91%	3.54
800	88%	3.32
1600	88%	2.92
3200	87%	2.27
6400	51%	1.37
10000	48%	1.30

The second experiment was under the same situation of the first experiment but with volume difference and classical music as sound stimulus. The results showed that when volume was decreased or increased, the subject answered the direction where volume was smaller (Table 2). The purpose of the demonstration is to demonstrate the experiments.

Table 2. Results of experiment 2

Cut-off frequency( Hz)	Volume(dB)	-10		Constant		10	
		Rate	Value	Rate	Value	Rate	Value
400		27%	3.46	56%	3.33	63%	3.23
800		33%	3.90	42%	3.07	70%	3.13
1600		35%	3.37	43%	2.33	63%	3.33
3200		39%	3.47	27%	1.90	80%	3.50
6400		30%	3.47	47%	1.57	70%	3.73
10000		40%	3.47	53%	1.57	63%	3.60

## 3 CONCLUSION

The two experiments’ results showed that human judge the obstacle existence according to the comparative difference in volume.

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