
Reviews

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Events

Study Day on Computer Simulation of Musical Creativity

University of Huddersfield, United Kingdom, 27 June 2015. Information about the study day and video recordings of the presentations given during the event can be found at <https://simulationofmusicalcreativity.wordpress.com/>.

*Reviewed by Valerio Velardo
and Steven Jan
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The Study Day on Computer Simulation of Musical Creativity was held at the University of Huddersfield, United Kingdom, on 27 June 2015. The event was an opportunity to explore new lines of research in generative music, simulation of musical societies, systems to enhance the creativity of human users, and evolutionary and cognitive-based models for creative musical systems. Both theoretical and practical research were presented, each complementing the other. The main goal of the study day was to provide a multi-disciplinary platform to researchers with different backgrounds who were interested in computer simulation of musical creativity (CSMC), for discussing and promoting their work and fostering cross-fertilization. The

study day occupied the area of intersection between music, artificial intelligence (AI), cognitive science, and philosophy.

Of the 36 delegates, who came from all over the world, 15 gave presentations on their work. The program consisted of two oral paper sessions, three workshops, one keynote lecture, and a poster session. The works presented covered numerous topics, such as the generation of rhythm and melodies, simulation of pop and jazz music, music programming frameworks, and computer-assisted systems for music analysis.

Research presented at this conference can be roughly classified into three categories: computers as composers, societies of musical agents, and computer-assisted musical systems. In the remaining parts of this review we summarize the main contributions to these categories.

Computers as Composers

The central topic of the CSMC has traditionally been the creation of automated meta music. Systems proposed at the study day with respect to this category can be divided into two subcategories: approaches that generate rhythm only, and systems that produce fully formed music.

Andrew Lambert, Tillman Weyde, and Newton Armstrong presented a connectionist, machine-learning approach to expressive rhythm generation. Their framework is based on cognitive models implemented as a multi-layered recurrent neural network. The first layer, a gradient frequency neural network, is used as input to a second layer, a "long short-term" memory neural network. Once the mixed network is trained on a data set of music containing expressive timings, it is then able to predict rhythmic events. These predictions can in turn be used to generate new

rhythms. The system is robust for predictions, but some participants raised questions regarding its generative behavior. Machine-learning techniques effectively produce music within a musical style, but they cannot escape the stylistic boundaries of the musical set used to train them.

To overcome this issue, Rafael Valle and Adrian Freed proposed Batera, a drum agent able to learn different styles and to interpolate heterogeneous musical features between them. The system exploits probabilistic finite-state automata and considers rhythmic expressivity, musical structure, and drum patterns learned from a training set. The musical output is a stream of drum-based music that can mix together the styles learned, both in terms of rhythmic patterns and instrumentation. Batera can be seen as an instance of a system characterized by what Margaret Boden terms "combinatorial creativity." In other words, Batera generates novel musical artefacts by combining uncorrelated, pre-existing ideas.

Although very sophisticated, the two approaches discussed so far focus on rhythm only. Of course, music is an extremely complex phenomenon, which comprises many dimensions at once (e.g., melody, harmony, counterpoint, form, instrumentation). A few approaches presented at the study day were able to produce fully shaped music. The system proposed by Tom Parkinson can create a potentially infinite stream of slow-moving jazz music in real time. The ensemble is limited to piano, trumpet, and cymbals. Behind the scenes, probabilistic choices dictated by Markov chains determine chordal sequences and the specific instruments involved, which play together at one time. The approach generates interesting musical results within a specific subset of jazz music while ignoring high-level musical form.

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PopSketcher, a framework proposed by Valerio Velardo and Mauro Vallati, tackles the issue of musical form, by producing sketches of pop songs. Sketches are blueprints that contain fundamental information about the harmony, melody, and form of a song. A feature of this approach is that it uses a range of diverse, AI techniques for different compositional tasks. For example, the generation of form is carried out with a probabilistic generative grammar, and a dynamic naive Bayes classifier is responsible for the selection of chords. This strategy is in line with the divide-and-conquer approach used in much AI when dealing with complex issues.

A general point that emerges from the comparison of all the systems presented at the study day is that, at least for the moment, none of them is able to show what Boden terms “transformational creativity.” For Boden, a system is transformationally creative if it is able to transcend the boundaries of its given conceptual space and create its own new rules of generation. The frameworks proposed at the study day, on the other hand, are only able to explore their given conceptual space. The future line of research for systems belonging to the “computers as composers” category is therefore clear. Not only is it necessary to improve the overall compositional results of these approaches, but it is also important to design new, flexible architectures that may lead to the emergence of transformational creativity.

