Soundscape Performance Works via Interactive Environment for Immersive Audiovisual Scene Generation

JOINT DETAILED PROJECT DESCRIPTION

1. Joint Project Summary

This project calls for:

1. The development of rich, immersive real-time audiovisual framework that supports environments for both artistic creations, such as music, image and theatre, as well as high fidelity telepresence applications, such as distributed musical performance or collaborative engineering design. The framework provides model-based scene generation, and an audio equivalent that we call the "*soundscape*": a modeled audio performance space consisting of sounds and sound objects (audio sources and sinks). These objects may be represented in space as graphical objects (including light sources) with computational properties for modulating audio streams. An important aspect of our integrated audiovisual framework is that both soundscape and scene generation are integrated in the same 3D space, using the same geometry and object descriptions, and making it possible to deal with sound and light interchangeably.

2. The development of interactive musical instruments, based in the concept of a spatial tablature for performance; and the production of a series of live music performance works, conceived for the framework described above, and incorporating use of these instruments. Note that the works will be performable in a framework that uses inexpensive commodity hardware; they will not be venue-limited by exigent technical requirements or production costs.

Both artist, Settel, and scientist, Cooperstock are intent on co-developing the framework described above, with different objectives in mind: Settel will develop musical instruments, performance frameworks, and create music for live performance, while Cooperstock will integrate immersive audio implementations in his immersive multimodal interactive environments (e.g. Shared Reality, etc.). Advances by each collaborator will be highly transferable to the other.

Human resources are mostly required for this project, drawing mainly on students and named collaborators in the project.

2. Concept

In computer-generated movies, a story is modeled; pertinent objects, characters, scenes, and even point of view (e.g. objective or subjective) are specified in the 3D model; they interact as the model is rendered from one moment to the next. In this way, the computer model is like a theatre set where action takes place. The key point in common our framework has with computer-based animation systems is the importance of the computer-based model and its ability to immersively render objects and action in space. However, unlike these systems, our model-based framework provides us with a setting (audiovisual environment) or performance space where sonic action is deeply incorporated, and where audio and musical interaction can happen—from the creator's (performer's) point of view.

The underlying concept is that sound may be modeled, represented and manipulated in much the same way that light can be, with intensity, direction of travel, dispersion, refraction, panning, reflection etc. We are constructing a soundscape (framework for an audio space), where the behavior of light is used as an analog for the representation, behavior and manipulation of sound in 3D space. The same model-based graphical interfaces with lighting, that have been used so effectively for 3D computer games and computer-generated animation can be used in our framework to provide users (or performers) with unusual and effective ways to immersively work with sound.

This framework will support the music production in this project, making it possible to realize: (1) radically new designs for musical instruments that exploit the higher dimensional audio space of the framework, (2) new performance pieces that integrate these instruments, and (3) new performance contexts/situations for these pieces to be performed in. In addition, new approaches to music score representation are likely to emerge.

The significance of this approach lies in part on its utility for diverse application domains, including the development of immersive audio environments for telepresence, where spatial attributes of sound, such as orientation, intensity, diffusion, etc., are highly important but often overlooked factors that affect one's perception of the realism of the environment.

3. Overview

3.1 Background

A primary scientific inspiration for this project stems from the demands imposed on the user in terms of the complexity of computer interaction for creative tasks. We focus on the refinement of authoring and performance tools to a degree where one can begin using these creatively without an inordinately steep learning curve: functional transparency. Below are three pertinent examples:

The first example involves electro-acoustic composition/performance, and is offered directly by the artist applicant. As audio processing techniques have advanced, the control requirements for electro-acoustic instruments have become increasingly demanding (distracting) of the performer: their instrumental technique alone is not enough to play their instrument as an increasing amount of computer operation is required. In short, the Settel's conventional electro-acoustic approach to composition and instrument design is breaking down. Proposed in this project are promising new and effective ways to balance (electro-acoustic) instrumental complexity with performing transparency.

