



SIGGRAPH96

Creating and Manipulating Sound and Music to Enhance Computer Graphics Courses # 17 and 18

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CREATING AND MANIPULATING SOUND TO ENHANCE COMPUTER GRAPHICS

I Algorithms and Techniques

This course introduces concepts of digital sound synthesis and manipulation, discussing theory, algorithms, and issues in the computation of sound alone, and combined with graphics. Specific topics include psychoacoustics, algorithms for audio synthesis and processing, and networked audio. The strengths of each algorithm for particular classes of sounds will be covered.

II Applications and Demonstrations

This session will involve specific applications and demonstrations illustrating the use of sound synthesis to enhance graphics applications. It is designed to present alternatives to sampling synthesis for those who want to apply more expression in the control of audio. Specific topics will include sound in GUI-controlled applications, in animations, Virtual Reality, HTML and VRML.

Speaker Biographies

Perry R. Cook attended music school at the University of Missouri, Kansas City Conservatory of Music, and engineering school at the UMKC School of Electrical Engineering. He then earned Masters and PhD degrees in EE at the Stanford University Center for Computer Research in Music and Acoustics (CCRMA), researching the physical modeling of the voice and musical instruments. While at CCRMA Perry also researched and created a number of controllers for expressive real-time music synthesis, and software for interactive music performance and composition. In 1993-4 he was Senior Research Scientist for Media Vision (now AuReal) Inc., designing silicon and software for music synthesis and processing. He returned to CCRMA as Technical Director in 1994, researching and teaching voice analysis/synthesis and psychoacoustics. In January 1996, Perry joined the faculty of the Computer Science Department of Princeton University, with a joint appointment in the Music Department. He continues work in physical modeling, expressive controllers, and psychoacoustics. Perry will be teaching and researching Human Computer Interface Technology, with his interest in how the performer/musician interfaces with the instrument driving projects both in connecting humans to computers and sound, and in the construction of “virtual” performers.

Robin Bargar is a composer working in acoustic and visual media. He has performed real-time image-sound works with the Cleveland Orchestra, National Symphony, Cincinnati Symphony and others. Recent performances and presentations include the Second International Symposium on Electronic Arts; the SIGGRAPH Electronic Theater 1991, 1993, and 1995; and the International Computer Music Conference 1991-1995. Mr. Bargar has been guest lecturer at Tokyo University, the Institute Universitari de L'Audiovisual, Barcelona, and University de Nice. He was a finalist in the 1991 International Electro-Acoustic Music Competition in Bourges, France. The Listener, a computer animation created by Bargar and artist Chris Landreth received the NICOGRAPH 1990 and 1991 Arts and Entertainment Award and the 1991 Special Multimedia Prize (Tokyo, Japan). This work was syndicated on MTV's Liquid Television. In 1996 Mr. Bargar and Mr. Landreth received an Oscar Nomination for the category "Best Short Film, Animated," for their computer animation, the end. This animation also received the Special Award for 3D Animation, PIXEL-INA Awards, and the Special International Award of the SACD (Society of Dramatic Authors and Composers) for Excellence in Narrative Structure, at the Imagina Festival, Monaco, February, 1996. At the National Center for Supercomputing Applications Mr. Bargar established the Audio Development Group, where he currently directs research concerning sound synthesis and composition for computer graphic and virtual environments.

Adrian Freed has been responsible for software and systems development at CNMAT since 1989. Before moving to CNMAT he co-developed the Reson8, a multi-processor signal processing engine based on the Motorola DSP56000 that was optimized for resonance sound synthesis, sound mixing and spatialization. Before this he developed hard disk audio recording technology at WaveFrame. His pioneering work on graphical user interfaces in audio post-production, the MacMix program, resulted in Studer Editech's widely respected Dyaxis system. His debut in the computer music field came in 1982 at IRCAM where he was responsible for computer systems.

Xavier Serra is currently in the faculty of the Pompeu Fabra University and Executive Director of the Phonos Foundation of Barcelona. He is the head of the Music and Technology Department of the Audiovisual Institute. His research activity is centered on digital sound synthesis and processing and in audio for interactive applications, areas in which he has published technical articles and has been invited to many specialized conferences. He received a Ph.D. in Computer Music from Stanford University in 1989 at the Center for Computer Research in Music and Acoustics (CCRMA). He was Chief Engineer at Yamaha Music Technologies from 1989 to 1991 and has been a professional musician for many years.



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Sound and Music for Graphics 1: Algorithms and Techniques

Morning (Course 17) Contents:



	page#
1) Welcome, overview of course, speaker introductions	i-viii
2) Sound in Digital Media, Some Opening Thoughts	1
(a) What you Might Be Thinking About Sound (Isn't Sampling the End?)	
(b) What We Hope You Will Think About Sound (If Sampling Isn't The End, What Else is There?)	
(c) Parallels Between Sound Synthesis and Animation/Rendering	
(d) Goals, and How We Propose to Achieve Them	
(e) Integrating Sound and Graphics: systems issues	
3) Views of Sound	25
(a) Time Domain and Frequency Domain	
(b) Production and Perception	

4) Survey of Synthesis and Processing Algorithms	37
(a) Additive Analysis/Synthesis	
(b) Subtractive Analysis/Synthesis	
(c) Non-Linear Synthesis (FM, WaveShaping)	
(d) Spectral Modeling	
(e) Modal Synthesis	
(f) Physical Modeling	
5) Controlling and Scripting Sound Synthesis and Processing	69
(a) Note and Event Lists, MIDI	
(b) Relations to HTML, VRML, etc.	
(c) Firewire, LAN's	
(d) Coherent, multiplatform control from Tcl/TK, Matlab, MAX, Visual Basic, Java, C, C++	
6) Synthesis Platforms, Software Environments, and Computing Issues	95
(a) MIDI modules vs. Sound Cards vs. Software Synthesis	
(b) Reliable, low latency control and Real-Time Issues	
(c) Networked Audio	
(d) Synchronization with Gesture and Graphics	



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Sound and Music for Graphics II: Applications and Demonstrations



Afternoon (Course 18) Contents:

- 7) Re-Welcome, afternoon overview, (re)introductions i-viii

- 8) An Introduction to using the Software 115
 - (a) FM, Modal, and Subtractive Synthesis
 using "Synthesis ToolKit"
 - (b) Physical Models Using the "Synthesis ToolKit"
 - (c) Controlling spectral transformations
 using the SMS software
 - (b) Real-time Additive Synthesis and Control
 using "CAST" (CNMAT Additive
 Synthesis Tools)

- 9) GUI Controlled Sound, WEB Applications, 137
 and Animation
 - (a) Controlling Sound with Basic GUI Controls
 and MIDI
 - (b) Sound Connected to Animation software
 - (c) Sound Connected to WEB applications
 - (d) WEB applications for sound transformations
 and morphing

Presentation and Demo Only:
(no course notes on sections 10-12)

10) Animation Applications and Demos
 Selected Animation Projects by all Presenters

11) Web Demos and Guided Tour of Interesting Sites

12) Wrap up

Appendices:

Robin Bargar, Links and References

Adrian Freed, Links and References

Other Course-Related Links

Perry Cook, “Synthesis Toolkit in C++ Version 1.0”

Xavier Serra, “Current Perspectives in the
 Digital Synthesis of Musical Sounds”

Xavier Serra, “Reference for the Spectral Modeling
 Synthesis Software”