NEST-2003-1 ADVENTURE

eXploratory Environment for Navigation and Analysis of Komplex data by Interdisciplinary Sonification
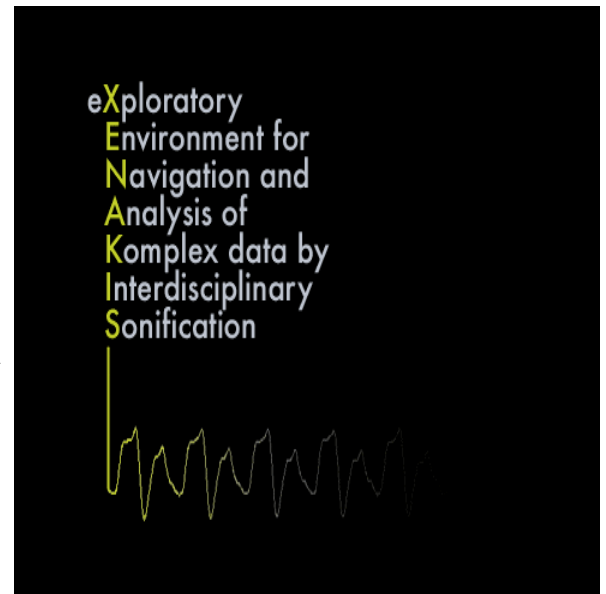
XENAKIS

September 2003

STREP

FULL Proposal

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Duration: 36 months
Co-ordinator: Compass, Social Research, Graz/A

Abstract

Many fields of science work with complex, multidimensional data which may contain different thinkable patterns. Two techniques are in common use to detect inner structure in data: Visual display, e.g. graphs, in effect using perceptive abilities of the human eye to detect 'evident', i.e. visual patterns; and statistical methods, essentially employing mathematical transformations to arrive at less complex data, until patterns become detectable.

While both are successful and well-established methods, they have inherent limitations; visualization is limited by the perceptive weaknesses of the eye (e.g. slow time resolution, limited number of displayable dimensions), and statistics is limited by the individual's mathematical understanding of the complexity of the data transformations - and their meaning for the data under analysis.

Sonification, the representation and analysis of data by means of sound, offers a promising alternative. The ear is the most accurate measuring device in the human body, for example in terms of temporal and frequency precision. We use it constantly for orientation in our environment, it can follow complex sound properties, and it can trace multiple streams of auditory events simultaneously.

However, sonification is still not as common as visual display or statistical analysis.

XENAKIS will revolutionize sonification by focussing on challenging data from multiple scientific fields and integrating artistic expertise with psycho-acoustic knowledge in order to create meaningful and effective acoustic data representations.

The XENAKIS team will deliver these Sonification Designs, and the powerful software tools required to realize them. Sonification is inherently interdisciplinary, and the research team consists of sound experts, specialists for interface design, artists, social scientists and physicists, with many partners already building bridges between domains.

XENAKIS will result in a wide range of possible user applications that will allow for flexible experimentation with translations of data dimensions to sound properties. We aim to prove the usefulness of this approach for a wide range of sciences, for artistic contexts, for improving public accessibility of the sciences, and for a compelling dialogue with the public.

Relevance to Objectives of NEST[1]

XENAKIS is **interdisciplinary** since it aims to explore the potential of a new methodology (sonification) to represent and analyse complex data. XENAKIS will integrate artistic and psycho-acoustic expertise into realtime synthesis frameworks. The project will investigate the degree to which sonification can be established as an innovative tool for the analysis of complex data across the boundaries of academic disciplines. XENAKIS is a pioneering multidisciplinary initiative bringing together researchers in natural and social sciences, engineers, and artists. XENAKIS does not fall within the scope of the Thematic Priorities of the FP 6, since it integrates sound art, psycho-acoustics, social science and physics and interface design.

XENAKIS is **exploratory** and hence based on a flexible work plan which develops sonification engines in three short cycles, to facilitate quick steering of the development process. XENAKIS is based on the spirit of creative thinking in research. Thus XENAKIS' aims are ambitious – to establish sonification as *the* new method to analyse complex data – with a potential high impact in very diverse disciplines (such as social sciences, astronomy, linguistics, and seismology). The exploratory character of the project calls for a flexible development process which is responsive to unforeseen discoveries emerging of the close interaction between sound experts and target field researchers. This strategy may lead to deviations from the initial definition of the objectives and the workplan. While this constitutes a potential risk it is warranted by the high impact of "creating a new basic technology" and methodology.

XENAKIS is **experimental** and **novel** as it is a research project "using new approaches to investigation and analysis" and "using new unconventional ways of developing and exploiting knowledge". XENAKIS is definitely unconventional since sonification is not as established a technique as mathematical statistics and visual display of data. If sonification proves to be an appropriate response to the need to understand ever larger and more complex data sets in various sciences, XENAKIS will be "opening up new avenues for progress in science and technology". It will thus contribute to "strong strategic positions of European science and technology".

