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68 Fifth Avenue New York, NY 10011
212 229 6825 piim.newschool.edu

Stockwatch: A Tool for Composition with Complex Data

SAMUEL VAN RANSBEECK & CARLOS GUEDES, PhD

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ABSTRACT Composers always have used extra-musical elements in their music. From at the least time of ancient Greece, composers have been attracted by numbers, and have used numbers in their compositions. This paper focuses on the use of one kind of numerical data, more specifically, stock market data. A software tool to sonify stock market data is presented with all its possibilities and examples. The goal of this program is to show that a non-sonnic data stream (financial data) can be transformed into a credible music composition.

DATA SONIFICATION

Sonification of data has already been investigated as an assistant application for various purposes: the Geiger counter to measure radiation, sonar to measure distance, etc. These examples of sonification are yet to offer many interesting pathways of exploration. There are compelling reasons to utilize sonification of data. Among these:[1]

- Sound can portray different data sets using different timbres;
- Sound naturally represents changes over time;
- Sound allows microstructure to be perceived;
- Sound rapidly portrays large amounts of data;
- Sound alerts listeners to events outside their current visual focus;
- In sum, sound holistically brings together many channels of information.

Therefore, the use of sound offers benefits in highly visual environments where lots of information has to be processed. For example, stock brokers have to see many screens to get all the necessary information for their trading actions. By rerouting parts of this information in an auditory manner, it can relieve the visual pressure and let them pay more attention to every elements. Using the visual and auditorial senses, the processing of this information could happen much more efficiently.

VARIOUS APPLICATIONS OF DATA SONIFICATION

Various applications could be further developed using data sonification, examples include:

- *An alternative for visual display* to help visually deficient people. The computer can speak out the data thus giving the person access to information that he would be unable to get using only visual display.
- *A computer interface:* the other way around is also possible. Instead of entering information through a keyboard, speech recognition can be used being for general commands or for entering texts in the computer.
- *A data analysis tool:* In order to get insight in a complex data stream, it is necessary to get different viewpoints. Adding sonic display to the visual representation, can help the user get a better insight into the structure of the data. Some changes in data are easier to understand audibly than visually—for example, changes in rhythmic structure.

THE USE OF COMPLEX DATA IN MUSICAL COMPOSITION

Using extra-musical elements in music composition is a practice that is centuries old. Dufay for example, based the proportions of his motet Nuper Rosarum Flores on the proportions of the cathedral of Santa Maria del Flore.[2] Maurer divides algorithmic composition in two distinguishable types: stochastic music, and rule-based music.[3] Stochastic music (stochastic coming from the Greek word which means random) uses chance operations to get it's results. The music of John Cage is most famous for using chance operations, resulting in so-called aleatory music. On the other side of the spectrum, Iannis Xenakis used stochastic processes to create structured compositions. After the stochastic process was run, Xenakis wrote a "fixed" score, realizing only one of the many possible variants.

As implied, rule based music uses a set of rules to create a composition. It is the struggle between stability and instability that make stochastic music interesting. Supper[4] divides this type of composition in three categories:

- "Modelling traditional, non-algorhitmic compositional procedures;
- Modeling new, original compositional procedures, different from those from the past;
- Selecting algorithms from extra-musical disciplines"

The first category uses rules based on traditional processes. A composition that uses these rules can be a modern rendering of polyphonic music or music in the style of Mozart. Schottstaedt developed a system that created automated counterpoint species with an implementation of Fux' Gradus ad Parnassum.[5] Ebcioğlu designed CHORAL, a program to harmonize chorals in the style of J. S. Bach.[6] The goal being that "the listener cannot distinguish whether the piece has been generated by means of algorithmic or traditional composition."[7]

The second category uses new compositional procedures. In contrary to the first type, the algorithmic process is to be shown to the audience, the formal process is an integral part of the artwork. An example of this type of music is *Çogluotobüsisletmesi* by Clarence Barlow. All musical elements were calculated according to a composed meta-structure: the algorithms.

A domain of compositional processes is the use of complex data in composition. Algorithmic procedures like the use of stochastic formulas or fractals have been used by composers such as Iannis Xenakis, Clarence Barlow, and Karlheinz Essl, amongst others. Next to the use of stochastic formulas, evolutionary approaches have been used, whereby a process of natural selection and mutation serves as the genesis of a musical piece.

