Adrok Sonification Concert: Three Improvisations

Sijin Chen

Pianist/researcher,
Geisbergstrasse 30, 10777
Berlin, Germany
sijin.chen@web.de

Kees van den Doel, Colin Stove, Gordon Stove

Adrok Ltd,
49-1 West Bowling Green Street, EH6 5NX
Edinburgh, Scotland
kdoel@adrokgroup.com
gstove@adrokgroup.com
cstove@adrokgroup.com

Make Li, James Harkins, Lin Zhang

Xing Hai Conservatory of Music/Music and New Media Innovation Centre,
398 Wai Huan West Road, University Mega Center, Pan Yu District, 510320
Guangzhou CITY, Guangdong Province, China
limake@xhcom.edu.cn
jamshark70@gmail.com
soniclzhang@gmail.com

ABSTRACT

This project is the result of an interdisciplinary, cross-cultural and multi-locational collaboration between Edinburgh, Vancouver, Berlin, Guangzhou and Shanghai. Scientists and sound artists teamed up for the production of the recorded concert of three works. Our sonic raw materials are radar and microwave data provided by Adrok Ltd., which his normally obtained as part of some imaging of either the subsurface of the earth or, in one example, the human heart. The scanning and imaging technology [1,2] utilized by Adrok are somewhat similar to seismic probing, except radar and micro waves are used instead of sound waves. Objects in the earth (or in the human body) are exposed to pulses of coherent electromagnetic waves which interact in complicated ways with the object to be probed. Interpreting such data is notoriously difficult and is usually performed using extensive signal processing and visualization. EM waves can easily be auralized by changing the sampling rate from GHz to KHz, and such a data representation can sometimes reveal structures that are difficult to obtain otherwise. A well-known example is the detection of underground nuclear testing [4]. Recently at Adrok we have introduced a listening-based method for equipment quality testing [3]. The current collaboration between artists and scientists tries to achieve two goals. Fist to give musicians a free hand to create music from our data we hope to discover new methods to extract useful information from our data. Second, by sharing the scientific context of our data with the artist we hope to achieve a fusion of the different senses of beauty in organized mathematical structures in nature and in free human creations.

1. INTRODUCTION

Geophysical data from subsurface scanning of natural resources with microwaves, a technology of Adrok Ltd, are sonified and applied in a collaboration between industry, science and music. Such sonification of data have become a narrative and compositional inspiration for the concert. Three distinctive works are created by using the same set of ADR data. We hope to provide diverse artistic perspectives towards the data, for the overarching purpose of (a) science communication and education via arts and (b) exploration of human creativity in corporation with technologies. Specifically, (1) the sonic interpretations of data offer alternative data analysis ideas for scientists to consider. (2) The results can be used as educational means, for example, for geographical and geo-tech knowledges. Likewise, (3) such practice informs sound design and music composition with novel source of data, which also trigger aesthetic and ontological reflections in sound studies. The following is three brief statements for the three works in the concert.

2. CONCERT PROGRAMME AND STATEMENTS OF THE ARTISTS

2.1. Improvisation 1 (Make Li, Sijin Chen)

https://vimeo.com/702167534

By using the piano material as the signal source of the rhythm part and trigger sampling synthesizer, the strength and pitch of the piano are used to encapsulate the original

signal of ADROK (R7WOODEN Wreck-X1 in Capillary-firth of Forth-ALL). Output the original signal to the channel and send it to IR Reverb; The IR of the reverberator sampled the "resonance" information of the ADROK signal again. Divide the signal into two tracks and improvise at different times，to control the balance between hearing and feedback effect. For the rhythm part design, the work uses (GCS-Sonic (4) GCS's HEART Music-Spiral) material to form fluid variations through extreme LFO and pitch variations.

The creation of this work attempts to explore the imitation of non- "natural" sound to natural environment noise in timbre creation. The improvisation part of IR is triggered by piano to become the ambient sound. The material of the heartbeat data is used for the imagination of "sinking or diving" and "inner rhythm." We try to bring out the poetics of data from rock and heart scanning, therefore, enable a "travel" in time, space and culture. The heartbeat data is collected from a scientist (Dr. Colin Stove) in Edinburg. A personal meditation is merged into depersionalised "sound of rock from Shetland." The material of piano music is an improvisation on a piano made in Berlin more than 80 years ago, recorded in Berlin. The piano improvisation is a reaction to the sonifications and again mixed in the final work, which is produced in studio in Guangzhou. The information of locations, personal and cultural backgrounds is embedded in the acoustic result but leave it open to listeners to re-interpret and re-situate.

2.2. Improvisation 2 (James Harkins)

https://vimeo.com/702167497

The aim of the work was twofold: first, to explore analytic sonification strategies for these data sets, and second, to apply these in a free, artistic context.

I was struck by the observation that a set of scans would show broad similarities with minute differences between them, where the differences indicate features of interest. It would be easier to subtract out the similarities in the frequency domain. For my demonstration, I use the heart scans ("GCS-SONIC(4) GCS's HEART Music-ALL"), where the data had already been assembled into one audio file. For analysis, these need to be split into frames. Because the shapes are mostly similar, autocorrelation is a good technique to identify the period of repetition. Then an automated process, coded in the SuperCollider programming language, reads each frame in turn, resamples up to the next power of two size, performs a Fast Fourier Transform and appends the spectral data in polar format to a new data file to use for sonification.

SuperCollider's extension plugins include a phase-vocoder buffer reader, for which the data were prepared in the previous step. To differentiate figure from ground, I read two adjacent frames, one at the requested position and the one immediately preceding, and subtract their magnitudes, leaving behind partials that differ. Moving slowly through the data set reveals obvious points of interest. (It is perhaps not enough to compare only two adjacent frames; this technique could be improved by estimating the stable components over a wider segment of the file.)

Playing further with the sound, a phase vocoder spectral enhancer plugin helps to create dynamic shapes within notes, or accentuate percussive attacks. I then reformatted this synthesis code to be compatible with my live-coding programming dialect, ddwChucklib-livecode (which also runs within SuperCollider, and is released as a Quark extension package) and prepared a short performance with an ambient layer of long tones (which is later cut up into rhythm) and a percussive layer with irregular rhythms.

2.3. Improvisation 3 (Lin Zhang)

https://vimeo.com/702167705

Listening through the provided Adrok material, I discovered some samples with intriguing timber quality already. Even though the documented signal physically means different, but the psychological sonic impression can trigger alternative cultural and musical memory or imagination. The target of this composition is set to implement original signal wave file as intact as possible, construct with fundamental music principle from around world, roots rhythmical signature and tranquility sound scape, mixed with a dark drone metal compression.

3. ON THE DATA USED

Adrok's proprietary Atomic Dielectric Resonance ("ADR") technology [1,2] is based on the principle that different materials will reflect and absorb electromagnetic radiation (radio-waves, microwaves) at specific frequency and energy levels. The ADR geophysical system transmits a wave packet that resonates and reacts with the sub-surface materials, allowing structures to be detected down to several kilometers under suitable conditions. The returning resonant energy response is accurately received, in time and space, and measured in terms of energy, frequency and phase relationships. Data resolution is many times greater than acoustic imaging methods such as seismic, ultrasound or other radar imaging such as ground penetrating radar (GPR).

The interactions of the ADR wave packets with the materials in the ground (or human body) are very complicated and ultimately governed by the principles of quantum mechanics. For this reason, the data analysis is complicated as there is a lot of "detective work" required to figure out what material features caused which features in the data and we hope that engaging with musicians will lead to the discovery of improved data interpretation methods.

4. REFERENCES

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