An Interface for Live Interactive Sonification

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Abstract

Sonification is generally considered in a statistical data analysis context. This research discusses the development of an interface for live control of sonification – for controlling and altering sonifications over the course of their playback. This is designed primarily with real-time sources in mind, rather than with static datasets, and is intended as a performative, live data-art creative activity. The interface enables the performer to use the interface as an instrument for iterative interpretations and variations of sonifications of multiple datastreams. Using the interface, the performer can alter the scale, granularity, timbre, hierarchy of elements, spatialisation, spectral filtering, key/modality, rhythmic distribution and register 'on-the-fly' to both perform data-generated music, and investigate data in a live exploratory, interactive manner.

Keywords: Sonification, Interactive Sonification, Auditory Display.

1. Introduction

Sonification is the representation of information through sound, and is useful for exploring and analyzing datasets. Sonification has previously been typically a static process, where methods used have generally focused on a) data import and preparation, b) mapping data types to particular auditory parameters and then c) synthesizing and playing back the resulting audio. Recently, Interactive Sonification research has extended this method to allow the interactive control of sonification processes. For instance, Hermann et al. have created a tangible interface for accessing multivariate data [1], and Bovermann et al. have built a system for the interactive sonification of the movements made during juggling [2].

However, many sonification practitioners do not attempt the sonification of data purely as an exercise in data analysis, but because they conceive that sonifying data can produce original aesthetic musical outcomes. Musical or aesthetic applications of sonification are numerous, and this parallels a trend in visualisation design, whereby there are many designs for visualisations whose value is determined primarily by their aesthetic quality, rather than purely their data analysis benefit.

1.1 Performance Context

Generally, the interface discussed in this paper is designed for time-series data, and, more specifically, for real-time data received from sensors. Data of this type could be obtained from various sources such as accelerometers, motion tracking systems, tilt sensors, distance sensors, online data feeds, temperature sensors, CPU load sensors, light sensors, among many others. The perceived role of this interface is to gather the data sources to a central location, sonify them, and control the interaction between each of the sonification streams.

For instance, consider the situation where a dance performer is providing acceleration information in two axes (taken from accelerometers), and there is also a set of pressure sensors in various positions around the performance space whose output is translated to described the spatial position of the dancer. These four data streams could be worked into a sonification system that was static and was unchanged over the course of the performance. Alternatively, and this is the focus of the current interface design, another sonification performer could receive these data sources and, through the use of this interface, control and alter the sonification mappings, in a real-time musical response to the data and to the dance performer. The dancer's movements are translated through the musical interpretation of the sonification performer.

2. Interface Design

The design of this system is part of the modular AeSon toolkit we have discussed in previous research [3]. The interface has several layers and takes a hierarchical approach towards mapping and control. Every part of the interface should be controllable during the sonification process to provide interaction possibilities.

2.1 Spatial Arrangement of Sonification Streams

Each sonification stream is represented as an object in a 3-dimensional spatial layout, where the *x* and *y* location controls the object's auditory attributes. Song and

Beilharz [4] have found a positive effect of spatial separation (in the horizontal plane) upon stream discrimination, and Ferguson and Cabrera [5] found an association between the spectral content of sound and its perceived vertical location. Therefore the *x* location is used for a pan control, and the *y* location is used to alter the spectral content using a shelf filter.

Using this spatial layout provides a number of improvements for the user interface: a) The user can easily see the separate streams, and can assess the information provided by each of auditory stream objects; b) Spatial and spectral separation is encouraged using this interface, and c) no specific knowledge of audio is needed to select the stream and spatially rearrange it.

2.2 Sonification Stream Activation States

The spatial layout described above provides control over the sonification streams with reference to each other, but each sonification stream object incorporates several other basic controls. A mute button, placed in the top left hand corner of each stream, controls whether or not the stream is muted. The visual representation of the sonification stream provides visual feedback on the mute state of the stream, through alteration of the colour of the outline of the object.

Also, for each stream the name of the input data is displayed in the top bar, and some descriptive statistics described in the left-hand side fold out drawer. Furthermore, a graphical representation of the data is placed in the middle of the stream. The data is graphically represented on receipt, which allows the user to quickly make associations between the interface, the sounds created and the controls located within the visual display.

Each object has various states of activity, depending on the interaction that is being applied. These include: a) Active and fully responsive, with all controls fully visible, with both menus folded open. b) Active and responsive with menus closed – triggered when the pointer is hovering above the object. c) Active but latent, displaying the movement of the data but hiding most of the controls except the mute and solo buttons. d) Inactive, displaying only the mute and solo button, triggered when the mute button is pressed. Figure 1 describes these states.

2.3 Incorporated Mapping Methods

Each sonification stream's mapping process also relies on many parameters that may not necessarily be common across all the streams. These parameters are controlled via an interface that exists in the right hand draw of each of the audio stream objects.

The most common method for sonifying data is to represent the data using notes whose pitch corresponds to the datum being represented. Another method is to play an audio sample when a data threshold is crossed, as would be expected for an alert or alarm. A further possible method is a granular synthesis engine. These methods are controlled in the interface, but inherit all the parameters provided by the spatial layout. Therefore, consistent control over all the sonification streams is provided, but a variety of sonification methods is maintained. Finally, a set of option presets allows interactivity to be maintained even while the right-hand menu is closed.

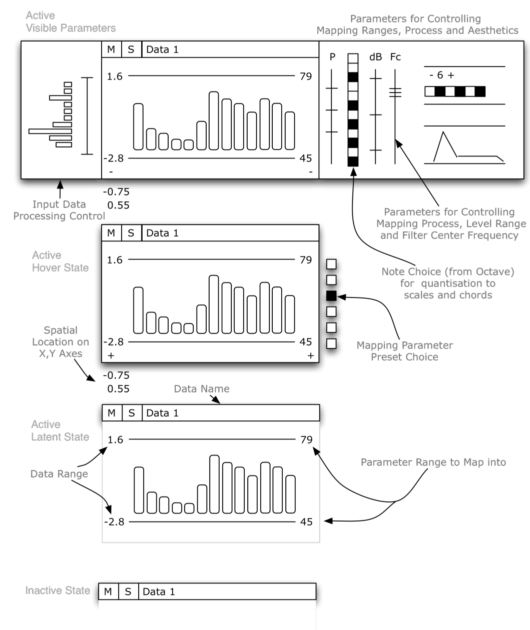

Figure 1: *This diagram shows a stream in the various activation states described in section 2.2. It also demonstrates the interface for assessing data, mapping it to sound parameters (using a pitch mapping in this case), selecting presets, and muting streams. In the interface there is one of these objects for each data source, using the spatial arrangement described in 2.1.*

Acknowledgements

This research was funded by the Australian Research Council's Discovery Projects scheme (DP077310).

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