Presentation for CENIC Annual Meeting
March 15-17, 2004, Marina del Rey, CA

Name: **Distributed Immersive Performance**

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Abstract

We describe a real-time, multi-site distributed interactive and collaborative environment called Distributed Immersive Performance (DIP). The goal of this work is to develop the principles for interactive, live musical performances in which the participants - subsets of musicians, the conductor and the audience - are in different physical locations and are interconnected by multichannel audio and video links. DIP is a specific realization of broader immersive technology - the creation of the complete aural and visual ambience that places a person or a group of people in a virtual space where they can experience events occurring at a remote site or communicate naturally regardless of their location. Our objective is to reproduce this ambience with realism approaching the limits of human perception.

The DIP experimental system has interaction sites and servers in different locations on the USC campus and at several partners, including the New World Symphony of Miami Beach, FL. The sites have different types of equipment to test the effects of video and audio fidelity on the ease of use and functionality for different applications. Many sites have high-definition (HD) video or digital video (DV) quality images projected onto wide screen wall displays completely integrated with an immersive audio reproduction system for a seamless, fully three-dimensional aural environment with the correct spatial sound localization for participants. The system is capable of storage and playback of the many streams of synchronized audio and video data (immersidata), and utilizes novel protocols for the low-latency, seamless, synchronized real-time delivery of immersidata over local area networks and wide-area networks such as Internet2.

We first describe our initial realization of immersive technology, an on-demand unidirectional Internet application called Remote Media Immersion (RMI). We then concentrate on the concepts and technical challenges of creating a Distributed Immersive Performance Environment. We describe the DIP experiments conducted in the past year, including a cello master class (asynchronous playing) and two collaborative performances (duets, synchronous collaboration), documenting the experimental setup and the musicians' experiences.

The DIP environment is a platform for multimedia creation, archiving, representation and transmission of electronic experiences. It facilitates new forms of creativity by enabling remote musical collaborations. Musical collaboration demands a level of fidelity and immediacy of response that makes it an ideal testbed for pushing the both the limits of human perception as well as current technology. The performance of such an experiential system can be measured and quantified through the capture, replay and analysis of digital music signals. We discuss several technical challenges common to the DIP scenario and a broader range of applications. These challenges include: (1). low latency continuous media (CM) stream transmission, synchronization and data loss management; (2). low latency, real-time video and multichannel immersive audio acquisition and rendering; (3). real-time continuous media stream recording, storage, playback; (4). human factors studies: psychophysical, perceptual, artistic, performance evaluation; (5). robust integration of all these technical areas into a seamless presentation to the participants. Finally, we describe the relation of DIP to immersive, collaborative interaction projects at other institutions.