Societies of Music Agents

There were two main contributions in the category of societies of music agents, one practical, the other theoretical. Marcelo Gimenes introduced CoMA (Autonomous Musical Communities of Musical Agents), a

system that is designed to simulate musical evolution in virtual environments. CoMA comprises a number of artificial agents that compose and exchange melodies with each other. The musical style of an agent is determined by a set of musical patterns containing information about pitch and rhythm. During their life cycle, agents accumulate new sets of patterns based on the music of other agents with which they interact. This process leads to the stylistic evolution of agents. CoMA can run without the need for human intervention, and the agents can make “motivated decisions.” This is made possible thanks to perceptual, cognitive, and decision-making global models, which simulate fundamental cognitive elements found in humans.

Steven Jan presented a paper that challenged the boundaries of musical creativity, claiming that whale song can be deemed as creative. Jan argued that whale song is analogous to human music in that it follows a similar cultural-evolutionary process that continually redefines it, and it emerges from the interactions between members of a society. The main difference between these two instances of music is that whale song is still at an early stage of evolution. Jan suggested that sociality, physicality, and embodiment, which are elements common to both human music and to whale song, should all be considered when developing algorithms for generating music, with the aim of emulating creative musical processes in societies of biological agents.

Computer-Aided Music Systems

Music computer systems can also be used to enhance the creativity of humans. The works presented at the study day in this category can be split into two subcategories:

computer-assisted composition, and computer-assisted musical education. The boundary between these two subcategories is often blurred, so it is not always easy to identify a system as belonging clearly to one or the other.

Computer-assisted composition systems can also intervene at different stages of the creative compositional process. For example, the Abjad Python API presented by Trevor Bača, Josiah Oberholtzer, and Jeffrey Trevino helps composers to visualize sketches, compositional materials, and complete scores within an integrated interactive environment. The aim of the framework is to act as a medium between musical thought, formal models, and musical notation.

Computers can revolutionize the performance and the structure of a musical piece, as in the case of *Multidimensional Interstice*. In this composition, Alannah Halay explores the use of an iPhone app to let the audience interactively decide the form of the piece in real time. *Multidimensional Interstice* treats members of the audience as additional composers. The use of technology, and the participatory element of the piece, results in the roles of the composer, performer, and audience becoming enmeshed.

A highlight of the study day was the keynote lecture on computer-assisted musical creativity given by Eduardo Miranda. Miranda posited another way to use computational systems to enhance the compositional creative process. In his career as a composer, Miranda has developed algorithms that generate raw musical materials, which he then digests and reinterprets to compose fully shaped pieces. The large-scale orchestral composition *Mind Pieces* (2011) is an instance of this compositional practice. For this piece, Miranda developed an “artificial life” algorithm,

mapping some of the features of virtual biological agents onto pitch and duration values. The musical results obtained from the program were then used by Miranda as a basis for one of the movements of the piece.

Computer systems can be used to enhance the music learning process as well. Torsten Anders and Örjan Sandred presented a music constraint programming system that can be used to explore the rules of harmony and counterpoint in a visual environment. Users can select a number of compositional rules and observe how they generate musical passages that respect the specified constraints.

Michael Clarke, Frédéric Dufeu, and Peter Manning proposed an interactive environment that allows beginners and experts alike to creatively revisit John Chowning's well known composition *Stria* (1977).

This standalone application enables users to engage aurally and visually with the compositional techniques utilized by the composer. Users can also experiment with changing the time, pitch, and spatialization parameters of the algorithm used by Chowning to compose *Stria*, in order to generate their own musical variations.

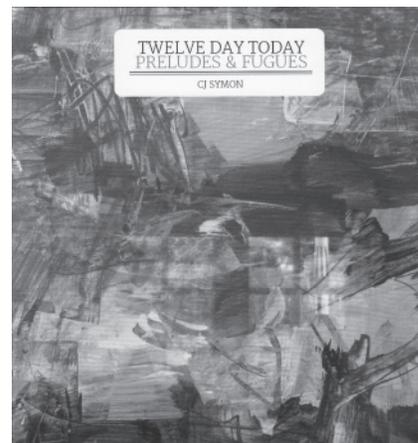
Conclusion

Research on algorithmic music and computer-assisted composition is almost as old as computers themselves. Lejaren Hiller and Leonard Isaacson composed the first computer-generated score, the *Illiad Suite*, in 1957. Thereafter, the number of generative systems grew considerably and today research in CSMC, in all of its declinations, is widespread. Nevertheless, there are still few conferences specifically devoted to CSMC. The Study Day on Computer Simulation of Musical Creativity

filled this gap, since it was an initial attempt to create a common forum meant to accommodate researchers from different backgrounds involved in CSMC.