Another example was presented to us by colleagues in the Department of English at McGill University, who wish to use computer technology for the recreation of historical stage sets from the Shakespearean era and to permit students of Shakespearean theatre to immerse themselves in such environments, so as to rehearse a particular play while surrounded by virtual} actors or avatars. The creation of these stage sets encompasses both visual scenery and acoustic effects, drawing from resources of textual descriptions, drawings, and photographs, while interaction with the avatars requires that these be programmed to locomote and *speak* their lines at appropriate times. While these ideas are hardly novel in the context of Hollywood special effects generation, the concept of empowering the theatre major to create and manipulate the scenes and actors without becoming a computer programmer is revolutionary.

As a third example, consider the conventional pro-audio recording/post-production studio, where multi-channel audio (surround sound) signal processing offers many new possibilities: there are more things to do with more channels of audio. However, in order to perform dynamic panning and multi-bus effects processing on a signal, several hands are needed, or off-line multi-pass processing is required. While the desired task is simple to imagine, it remains difficult to realize. A new approach, discussed below, offers greater functional transparency, making it possible to perform such a task simply and in real time (see videoclip: “soundscape.mov”).

Important to the transparent execution the complex tasks described above, is the provision of a suitable user interface that responds in a rich manner to gesture and bi-manual manipulation, such that the user is freed from the confines, complexities, learning curves, and most importantly, abstraction, of traditional keyboard-and-mouse operation.

3.2 Core

Central to this project is the development of an integrated audiovisual space where actions, objects, content streams, and users have representations and interact in real-time within a 3D modeled framework for sound and image (including modeled light). The framework lends especially well to the kind of applications we work with. These applications utilize deeply immersive environments to support artistic creation and performance for music, image and theatre, and to support high fidelity telepresence, such as distributed musical performance or collaborative engineering design.

In our framework, the 3D audio space, which we call the "*soundscape*", and the 3D scene generation are integrated in the same 3D space. The *soundscape*, consists of sound objects (audio sources and sinks), which may be represented in space as graphical objects (including light sources) with computational properties for modulating audio streams. Both the soundscape and the 3D scene generation use the same geometry and object descriptions. Sound and light representations and behavior can be based on the same physical model, which describes, for example, diffusion, reflection, refraction, absorption, dissipation, etc. This makes it possible to deal with sound and light interchangeably. Additionally, the user's (or performer's) presence in 3D space is modeled. Their position and orientation is dynamically tracked as they interact with the environment; the data that is captured by movement detectors is used to update the model of the user within framework described above.

The power and appeal of using this framework is that:
(1) it yields rich and seamless user (musical instrument) interface possibilities, allowing a singer, for example, to direct their voice in a sound sensitive space, in the way that one shines a flashlight to reveal features in a dark space. Or it allows a singer to use the position of their head to direct their voice to "virtual microphones" located in the soundscape (modeled audio space). It provides a spatial tablature for the instrumentalist.
(2) It provides alternative and efficient ways to perform audio processing. For example, recording studio engineer can perform surround-sound panning using the modeled diffusion properties of a given sound source to determine the spread pattern of the sound in the speaker field.

Most important, given the multi-disciplinary nature of this project, this approach provides a way to create musical instrument control interfaces, which are seamlessly integrated to sound generation and the performer's technique. In tandem with the development of the framework, will be the development of interactive musical instruments and the production of a series of live music performance works, conceived for performance in the framework described above, and incorporating use of these instruments.

4. Collaboration

Both principal applicants, Settel (musician) and Cooperstock (scientist), have collaborated previously (http://www.aes.org/technical/nyu.html, http://www.google.com/search?q=sat+cooperstock+settel&ie=UTF-8&oe=UTF-8). Both are keenly interested in:

1. Model-based real-time audiovisual environments which support scene generation.
2. Sound-source simulation (using multi-channel audio diffusion) and 3D audio modeling.
3. Multiple audio layers (polyphony).