Why would one use complex data in composition? Complex data do not provide random sequences but have an inner structure. The challenge is to map the sequences to music in such a way that the underlying structure becomes audible. Using complex data, new compositions are possible that would not have been thought of under a traditional compositional approach. It is this aspect of the procedure that makes composition with complex data interesting.

STOCKWATCH: A TOOL FOR COMPOSITION WITH COMPLEX DATA

Stockwatch is a program that takes stock quotes from stock indices worldwide (selected by the user) and translates them into music. In addition, an improvisation module is built to improvise music based on the music generated by the stock quotes. Using *Stockwatch*, new kinds of musical sequences are generated. Stock quotes are in no way aleatoric sequences but have an underlying structure, which emerges to the listener through familiarization. It is the underlying structure that distinguishes music based on complex data from other unstructured compositional methods that offers an alternative approach for composing music.

THE USE OF STOCKWATCH

In musical composition in the past year *Stockwatch* has been shown initially in January 2008 as an installation work at esmae, Porto, Portugal, it has garnered acclaim from professors and visitors at the school. Subsequently, a downloadable version was put on the internet and was positively received with feedback worldwide from musicians, music professors, and economists. The possibility to record the generated musical sequences as MIDI-messages makes it possible to use the music for non-realtime compositions. *Um só* is an electronic composition made up of a collage of recorded sequences. Besides electronic composition, traditionally notated composition is also possible, as it can also be seen in the included examples on the software package.

THE DEVELOPMENT OF STOCKWATCH

Stockwatch has been developed as part of the course of composition at ESMAE in Porto, Portugal. The principal author of this paper was guided by Carlos Guedes who revised the software and helped in improving it. The program has been totally built in MAX/MSP, an environment for building applications. To design the graphical user interface, iWork was utilized.

Stockwatch is a musical application that basically takes an index of stocks and translates them into music. To do so, the user selects a stock index, the computer then translates the values in MIDI-pitch and outputs them to the speed the user determines. Channels 1 and 2 use the real input of the stock values and translates them into messages to be output. The user can assign the output of the index (at which speed a new note will be played), and the duration of every note. Channel 3 runs the output of Channel 1 through a Markov-chain, thus improvising over the "real" pitches. Channel 4 runs the output of Channel 2

also through a Markov-chain, thus improvising over it and adding a random interval to the note to insure maximum variety. If the output speed and the duration are different in Channels 1 and 2, the output in Channels 3 and 4 will vary accordingly. Pitchbend is affected by the change in value of the stocks. Every channel varies this pitchbend a little to create maximum diversity. The combination of the features described above create a very interesting musical results. It is through these combined features that the electronic composition *Um só* was created.

THE FUTURE OF STOCKWATCH

A second incarnation of *Stockwatch* will involve the expansion of the data stream so that not only stock quotes will be used, but other kinds of data streams may be ingested. These data streams could consist of weather data, seismic data, traffic data etc. The aim is to turn *Stockwatch* into a fully compositional tool that gives composers the opportunity to assign musical parameters to different data streams and in this way create compositions made up of various sources.

The software can be obtained by sending an email to Thinksamuel@yahoo.com.

BIOGRAPHY

Samuel Van Ransbeeck is a Belgian composer, currently residing in Portugal. He is enrolled in the masters course of composition at ESMAE in Porto. His work ranges from acoustical to electronic composition and multimedia projects.

Carlos Guedes is a Portugese composer. He holds a PhD in composition and focuses on the field of interactive music. Currently, he is coordinator of the masters course of composition at ESMAE in Porto, Portugal.

NOTES

1 Thomas Hermann, "An overview of auditory displays and sonification" (2006), http://sonification.de/main-ad.shtml (accessed June 15, 2009).

2 H. K. Taube, *Notes from the Metalevel: An Introduction to Computer Composition* (Abingdon: Routledge, 2004).

3 J. A. Maurer, "A Brief History of Algorithmic Composition" (1999), http://ccrma.stanford.edu/~blackrse/algorithm.html (accessed June 15, 2009).

4 Martin Supper, "A Few Remarks on Algorithmic Composition," *Computer Music Journal* 5, no. 1(Cambridge, MA: Massachusetts Institute of Technology, 2001): 48–53.

5 Bill Shottstaedt, "Automatic Species Counterpoint," (Stanford: Center for Computer Research in Music and Acoustics, 1984).

6 Kemal Ebcioglu, "An expert system for harmonizing chorales in the style of J. S. Bach," *The Journal of Logic Programming* 8, no. 45 (New York: Elsevier, 1990): 185.

7 Supper, 48–53.