Synthesis of environmental sounds in multimedia applications
Munteanu, E.; Darvishi, A.; Guggiana, V.; Schauer, H.; Rauterberg, G.W.M.; Motavalli, M.

Published in:
Educational multimedia and hypermedia : Graz, June 17-21, 1995 : proceedings of ED-Media 95, World Conference on Educational Multimedia and Hypermedia

Published: 01/01/1995

Document Version
Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

Please check the document version of this publication:

• A submitted manuscript is the author's version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
• The final author version and the galley proof are versions of the publication after peer review.
• The final published version features the final layout of the paper including the volume, issue and page numbers.

Link to publication

Citation for published version (APA):
Synthesis of Environmental Sounds in Multimedia Applications

Eugen Munteanu, Alireza Darvishi, Valentin Guggiana, Helmut Schauer
Department of Computer Science, University of Zurich, Switzerland
E-Mail: munteanu@ifi.unizh.ch

Matthias Rauterberg
Usability Laboratory, Work and Organizational Psychology Unit
Swiss Federal Institute of Technology (ETH), Zurich, Switzerland

Masoud Motavalli
Swiss Federal Laboratories for Material Testing and Research (EMPA), Dübendorf, Switzerland

1 Introduction

This paper presents work in progress on automatic generation of "environmental sounds" based on physical
modelling. The increase in complexity of the Graphical User Interfaces and the expansion of Virtual Reality
and multimedia applications has led to the necessity of using sound to ease the human computer interaction.
This category of sounds can be used as non-speech audio presentation of objects and as interaction mechanisms
non-visually interfaces. They occur in everyone’s experience and exclude the necessity of previous special training.
They are also very suggestive, permitting the meaningful mapping of events from the real world to computer-
related activities and are not annoying for the user.

2 The Approach

Every sound could be described as result of interaction between objects in specific environments. Each interaction
has attributes that influence the generated sound. One can distinguish between object-specific and context-specific
attributes. The first category includes material parameters, shape, size and allows us to find for each object a
physical model (i.e. the equation of motion with boundary conditions and their solutions), assuming that the
natural modes of vibration are at the origin of the sound. The second one includes parameters such as: position of
the interaction point related to the body of objects, the speed and force at the moment of interaction, etc. These
attributes control the manner in which the individual natural modes of vibration are excited (initial spectrum of
the sound), the behaviour of their amplitudes in time (modal damping), and the overall decay of the sound wave
(system damping or reverberation time). The last one needs a thorough description of the whole system,
including the acoustical room where the interaction takes place and is very difficult to be modelled through
mathematical descriptions. In this case a qualitative analysis is preferred that provides values for different usual
interaction patterns.

3 Potential Applications

• Human Computer Interfaces. Sound can provide information and can ease the communication between
computer and user. Many transitions, events, operations, file/resource management tasks are suited to be
signalised with adequate, not annoying sounds. Our everyday experience provides meaningful analogies so that
we can easily find "audio" correspondents for the above-mentioned activities.

• Virtual Reality. Most of the sounds that are used in the current virtual reality applications are stored on
disk and need large memory space. These applications are always interactive and allow the user to self-configure
his virtual spatial room. The sound library is often limited and can not contain correspondents for all the
possible sound producing events in the virtual room. Model generated sounds offer the possibility to configure
the virtual space also from the acoustical point of view, in a sense that all the objects, through their parameters
and physical model, can produce sounds according to their possible interactions. This is a much more powerful
technique than a simple sound rendering of the virtual space with arbitrarily chosen sound sources and increase
the degree of "reality" of these applications. The drawback of the method, its expensive computational cost in
case of complex interacting objects, becomes less and less significant, as the computing power of the new
machines increases.

• Visually Impaired Computer Users. Blind or visually impaired people make use of everyday sounds for
orientation in their life. The integration of everyday sounds in user interfaces brings forward new ways for this
group of computer users. The use of software systems and applications (for instance learning tools for training)
supplemented with everyday sounds become easier and more intuitive because these sounds are close to their
mental model.