Both collaborators are intent on co-developing the framework described above, with different objectives in mind: Settel will develop musical instruments, performance frameworks, and create music for live performance, while Cooperstock will integrate immersive audio implementations in his immersive multimodal interactive environments (e.g. Shared Reality, etc.). Advances by each collaborator will be highly transferable to the other.

In addition to having a shared common technical focus, Settel and Cooperstock bring to each other valuable experience and solutions to pertinent problems: for example, Cooperstock offers Settel a solution to the problem of multi-projector image continuity or multiple projector calibration; while Settel brings his latest work in Sound Source Simulation and gestural musical instrument control to the collaboration.

The structure for collaboration is based on research/development and artistic production, incorporating a significant degree of involvement in each area by both artist and scientist. The production component will serve as both a prototyping vehicle and platform for artistic creation, providing needed experience for successive advances and iterations (artistic and scientific) in the evolution of the project. Settel will direct the production of performance pieces for the framework, while Cooperstock will direct the research and development for the development of the framework; both will collaborate in the framework's conception, design and specification.

The co-development and exploration of the audiovisual framework for artistic purposes also has practical benefits including the improvement of videoconferencing systems, where the modeled realism of sound source location and behavior can render the audiovisual space significantly more coherent, conveying a greater sense of co-presence for the participants.

5. Artistic Vision

The text in this section is presented by the artist applicant

The artistic vision underlying the approach described in this text is focused, intense and passionate. It reflects years of working with, and composing for instruments with live electronics. At the same time, it also reflects an excitingly new and major shift in my approach to creating music, instrument design and performance situations.

5.1 The Musical Experience

In order to provide the reader with a more concrete idea of what a performer (and audience), might experience during performance, imagine the following from the singer's subjective point of view (see soundscape3.jpg).

"You are wearing a wireless microphone headset, and a head orientation and position sensor. You are singing on stage while your sound, represented as a flashlight-style beam, is casting light on to sound-sensitive objects in the projected space around you. The louder you sing, the wider the beam of light becomes. The objects instantaneously process the sound of your voice (echo, reverb, transposition etc.) when you sing in (shine in) their direction. As you rotate your head, the lighted area in front of you moves around the space accordingly, casting light (sound) directly on to other sound-sensitive objects--sometimes more than one at a time. At all times, you are controlling where your sound is going in the space, and therefore, how it is being processed".

5.2 Relevance

Having realized an initial study using this new approach (see espace-v.html), it is already quite clear to me that this approach promises to provide solutions to the problem (discussed in section 3.1), making it possible to play complex instruments without having to operate the computer in the process.

But most important, the framework described in this project offers a radically different way of thinking about, and interacting with, sound and music: the performer is immersively surrounded by projected image and multi-channel audio; while sound is conceptually represented, manipulated and produced via computer-based 3D modeling, which uses the behavior of light as an analog for the treatment of audio. In short, the production and the control of sound is integrated conceptually and physically in the soundscape, which as a performance framework, offers possibilities for use in installations, conventional concert venues, distributed performance configurations (with our without audience).

Working in this way involves serendipity, favors musical discovery, and is quite simply, extremely exciting and inspiring to me.

6. Technical and Scientific Issues

Our primary scientific goal is to develop a novel gestural interface and test the limits of its fidelity, expressiveness, and learnability in the context of immersive environments applications. This entails development along two parallel tracks of gesture recognition and integration of these gestures into immersive authoring applications, both for graphics and audio.

6.1 Scientific Challenges

1. Development of a seamless 3D model which coherently integrates objects in the 3D scene space and soundscape, and which provides a modeled representation of the user (performer). This includes merging diverse scene content, such as synthetic images and sounds with live audio and video streams.

