Musical Landscapes Using Satellite Data

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Abstract: Landscapes have always served as a source of inspiration for musical composers. Using the tools of sonification, a number of musical compositions were created using satellite imagery of urban areas in Alberta, Canada. Using the landscape as a source of data for sonification creates a variety of interesting sonic and visual experiences; we are letting the landscape sing.

1 Introduction

Sonification of data is the rendering of sound from data that contain no native acoustical signal. Given the wide array of data possibilities, it comes as no surprise that sonification projects are often interdisciplinary in nature. For this project, the combination talents in the musical/visual arts and natural sciences were used to create interesting musical compositions from satellite image data.

Vast quantities of satellite imagery of the earth's surface are collected on a daily basis. The analysis of these data is a complex combination of visual interpretation and digital image processing. Scientists studying the data from these images are primarily focused on retrieving the information they contain in a static image-processing environment. These images provide us with not only data about the planet, but have an aesthetic appeal that is often overlooked. The overhead view provided by these satellite images present our world from a unique perspective. Our natural and human-modified landscapes create interesting visual shapes, arrangements, and patterns on the landscape. This research was focused on different ways of interpreting our places. We examined a variety of different visualization techniques in conjunction with data sonification to explore what satellite images sound like.

The use of sound to aid in the interpretation of data has found many practical uses from the Geiger counter, sonar, and many medical displays to name but a few. In this instance, the use of an auditory signal is more easily interpreted than a visual cue. Other more recent research has involved the implementation of sound to help the blind navigate using computer maps and the global positioning system (Golledge et al. 1991; Fanstone, 1995; and Jacobson, 1996).

With the advent of more user-friendly software applications for the production of sound, the development of new and novel ways of using data sonification to interpret complex data sets will become more common. From analyzing geographic data (Zhao, et al. 2004), climate change data (Quinn, 2000), to helping understand atomic particle movement (Sturm, 2000). The majority of these research projects have focused on either the need for complex data analysis or on the transformation of data into sound only. In this project we present a combination of a variety of visualizations of the actual data in conjunction with the sonification of these data, yielding a true multimedia experience.

2 Motivation

People have always tried to survey their environments from above. The earliest maps were markings on clay tables from Babylonia dated around 2500 B.C., which depicted the 2-D location of important landmarks. These markings were meant to help people describe the relationships between identifiable features from a planimetric perspective that we do not have, but all seem to understand. Over the proceeding centuries, civilizations have developed techniques and technologies to make this process more accurate, but it wasn't until the advent of the first photograph that recordings of the earth from a bird's-eye view was made possible. Since that time, images of the earth have become a major source of geographic information and geographic awareness. We are now able to remotely sense our place on earth with a dizzying array of sensors, spatial and spectral resolutions. Recently, these instruments sent to other planets to be our new explorers.

With the ever-increasing volume and variety of complex data and the advent of multimedia technologies, sonification is beginning to play an increasingly important role in data exploration (climate change data, human genome project, etc.). The vast quantities of information produced by modern instrumentation open up a wide variety of interests in new representations of this information. The motivation for this project was to explore the use of satellite imagery as a source of data for creating musical compositions. While composers of music have always used landscapes as a means of motivation, we wanted to explore the ways that landscapes, by using satellite data and sonification tools, could create their own sound.

In this instance, we were more interested in the

creative process than in the direct interpretation of these data in a scientific context. When experimenting with the composition of these data it is important to recognize that artistic products are not cold, objective, and reproducible experiments. Normally artistic endeavors involve human decision-making that shapes the nature of the content and its form of expression. While often an artistic work may derive from inspiration—ideas or emotion and use traditional forms appreciated by others and be thought of as being mostly subjective and personal, a creator may utilize concepts that are from outside of the normal artistic activity.

The majority of sonification efforts to date have involved the transformation of many different types of data into sound. In this project, we present not only a sonification of satellite image data, but visualization as well. The visuals are meant to complement the musical composition, and in the piece entitled "Spiral from Nose Hill" the 3-D fly through of the data approximates the position of the sonified data. This technique enriches the musical experience by using the power of the visual system to help transmit the emotional response triggered by the sonification.

