SONIFYER
A Concept, a Software, a Platform

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ABSTRACT
In this article we would like to focus on two structural points that could be useful for improving the general acceptance of sonification research: On the one hand we will be advocating a new generation of sonification software that can be easily and intuitively used by researchers and amateurs alike. On the other hand we will argue for an acoustic forum for our sonification community to be established that will help to foster exchange and discuss listenable research results. For both aspects we will describe our ideas and prototypes as a possible starting ground for discussion.

1. INTRO
Sonification has a long history. Some people date it as far back as to the ancient beginning of science in pre-Socratic time, mentioning that already Pythagoras demonstrated mathematical relations by acoustic experiments on the monochord. Usually the liberal arts, which brought together music and mathematics, or Johannes Kepler's "Harmonices mundi libri V" (1619) are also named in this context to prove the importance of an audio-centered way of research.

You can however just as well maintain that sonification has a short history: e.g., for audification at least a loudspeaker and/or a phonograph is needed, which were not invented before the 1870s. From this time we can still find some few papers proposing methods such as [1] using the newly invented telephone to auscultate nerve and muscle cells. This pragmatic approach of trial and error has been followed for somewhat more than a century, even though there are only few papers published on sonification as a method of converting measurements into sound.

Insofar, ultimately one could even claim that sonification has almost no history at all. It is a young and avant-garde research field not older than 1992, coming into life with the first International Conference of Auditory Display in Santa Fe. With this conference Gregory Cramer, who invited for the event, started a new research movement, giving it a name and a kickoff meeting. A research community has been formed by the yearly ICAD, developing a corpus of scientific papers and, recently, even musical concerts.

An equivalent of sonification, which one might call its "sister method", is visualization. We will assume here that its starting point was the invention of the Cartesian coordinate system, which was developed in the 1630s and subsequently experienced an amazing scientific success story. Doubtlessly this success was not only owed to the visual evidence yielded by this new tool, but also to technical reasons: coordinate systems are very simple to use and their visual results can be easily printed and distributed.

2. USABILITY AND DISTRIBUTION
In the following we will argue for more attention to be dedicated to the aspect of usability and distribution in sonification. Sonification brings together know-how from very different fields such as sound, or music, on the one hand, and science, or scientific experiments, on the other. It involves sound experts and scientists, who sometimes will all be the same person, but sometimes not—and this is what demands a lot of exchange. Since most of sonification is done with software, we posit that the design of this tool should be designed as user-friendly as possible. Its design should allow easy and intuitive sonification also for non-professionals users, and it should follow the "plug 'n play" approach in order to be able to involve as many data producers and data interpreters as possible. Just to give an example, a great part of the success of Apple's Music Store was owed to the functional and handy design of iTunes. Hence, we encourage the ICAD community to pay special attention to software design and simplification of software installation. We need software that is so easy to download and install like "Sonification Sandbox", just to name one recent example from ICAD 2007. Likewise, we will propose our software "sonifyer" as another step towards a new sonification software generation.

The second argument we want to focus on in this article is distribution. Sonification will not become a proper and accepted scientific tool as long as we only talk or read about sound. So while we were delighted to discover e.g. the menu "Audio" at www.icad.org, we became somewhat disappointed when we only found one sound sample (last checked on 1st February 2008). But isn't this typical for a lot of our sonification research? Generally, one finds only few listening examples on the web compared to the abundant presence of visualization by pictures. But if sonified data are to be taken as serious as data in the form of scientific graphs, they must be widely published and distributed. And never have the underlying conditions for this move been better than today: the internet is the first medium and platform in human history that allows reproducing sound and making it universally available—at least within the scientific community. Marshall McLuhan would probably have termed this a "Gutenberg revolution". While we do not necessarily need to go that far, it seems however that there is a good chance for an acoustical turn in knowledge production. To make this turn possible, we need to develop formats for sound publications, just as scientific visualization uses its specific publication formats such as books and journals. In the following we will present some ideas on what could be done in this area.
SONIFICATION OF different seismic stations scattered all over the globe. We also paid a lot of attention to audification as our main sonification method when dealing with these data. Nevertheless sonifyer also works with parameter mapping—currently it uses frequency modulation synthesis (FM synthesis).

Secondly sonifyer works following a project approach; that is, just as Adobe InDesign or other programs, sonifyer brings together many different data sources. Different data sets can be imported and be handled on different levels (the formats that can be imported are so far: txt, eeg, and, from seismology, seed, saf, and gse; common audio formats such as aif, m4a, wav, mp3 can be used). A preset of parameters allowing instant play is provided. Changes are saved with every project.

For navigation we developed a Main Window (cf. figure 1) comparable to those of common audio programs showing oscillograms of the data and a player with, among others, start, stop, loop, and record buttons. The visual display can be controlled in the usual manner, i.e. in an adjustable window using mouse and cursor; markers can be set, different data sets can be selected or single channels be muted etc. Additionally, a slider for playback speed (forward and backward) is provided in a central position.