2. Development of appropriate interfaces for navigation and interaction within the space, including, the development of virtual light source effects. The user is tracked and represented in the 3D model driving the scene generation engine, virtual light sources may be used to produce lighting effects, including illumination and shadows, as a consequence of the user's position and movement in the modeled space. This technique allows us to indicate the user's presence in the surrounding scene space and soundscape, forming the basis of a richly immersive navigational user interface(see flashlight1.jpg, and shadow2.jpg).

3. Integration of systems for 3D scene generation, video tracking of people, user-orientation tracking, gesture recognition, camera-projector calibration, sound synthesis and sound source modeling.

4. Development of a content authoring environment for artistic production in soundscape.

5. Develop a control layer for remote soundscapes in distributed performance (collaborative) applications, to provide for audiovisual stream synchronization, and for environment and user-presence parameter linking.

6.2 Infrastructure

We propose the use of immersive, sensor-driven, multimodal, interactive environments as the physical and computing infrastructure for this project. Our “next generation” Shared Reality Environment, currently being deployed, provides this infrastructure, including six high-resolution (SXGA) LCD projectors, whose overlapping regions of front projection encompass a space of approximately 20 x 8 x 8' with fixed display surfaces along three perpendicular walls. The continuing work on occlusion detection for front projection, currently being developed by Cooperstock (see camproj.mov and shadow1.mp4) will be integrated in the environment.

We can simulate the effect of foreground scenery or avatar characters moving toward the front of the stage by lowering small sections of screen material from the ceiling, initially positioned very close to the wall, and translating these in depth as appropriate. Obviously, as the distance between a mobile screen and the fixed wall surface behind it increases, the range of allowable audience view angles that preserve this *illusion* would decrease. Therefore, this effect may be of greater importance for the human actors themselves, allowing them to visualize foreground stage scenery or avatars beside, or in front of, their own positions.

6.3 Graphics

On the graphics front, we plan to exploit software based on the popular Quake, which, importantly, provides editing capabilities *within* the rendered space. The integration of rendering and editing provides users the direct and immediate experience of visualizing their edits, just as WYSIWYG word processing displays the “final product” at all times. This capability is critical for the casual, non-technical user, but equally important is the move away from a computer-centric abstract menu-based interface for interacting directly or more naturally with content: the orchestra conductor is rarely, if ever seen leading the orchestra with a mouse.

6.4 Audio

Multi-channel audio output is provided by an array of eight loudspeakers and one sub-woofer, controlled through the Zeep Sound Source Simulation software. At the core of the audio framework is a real-time 3D-modeled low-latency (10ms) audio environment which receives audio signals and sensor information (position and orientation) from each performer, and which outputs multi-channel audio, and a "camera-view" wall-projected image of the soundscape where the sounds can be displayed, and where audio interaction occurs. Each view requires a networked computer-projector pair. Multiple views are possible for full (360 degree) surround projection, which is our ultimate goal. The audio framework is programmed in PureData/GEM-OpenGL, and can run on inexpensive Linux hardware.

6.5 User and Gesture Tracking

A key feature of the proposed interface for interaction in the soundscape is gestural control mapping for sound manipulation. The interface borrows from the flashlight model (see flashlight1.jpg and "voyeur2.mov"), where the user points a beam of light at some objects in space they are interested in. With our interface, the performer's instrument, say the voice (head), will be "pointing" or aiming its sound at audio processing objects in the soundscape. Thus, it is necessary to track the orientation of the performer's instrument (or singer's head); this will be done using relatively the relatively inexpensive 3D wireless magnetic sensors that La Kitchen, a project collaborator, is currently developing. These sensors provide an angle of rotation for each of three axes, with an excellent time resolution.

The crude gesture recognition work currently being developed by Cooperstock (see cgesture1.mov) will eventually be incorporated in the soundscape for meta-control. While, Settel and project collaborator, Marcelo Wanderley, of McGill's Music Faculty, will concentrate on the development of a spatial tablature interface for musical instruments (including voice).