CSMC still poses many challenges, however. As for music generation, the literature describes countless systems that perform relatively small compositional tasks (e.g., melodic generation, harmonization), but few frameworks have been developed that can create fully shaped musical pieces. During discussions the question arose as to whether these systems should try to emulate human cognitive structures. Some delegates agreed that the final aim of CSMC should be to understand human musical creative processes by means of computer simulation, whereas others thought that, regardless of the type of creative process employed, the focus should be on the output of the system only. In our view, these don't have to be mutually exclusive approaches. Rather, they complement each other, providing insights into both human and machine creativity.

Some participants suggested that researchers should develop societies of artificial musical agents. In this scenario, there is a shift from the level of the single system to the level of a network of systems communicating with each other. This shift is similar to the change of perspective occurring when studying human beings initially through the lens of psychology, and then through that of sociology. By simulating societies of virtual musical agents, it would be possible to understand how music evolves in human societies and how different musical styles arise. This aspiration expresses in a nutshell both the underlying spirit of the study day and the essence of CSMC: Computer simulation is a powerful tool to gain insights about real-life musical phenomena.



Recordings

CJ Symon: *Twelve Day Today Preludes and Fugues*

Compact disc, 2014; CJ Symon Music, 2/10 Paterson Street, Ainslie ACT 2602, Australia; electronic mail cjsymonmusic@gmail.com; <http://cjsymon.bandcamp.com/>.

Reviewed by Ross Feller Gambier, Ohio, USA

CJ Symon's compact disc *Twelve Day Today Preludes and Fugues* represents a curious undertaking by an Australian composer who "has been passionate about sound, music and art as long as he can remember" (quoted on the composer's Bandcamp site). When I first encountered this recording I was skeptical that it would be worth reviewing. The premise for this collection of pieces: To create preludes and fugues using samples of everyday items such as zippers, saucepans, locks, and plastic bags, seemed, on the surface, to resemble the practice of a pedantic schoolmarm. But after scratching the

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surface a little one discovers some timbral gems and unfamiliar contexts well worth listening to.

According to Symon, *Twelve Day Today Preludes and Fugues* "is difficult to classify." He continues: "Is it classical music, sound art, electronic/digital experiment, or noise music? It has motion and pulse, physicality and visuality; some find it relaxing and meditative, others find it tense. Abstract art and Baroque counterpoint and pulse provide the inspiration" for this series of pieces.

Symon acknowledges debts to preludes and fugues by J. S. Bach and Dimitri Shostakovich. Each of Symon's preludes and fugues explores its subject matter from a traditional formal perspective, but common sound palettes replace concepts such as key, and contrapuntal procedures are reflected in sound file duplication and overlapping, layering, and spatial interactions throughout the stereo spectrum.

Bach's preludes and fugues from *The Well-Tempered Clavier* all sport numbers and key names in their titles. Symon's titles use numbers but add additional layers of meaning in the form of descriptive subtitles that indicate which everyday sound was used for each piece. For example, the first piece is entitled *Prelude No. 1 – Zipper*. The primary sound samples for the other pieces include samples of a pan, lock, door, chair, water faucet, curtain or blind, plastic bag, lid, paper, cutlery, and a coat hanger. All are common household items. Besides the everyday aspect of these sounds, the fact that most of these sounds are usually associated with being indoors imparts a certain contemplative inwardness to the project, and provides opportunities for the composer to juxtapose these "inside" sounds with others, such as a flowing river or an urban traffic setting.

Symon's subtitles also seem to engage with the *akousmatikoi* myth in which Pythagoras' pupils heard his lectures from behind a screen, in order to better concentrate on the content. The subtitles for Symon's pieces serve to provide the listener with the originating cause of his primary source materials, however, which makes them function more like 19th-century programmatic labels. Symon claims that in *Twelve Day Today Preludes and Fugues*, "each sound carries, even if unconsciously and subtly for its observer, a spatial, physical, visual, psychological, cultural and symbolic significance. Each sound will solicit some familiar emotional response or recognition." More will be said about this in the conclusion for this review.