The aim calls for a truly multidisciplinary approach which so far has not been explored in this complementary composition: social science, experts in acoustics and psycho-acoustics, sound engineers, physicists, and artists. XENAKIS aims to be the worldwide pioneer in sonification of social data.

Potential Impact

The task of XENAKIS is to establish that sonification can enable scientists from different disciplines to produce a better (i.e. more truthful and complete) depiction of the complexity of their data. The more possibilities a method offers to retain full data complexity and to depict its multiple correlations simultaneously, the more accurate, effective, and meaningful the data analysis process will be.

If sonification proves to be an adequate instrument for the analysis of complex data, the gain for all scientific disciplines will be very high. Researchers will be enabled to interactively explore and analyze data of high complexity in a way that includes a larger number of different variables (data dimensions) at the same time.

Further, analysis with the ear will open a whole range of new views on the question of representativeness of data: while we currently operate on the base of probability statistics – which again very often proves to be beyond the layperson's understanding – the perception of data with the ear opens a new and more immediate approach to understanding and judging the meaning of the data.

XENAKIS will further the state of the art in sonification, and thus improve its general acceptance, availability and usefulness for both experts and lay people. Therefore XENAKIS will also enhance the societal accessibility of research methods and analysis and contribute to a learning society.

XENAKIS will have a potentially high impact on research methodology; successful XENAKIS sonification designs will make sonification as readily to use as visualisation or statistical analysis of data. In fact we believe that sonification can even turn out to be superior, since it is suitable of analyzing more complex data relations and making them perceptible.

Further, XENAKIS has the potential to reveal meaningful relations between variables that have remained unexplored using the traditional methods of statistics or visual display thus enabling new insights in these domains.

In addition, the Public Sound Installations (PSIs) in XENAKIS will have a societal impact by enhancing the accessibility of the analysis of complex data to non-specialists, thus creating a community of knowledge across Europe.

Since researchers of various disciplines collaborate in XENAKIS the results – the sonification engines and the designs – will not only be innovative, but also will be immediately useful for the various disciplines involved. Each researcher will expect different functions the software engine must support in order to be helpful for

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[1] All quotes from NEST Reference Document on ADVENTURE Projects, published by the EC/DG Research on 27 February 2003.

her/him. These expectations are valuable input for a project that aims to develop and test innovative tools. If most of these functions are included – i.e. if most of the expectations of the interdisciplinary consortium are fulfilled - sonification can become a very valuable method in future data analysis and exploration across a wide range of disciplines. Interdisciplinarity as it is manifested in the composition of the XENAKIS consortium can practically only be achieved by researchers from various European nations; experience with sonification is rare and so is knowledge and imagination about the potential benefits of sonification in the target field sciences (social science, physics, astronomy, seismology, linguistics.), thus the potential impact of XENAKIS can only be achieved in a transnational project at the European level. The necessary skills for developing the sonification engines are even more scarce throughout Europe: there are no two *Super Collider*-specialists in one European institution. The chief *Super Collider* developer in XENAKIS is an internationally renowned specialist who has written the official tutorial for this software platform.

Furthermore, extended experimentation with data sonification will allow deeper psychoacoustic insights how information in general can be represented intelligibly in the auditory domain. Beyond the obvious scientific value, these results will be highly useful for improved design of auditory displays on monitoring systems, mobile devices, multimedia applications, and for better interfaces for the visually impaired.

List of Participants:

Partner Nr	Organisation name	Abbreviation	Town	Country
P1	Compass, Institute for Social Research	Compass	Graz	Austria
P2	Institute of Electronic Music and Acoustics Graz (Institut für Elektronische Musik und Akustik an der Universität für Musik und Darstellende Kunst Graz)	IEM	Graz	Austria
P3	University Pompeu Fabra (Fundacio Universitat Pompeu Fabra)	FUPF	Barcelona	Spain
P4	Academy of Media Arts Cologne (Kunsthochschule für Medien Köln)	KHM	Köln	Germany
P5	Academy for Fine Arts Hamburg (Hochschule für Bildende Künste)	HfBK	Hamburg	Germany
P6	University of Dundee, Faculty for Applied Computing	UDUN	Dundee	UK
P7	Studio of Electronic Instrumental Music	STEIM	Amsterdam	Netherlands
P8	University of Arts Bern (Hochschule der Künste Bern)	HKB	Bern	Switzerland
P9	Animax Multimedia Theatre (Bonner Entwicklungswerkstatt für Computermedien e. V.)	BEC	Bonn	Germany
P10	University of Bielefeld, Neuroinformatics Group (Universität Bielefeld, Arbeitsgruppe Neuroinformatik)	BU	Bielefeld	Germany
P11	University of Graz, Institute of Sociology (Karl Franzens Universität Graz, Institut für Soziologie)	UniGraz	Graz	Austria
P12	University of London, Queen Mary College	QMC	London	UK
P13	Soundcity, Sound Architecture & Caleidophonic Interactions	Soundcity	Zürich	Switzerland
P14	University of Cambridge, Institute of Astronomy	IoA	Cambridge	UK