Gestures consist of both a static (shape or pose) and dynamic (trajectory) component. These may be recognized using a variety of systems, most of which, are currently available in the labs of Cooperstock, or Wanderley), including video-based methods employing multiple cameras that observe special tags (e.g. colored markers or IR emitters), data gloves, or magnetic coupling devices (e.g. the Ascension "Flock of Birds" or the Polhemus "Fastrak"), which we will likely use for prototyping purposes.

7. Integrated Workplan

Settel and Cooperstock will be working closely on a day-to-day basis throughout the project. The work will take place at the Lab for Intelligent Machines at McGill. As mentioned earlier, their collaboration is based on research and production, with a high degree of co-involvement in both areas. The workplan below describes the main scientific and artistic work to be done; most of which is co-dependent and will be carried out in tandem. Implicit to the plan is the use of artistic production as a test bed for experimentation and prototyping in the overall development stages of this project. Implicit to the work described below is the incremental development of the soundscape, and the production of content (models, graphics, sounds etc.) for the realization of each successive musical performance work.

7.1 Milestones

2004-10-01 ------- 2005-04-01

Develop soundscape environment

Provide model-based framework for display and manipulation of audio signals; includes functional DSP and graphical representation.

2005-02-01 ------- 2005-08-01

Integrate soundscape with immersive scene engine extending 3D-modeled world to include complex sound behavior and manipulation.

2004-10-01 ------- 2006-09-30

Content Authoring
Incorporation of existing audio and graphical frameworks for content authoring (e.g. file structures, software, interface tools) and incremental extensions of same.

2004-10-01 ------- 2005-10-01

Seamless interface design and construction
Modeling user presence and development of 3D interface for manipulation incorporating position, orientation, gesture and analysis of audio input for content manipulation, navigation and meta-control.

2005-10-01 ------- 2006-09-30

Initial Production Environment
Arrival at point where actual musical production can begin and continue through remainder of project

2005-11-01 ------- 2006-09-30

Distributed Collaboration Support
Support for synchronization, e.g. echo-suppression for polyphonic input, distributed manipulation of synthetic audio and graphic elements of the environment.

Artistic Production Schedule

The production of performance works serves a vital role in the collaborative advancement of the project. The planning of the performance works below, is synchronized with the parallel development work of Cooperstock and others, outlined in the milestones section above. Thus the performance works will gain incrementally in complexity from one to the next, advancing in three distinct phases.

2005-02-01 ------- 2005-08-01 : Preliminary Studies for Soundscape

- *Solo for Voice*, piece for singer with electronics using "Virtual Microphone Array" instrument with no projection (image/graphics).
- *Solo* for Instrumentalist for "Virtual Microphone Array" and one-screen (view) projection.
- *Duo* for local and remote musician, featuring one-screen projection, with IP-based remote musician. The soundscape environment will feature one remote sound source and sink.

2005-08-01 ------- 2006-03-01 : EspaceV Series for Soundscape

Realization of the following performance works:

- Solo for Voice with four-screen projection.
- Duo for voice and percussion, featuring multiple-screen projection.
- *Trio* for local singer with two IP-remote instrumentalists featuring multiple-screen projection, and representations of two sets of remote sound sources/sinks .
- *Trio* for local singer two IP-remote singers, featuring multiple projection (3 views: thee computer-projector pairs).

2006-03-01 ------- 2006-10-01 : Larger-scale performance works for Soundscape

- Split Septet for four local performers and three remote singers: multiple (four or more) surround screen projection.

- Soundscape audio installation for general public: Multiple microphones, local and remote visitors in linked shared performance environments with interactive audio.

7.1 Work Description

The work described below covers both scientific development and artistic production efforts.

General Environment

Environment Definition: The various databases and model descriptions, comprising sound and graphics objects, interface maps, and I/O configurations must be defined.

