REVIVE: An Audio-Visual Performance with Musical and Visual Artificial Intelligence Agents

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Abstract

REVIVE explores the affordances of live interaction between the artificial musical agent MASOM, human electronic musicians, and visual generation agents. The Musical Agent based on Self-Organizing Maps (MASOM) has memorized sound objects and learned how to temporally structure them by listening to large corpora of human-made music. MASOM is then able to improvise live interacting with the other (human) performers by imitating the style of what it reminds it of. For each musician, a corresponding visual agent puts its sound and musical decision into images thus allowing the audience to see who does what. This reveals the musical gestures that are so often lost in electronic music performance. For CHI, MASOM plays with two live performers for a 20 minute audiovisual REVIVE experience.

Author Keywords

Artificial Intelligence; Live Performance; Audio-Visuals; Musical Agents; Multi-agent Systems, Generative Art; Computational Creativity; Musical Metacreation.

ACM Classification Keywords

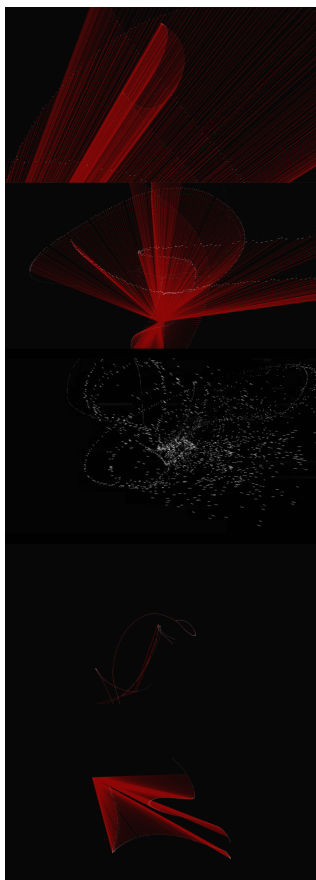J.5 [Computing Applications: Arts and Humanities]

Figure 1: Five still images of visuals generated by visual agents

Generative Art and Computational Creativity

Generative Art incorporates autonomous procedures in its making. The autonomous procedures used in Generative Art range from heuristics, that are often random or simple probabilistic procedures, to autonomous models that learn from a set of sample examples of outcomes (a corpus). These autonomous procedures of Generative Art implement artistic creative tasks. However, not all creative tasks are artistic. In that sense, the scientific field of Computational Creativity (CC) researches all creative tasks including artistic tasks, such as producing music, and non-artistic tasks such as creating a new culinary recipe. Two applied sub-fields of CC are Metacreation and Musical Metacreation (MuMe) [4]. Metacreation is to endow machines with creative behavior whereas MuMe studies the partial or complete automation of musical creative tasks. REVIVE is an art project that integrates Metacreation and MuMe systems to live Audio-Visual (AV) performances.

REVIVE: Project Description

REVIVE is an experimental electronic music project featuring Kıvanç Tatar, Philippe Pasquier, Remy Siu, and MASOM. MASOM is a musical agent, an artificial intelligence (AI) architecture for live performance [6]. A sub-field of MuMe, musical agents are artificial agents that automatize musical creative tasks. Together, the three sonic performers and three visual agents produce a live performance of experimental electronic music, electroacoustic music, musique concrète, soundscape, through structured improvisation [7].

MASOM stands for Musical Agent based on Self-Organized Maps. It is a machine improvisation software for live performance. The agent listens to itself and other musicians to decide in real time what to play next. MASOM is equipped with the latest algorithms in machine listening and is trained on a large corpus of experimental music and electroacoustic music. MASOM extracts high-level features such as eventfulness, pleasantness, as well as timbral qualities to analyze and 'understand' the musical forms. Through its listening, the agent learns sound objects and how they are organized in human-made music.