The disc begins with a thorough examination of sounds made by a zipper. Processing techniques also found in many of the other pieces are first heard here. These include: time expansion and compression, retrogression, pitch shifting, flanging, spatialization and depth techniques, and frequency filtering. Additionally, in the fugue, Symon utilizes many traditional contrapuntal devices such as canon, and imitation. There is even a miniature stretto section toward the end.

For each prelude–fugue pairing the prelude lays out the conceptual arena in which the primary sound source is presented in various forms. Each fugue focuses on the presentation of the primary sound sources within contrapuntal frameworks. For the most part the term "fugue" can only loosely be applied to the fugues on this disc. One is hard put to identify the three customary fugal sections, and even the basic idea of the subject is not always clearly in evidence. There are several reasons why this is the case. First, the samples Symon uses for his subjects are

mostly already concatenations and highly dense. When used in combination with other "voices" the music reaches maximum textural density very quickly, and, because the composer eschews suggestions of tonality, it is difficult to track each "voice." Second, in a Bach fugue one typically experiences the individual melodies within a consistent harmonic framework that serves to simultaneously unify them while also helping to keep each part distinct. Symon uses spatialization and to a lesser degree equalization to distinguish his parts, but because each part comprises a combination of primary sounds, and maximum density is reached early on in each piece, the sense of part distinction is largely compromised.

On his Bandcamp site Symon writes that for this compact disc "phrases are created out of associations. Polyphonic lines of sound are structured out of these phrases." Although he uses some contrapuntal techniques, the musical texture is not polyphonic because there is no discernible principle of verticality that ties his lines into a harmonic, or other, framework. Instead, the overall texture, or rather effect, resembles John Oswald's *Plunderphonics* pieces in which numerous samples are traversed in a short amount of time, with little change in textural density.

The first prelude and fugue contain many compositional and processing devices that can also be found in the other works on this compact disc. A favorite and effective device used by Symon is time compression and expansion. The simple application of this device can radically alter the semiotic significance of a given primary source. For example, applied to the zipper sample, Symon conjures buzzing insects and motorcycles, applied to a sample of a lock he conjures a ticking clock or rain sounds. It should be mentioned

that the time-altering algorithm that he uses produces very clean results, without the annoying digital "artifacts" common to this type of processing.

Often in the fugues on this disc, Symon first presents his source material by itself, and then in combination with copies of itself, to produce thick layers of heterophony. Although this produces in the composer's words "motion and pulse," the sense of pulse resembles a chaotic heterophony more common to pre- and post-Baroque periods than to the Baroque itself. In combination with the prelude and fugue references it offers a floating historical perspective that makes this music unique.

The two best pieces on this disc are *Prelude and Fugue No. 9 – Lid* and *Prelude and Fugue No. 11 – Cutlery*. In the first work Symon decreases density to create a translucent texture. In the recorded text that accompanies the lid samples one hears

the words "beautiful" and "glorious" spoken in a neutral manner. Perhaps the composer is, tongue in cheek, characterizing the new texture. This is effectively combined with a more subtle degree of control and development of the source samples. The fugue uses a sample of a lid rapidly oscillating on a hard surface after it has fallen. The oscillations gradually speed up as gravity carries the lid to a state of rest. The changes of speed create a simple yet dynamic effect that is not present in the previous preludes or fugues.

After the "wall of sound" density found in many of the previous preludes and fugues, *Prelude and Fugue No. 11 – Cutlery* sounds refreshing. It is one of the only works to utilize pitched material, produced from samples of metal utensils. At times the prelude sounds like a giant *mbira*, clock chimes, or tubular wind chimes. Evocatively (and humorously) the piece begins with the

sound of a drawer being opened, and ends with the sound of it being closed. In the fugue the samples of cutlery are altered, through pitch shifting and filtering, to produce a hodgepodge of analog pinball sounds.

The concept behind this compact disc raises some interesting questions. For example, without the aid of the title would a listener be able to identify, by ear, the source samples? Because, for the most part, little is done to sonically disguise the sources this may very well be the case. According to Symon, each sound triggers a familiar emotional response or recognition. But ultimately it is the triggering of the unfamiliar that makes a listener sit up and take note. Perhaps this was caused by an unusual combination of sounds, or an unlikely twist in the sonic plot. This disc offers us obvious sonic traces left intact, combined with those that are harder to identify, heard from behind the fabled curtain as it were.