Content Construction: For applications, and for each performance work, there will be additional classes of sound and graphic object configurations required as per the dictates of the works. Some initial configurations will need to be assembled for testing and later, a simple tool should be developed to allow the user to modify these configurations as desired. Gradually a library of reusable soundscape objects for the artistic productions will develop.

Graphics Environment: Using the OpenGL-based environment called PureData-GEM (PD/GEM), we will construct a 3D environment providing navigation and measurement tools, and view (camera) management. This effort is already well underway, with two concrete production systems having been developed by our group, one for sound object display and a second for video overlay and real-time perspective transformation. The bulk of the remaining work involves adding necessary functionality to OpenGL-PDGEM, such as shadow rendering, a light source object with adjustable geometry, a camera with adjustable lens geometry (for contiguous multiple view/projection situations), and a real-time waveform-to-texture map object.

Audio and Sound-Source Simulation: we have already developed software for highly configurable real-time sound source modeling under MAX/MSP. This is now being ported to PD for greater flexibility and integration with our other systems. Additional development of the simulator will be realized to include higher-order reflections, as well as source diffusion properties, for use in the Soundscape environment. Additionally, echo-suppression will be implemented for monophonic applications, and then for polyphonic ones.

7.2 Sensor Integration

Orientation Sensors: we will incorporate orientation sensors, including La Kitchen's wireless 3D magnetic sensor, which provides an angle of rotation for each of three axes, in order to determine the pose of the performer or user. We will need to develop a wearable harness, or microphone mount for this unit. A similar one dimensional inclination sensor will be used to sense the rotation of the microphone.

Position Sensors: likely utilizing video, as presently developed for our Shared Reality applications. We can detect and track a reasonably accurate outline of a user from a number of cameras and fuse this information together in order to obtain 3D data that is subsequently analyzed by our gesture recognizers.

Biofeedback Sensors: these have been made available to us through our collaboration with Thought Technology; their role in this project is of an experimental nature, which our collaborator Dr. Meyers will be exploring.

Gestural mapping: Professor Wanderley, our collaborator from McGill's Music Technology area will be providing equipment and assistance with movement detection systems and gestural mapping for musical instrument control.

7.3 Communication and Gesture

Network transport: we have developed a highly powerful network transport for the low-latency delivery of audio, video, and other sensory data. This software will be expanded to transmit metadata information, such as model selection, environment configuration, and object attributes as they are modified, so as to support distributed interaction across two or more soundscape performance spaces environments for distributed musical performance.

8. Project Team

8.1 Researchers and Artists

Jeremy Cooperstock (Associate Professor, Electrical and Computer Engineering): Jeremy will act as lead scientific investigator, supervising the research associate and graduate students in electrical and computer engineering who are working on the project on topics of video tracking, gesture recognition and interpretation, network communication, and integration of other sensors within the environment.

Zack Settel, composer and media artist, will be the chief artist, and direct the artistic research and production.

Marcelo Wanderley, assistant professor, Faculty of Music: Marcelo will collaborate with us on tracking, gesture analysis, and interface design. He is a recognized expert on the design of novel interfaces for musical expression. Wanderley's participation in the project will be related to the design of new musical instruments controlled by gesture. He will also contribute laboratory resources to the project, including hardware such as the Polhemus Liberty 6Dof Tracker, a Vicon System 460 with 6 M2 cameras and software for the analysis and modeling of movements, and an electronics development laboratory specialized in sensors for musical applications.

8.2 Industrial Participation

Dr. Hal Myers, President of Thought Technology, has agreed to loan to our project two ProComp+ multi-channel biosensor systems with necessary software. Dr. Myers also plans to invest a significant amount of time, assisting our project on aspects related to use of the scene creation system for therapeutic purposes. The use of these kinds of sensors will be explored for eventual use in the production of one or more of the performance pieces of the project.