3 The Data

All of the remotely sensed data used for this project come from the Landsat satellite system (Landsat-7). This remote sensing system is in sun-synchronous orbit approximately 700 kilometres above the earth's surface and is continuously acquiring images for the management and monitoring of the earth's resources. The Landsat series of satellites records data from a variety of areas of the electromagnetic spectrum (from the visible to thermal infrared) yielding many different views of earth. While the main motivation behind most earth observation satellites is to provide data on the surface condition of the earth, these images have a visual appeal all their own. The profound natural beauty displayed by the patterns, colours and textures on earth is a secondary product of these images and one that is often overlooked. They represent a form of natural art, and as such, can inspire, create interest and possess the ability to move people in many ways.

For this project, images of the cities of Lethbridge, Calgary, and the town of Bassano, Alberta, Canada were used (Figures 1-3). As the satellite imagery provides six different spectral bands, a wide variety of options existed for the selection of data for sonification. Transects of image data were then extracted (with X, Y coordinates as well as spectral bands) from each of the images to provide a flow and direction to the data. These transect were selected for their aesthetic appeal; there was no predetermined rationale. For example, in the Southside movement of Singing Lethbridge from the Sky, the transect moves from the downtown area, with it's busy pattern of office buildings, roads and parks, through a residential area and terminates in a park. Other areas were selected for their spatial patterns, which were then transformed into rhythmic sequences.

Figure 1. Landsat Image of Lethbridge.

Figure 2. Landsat Image of Calgary.

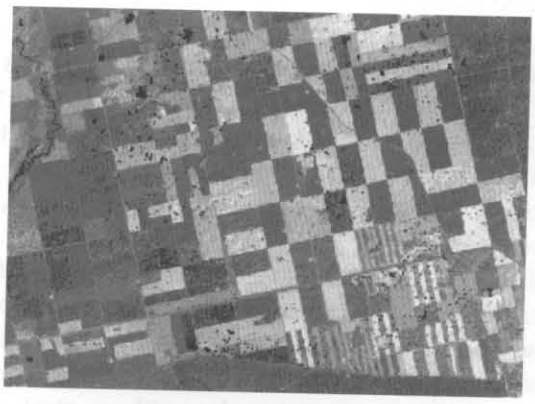

Figure 3. Landsat image of Bassano.

4 Sonification

The sonification of the satellite data was performed in Max/MSP. Max/MSP is an object-oriented programming environment that allows for a wide range of flexible options for the transformation of data into sound. In the crafting of the musical pieces, values like the transect coordinates and the spectral bands from the satellite imagery were used to drive different sonic parameters. The end result was designed to not only present the data, but to convey a sense of place through sound. An example of the programming required to produce this sonification is presented in figure 4.

In creating this sonification experiment, we were seeking to transcend the new, the news, the trend, the latest and the greatest, the right now, or the buzz. Of course humans are interested in non-mundane things, that is a given. This always has been and will always so be. The end goal was to present the listener with an experience that transcends the newness of the sound and enables them to identify with it. In this sense, music created using satellite data can present a geography of sound that can strike a chord for the listener.

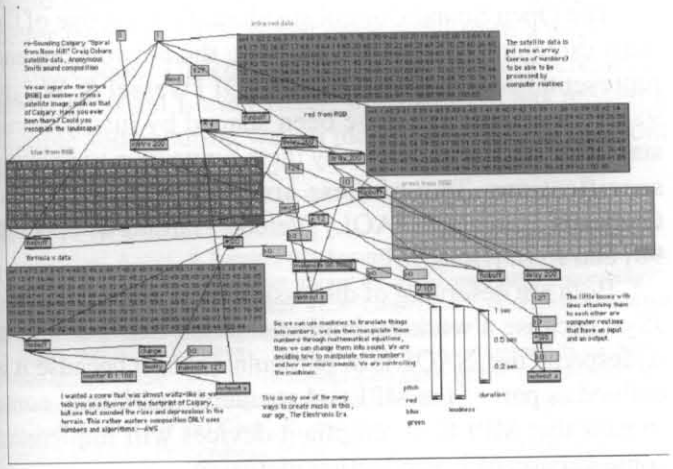

Figure 4. Sonification programming for Spiral from Nose Hill.

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