Listening to different channels in spatial order. E.g. in global seismology the location of each station results in a different listening position in relation to a given seismic event. With sonifyer one can do a virtual 3D walk through the different stations at every moment, just as if one walked through a room with each station being a speaker in a different point of that room. That makes it easy to compare the sound of e.g. the Sakhlin earthquake 1995 recorded at a station in East Russia versus its sound recorded at a station in California (cf. figure 2).

When listening to EEG data one might want to focus for a moment on signals from the forehead, the next moment to signals from the back of the head. There is also a visualization feature: when playing the data a changing glow at the measurement points shows the sound output of each channel.

The Map Window also allows the organization of data sets. Each channel symbol can be selected and rearranged, so that channels one wants to neglect can be sorted out and vice versa.

**Figure 1. Screenshot of Main Window of sonifyer (1.33)**

While allowing navigation in time in the Main window, sonifyer provides a second, parallel Map Window that allows
applied. It is also possible to use audification and FM for a data set at the same time.

Having learnt from experiences with partly unusable data we also built in a filter system that can be adapted (or used with presets) for each data set.

As already suggested in the last chapter, we see a major need (and also a chance) for sonification research in the involvement of more experts in each research topic, and in building up groups of experts. This could make some of today’s user tests obsolete and instead of having a sound objectified by asking amateurs whether they hear an aspect or not, one could put a stronger focus on experts’ opinions. Let us take a comparative look at the approach used for visualization in seismology: picking an event within a seismogram or interpreting a seismic cross-section is both done by purely visually-based decisions and thus requires extensive, long-standing experience. Once sonification data are informed by expert opinion as outlined above, there will be good reason to trust not only the judgment of a visualization expert about a picture, but also a judgment of a sonification expert about a sound.

Now to provide a platform for these experts (or new researchers who want to become experts), we integrated a Documentation Window in sonifyer (cf. figure 4). This window allows explaining and commenting on data sets. It is a kind of virtual forum, in which the group members involved can exchange their findings and interpretations. It personalizes and dates all statements, thus compiling a history of interpretation. – Technically this window has all opportunities of an Apple text editor. Pictures, sounds and movie clips can be integrated too with drag and drop.

Likewise, for EEG data you will also just find a handful of people scattered across the globe. Therefore bringing this knowledge together is essential for starting a scientific discourse.

Now for allowing such an exchange the internet seems to be the ideal platform for two reasons: First, when working together on a professional level, researchers need to communicate about interesting data sets, about sonification methods and appropriate parameterizations. Here we propose a kind of Wiki providing preliminary sound results as well as the opportunity to verbally describe and comment the hearing experiences.

Secondly, each research topic requires a corpus of proven results with well-chosen sound samples giving other researchers—who might so far only work with visualization techniques for instance—an opportunity to learn about sonification and to compare [3].

With www.sonifyer.org we have tried to set up a forum for such a sound-centered research. The website provides a general introduction to sonification and brings together research results from EEG sonification, audification of earthquake data and a collection of famous historical music pieces using sonification for artistic concerns. Most developed so far are the examples of EEG research. Here we provide sound samples as a kind of acoustic atlas, with EEG results typical of different ages (children, teenagers, etc.). There are also examples of "typical" EEGs taken from people suffering from schizophrenia, dementia, epilepsy, or depression. And for training, the website additionally provides an audiosocial overview on typical EEG artefacts as a patient swallowing, muscle contraction, eye closing etc.

In EEG research there is a tradition of visual atlases as [4] [5], which we now try to extend into the audio world. The sound samples were chosen after listening for months, but it goes without saying that better examples may come up with time. Therefore the idea behind it is to share and to improve the listening experiences of the professionals.

We also found out that—especially with complex noises from audification—listening constitutes only one part of the process, while the other is to describe what has been heard. Here, a verbal modus of description needs to be developed that is not limited to a detailed verbal description on what to listen to; this undoubtedly helps in analyzing a sound, but also visual sketches can be useful. At the moment we are experimenting with both, verbal and visual sketches. But obviously this is a challenge which cannot be standardized, and certainly not within the near future.

5. CONCLUSIONS

Our title "A Concept, a Software, a Platform" may sound like an outragious promise that cannot be fulfilled at the moment. But we are convinced that the two aspects of usability in sonification software and distribution of sound results are urgent topics for the next years of ICAD's development. We therefore hope to start a discussion on these questions, and we would want to follow the approach taken with sonifyer—or another software—and an internet platform for developing appropriate formats.

6. REFERENCES

504-509. This is the earliest published paper on audification we know; for further historical material cf.: Florian Dombois, "Sonifikation" in P. M. Meyer: Acoustic Turn, Paderborn, 2008, pp. 87-96; Florian Dombois, "The 'Muscle Telephone': The Undiscovered Start of Audification in the 1870s" in J. Kursell: Sounds of Science—Schall im Labor (1800-1930), Max Planck Institute for the History of Science—Preprint 346, 2008, pp. 41-45.


