

**The Effect of Reverberation and Echo on the Perception of  
Audio-Visual Simultaneity**

by

Mark Giglio

An Abstract of a Thesis Submitted to the Graduate

Faculty of Rensselaer Polytechnic Institute

in Partial Fulfillment of the

Requirements for the degree of

Master of Science

Major Subject: Architectural Sciences

The original of the complete thesis is on file  
in the Rensselaer Polytechnic Institute Library

Thesis Adviser

Paul Calamia

Committee Member

Jonas Braasch

Rensselaer Polytechnic Institute  
Troy, New York

July, 2008  
(For Graduation August, 2008)

## **ABSTRACT**

The difference between the speed of light and the speed of sound causes visual and auditory stimuli which are simultaneously generated by the same event to reach an observer at different times. Provided this latency is small, the brain combines the two into a single perceptual event. As this delay increases, the perceived simultaneity between the two events is lost. This thesis was designed to study the effect of echo and reverberation on the perception of audio-visual simultaneity. In this thesis, listeners were presented with a range of video samples with varying onset asynchronies of the auditory and visual cues. The audio clips were either anechoic or convolved with computer generated impulse responses to simulate reverberation or echo. Results show a breakdown of perceived simultaneity at -70 ms (audio precedes video) and +220 ms (video precedes audio) for anechoic signals which is in agreement with previous studies. By adding reverberation to the sound sample, an extra 40 ms of auditory latency could be added without affecting perceived simultaneity. In addition, this thesis examines the brain's ability to adapt to a constant audio-visual latency by exposing subjects to the same onset asynchrony 15 consecutive times. The adaptation process was steady for both the anechoic signals and samples with 2.5 seconds of reverberation. Simulations including an echo in the audio track were also tested, but the percentage of responses affirming simultaneity did not reach significant value, possibly due to the implausibility of an echo in a laboratory testing environment.