“La Kitchen”, is an internationally renowned research and production organization involved in applied research and software development in music technology, audio, and image processing (see Annex material). Currently they are developing a low-cost prototype sensor for 3D orientation (angles of rotation on three axes). La Kitchen has agreed to collaborate with our team on this project, and will provide consulting and support in their area of expertise: gestural interfaces, including hardware design for movement tracking, and software design for gesture recognition.

8.3 Benefits of participation to artist, scientists, and industrial partner

The Soundscape exists as an idea and a proof-of-concept (see demonstration perfView.jpg). The development of the soundscape and the musical creation that will emerge, depends on the realization of a project of this kind and scale; the resulting artistic and scientific gains will be considerable. The results of this project will also have practical application for both artistic creation and production efforts and will provide a valuable set of benchmarks for investigating the capabilities of high-resolution video tracking algorithms and comparing traditional keyboard-and-mouse with novel gesture-based interfaces.

9. Project Management

9.1 Intellectual Property

As grant-funded research, the scientific components of this work are subject to the terms of McGill's Policy on Intellectual Property; ensuing works of commercial value are shared on a percentage basis between the inventor and the university. Prior IP belonging to the parties (e.g. Zack Settel's audio sound source simulator, Thought Technology's biofeedback systems, La Kitchen's gestural recognition software, etc.) remain their own.

9.2 Evaluation of Collaboration and Research Outcomes

Evaluation of the scientific research outcomes will be based on publications in peer-reviewed conferences and journals and contributions to the start of the art in data visualization methods. Similarly in the arts community, the work will be diffused and reviewed in publications and will be submitted for presentation in electronic festivals such as SIGGRPAH and ARS Electronica.

With respect to the collaboration itself, it is understood that the milestones associated with applications (e.g. development stages of the framework and performance works) will each require a tight cooperation between the scientific and artistic components. As planned, the development of the necessary tools for each such task are based on an iteration between technical specifications and capability, artistic creativity and experimentation. Thus, achieving a reasonable degree success for each milestone would be indicative of successful collaboration between the applicants.

9.3 Dissemination of Results

Artistic

As mentioned above, the performance works realized in this project are intended for live performance; the underlying technical performance requirements are relatively modest, making it reasonable to present them in performance (installation or presentation) venues. Performance and presentation conformations for 2005-6 have been made; it is assumed that confirmations for 2006-7 will be forthcoming.

The following organizations solidly support the project, and have confirmed (see Appendix) the engagements below:

1. Groupe de Musique Expérimentale d’Albi (GMEA), France; season 2005-6; Invited Artist / Presentation.
2. Elektra Festival, Canada, Season 2005-6, Performance.
3. Société des Arts Technologiques (La SAT), Canada, Season 2005; Performance / Presentation.
4. Chants Libres, Canada, Season 2005-6, Performance / Presentation / Workshop.
5. Groupe d'Expérimentation Plastique du Sonore (GEPS), France; season 2005; Invited Artist / Presentation / Concert.

The following organization has indicated an interest in featuring the works; but we have not yet received confirmation:

6. Banff Center Media Arts Program, Canada, Season 2005-6; Performance / Presentation / Co-production for new work.

Scientific

The scientific contributions of the project in terms of technology (gesture recognition, video tracking) and integration of these in target applications (scene editing, networked collaboration) will be published in relevant conferences and journals.

Appendix

Images

(also on-line at http://www.zeep.com/soundscape)

Sheet 1:
4 soundscape1.jpg
Detailed description of the Soundscape content

5. soundscape2.jpg
Objective view of the Soundscape

6. soundscape3.jpg
Subjective (performer's) view of the Soundscape

Sheet 2:
7. espaceV_layout_1.jpg
Sketch of the Espace-V performance space logistics

8. espaceV_performance_4.jpg
Sketch of Espace-V during performance

9. espaceV_content_1.jpg
Sketch of the Espace-V soundscape content

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