The architecture of MASOM proposes an innovative perspective by combining a state of the art sound organization algorithm with pattern recognition algorithms (Figure 2). The musical agent creates a sound memory through automatic audio segmentation and thumbnailing, using audio features of timbre, loudness, fundamental frequency, duration, and music emotion features of eventfulness and pleasantness. The architecture applies Self-Organizing Maps [2, 3], a neural network machine learning algorithm. The agent organizes sounds on a two-dimensional map so that similar sound clusters locate closer to each other [1]. MASOM learns the temporality of musical form by applying pattern recognition on the organized sound memory. The agent assumes the musical form as temporal shifts on sound clusters that are organized in the feature space. During the live act, MASOM listens to the performance and locates its current state in the feature space. Using the previously learned temporal change patterns in the feature space, the agent generates sonic gestures to interact with other performers.

MASOM's architecture creates new artistic possibilities to be explored. Using MASOM, we could train a musical agent on the recordings of composers so that musicians could perform with the musical agent. Ideally, we could train a musical agent on any recording. In REVIVE, several MASOM agents are trained on various corpora of experimental electronic music including acousmatic music, glitch, intelligent dance music (IDM), and noise music. Acousmatic compositions use electronic means to create or process
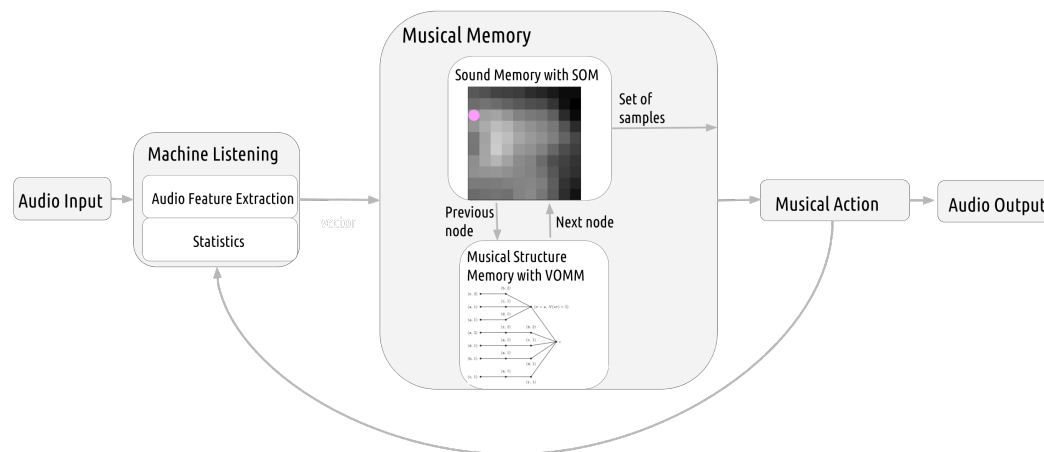
Figure 2: The system architecture of MASOM.

sounds to produce compositions. In acousmatic concerts, the audience listens to speakers in mostly dim-lighted or darkened concert halls. Glitch music explores the idea of using sounds that are generated by the failure of any procedure. For example, using computers, glitch composers and performers overload the cpu to generate clicks and drops on the audio output. IDM composers use any sound object to produce dance music, extending their audio palette to unconventional sounds. Glitch sounds such as clicks, short impulsive noises frequently appear in IDM compositions. Noise music stands on the louder and aggressive end of the musical composition continuum. Noise music employs loud sounds to stimulate the body. The stimulations can be an ear pain caused by the loud sounds or pulsations generated by loud bass frequencies to vibrate the human body.

MASOM learns from the recordings of fixed media pieces. The agent training process transforms these fixed record-

ings into interactive, performing agents. Charged with this knowledge and sonic memory, the musical agent then emulates the style of a composer. REVIVE celebrates music through iconic sonic textures.

Three musicians perform in this project: Kıvanç Tatar, MASOM, and Philippe Pasquier (Figure 3). REVIVE improves the audience's perception of sonic gestures using visual cues. Three visual agents visualize the actions of audio agents (human performers and MASOM). The visual agents are generative and informed by the decisions made by sonic agents. Visual agents can perceive the action of sonic agents using a machine listening algorithm with high-level music features such as eventfulness and pleasantness as well as low level features such as spectral features, loudness, and pitch related features. The visual agents also perceive if an audio agent is active and when an audio agent initiates sound. Using perception abilities, the visual
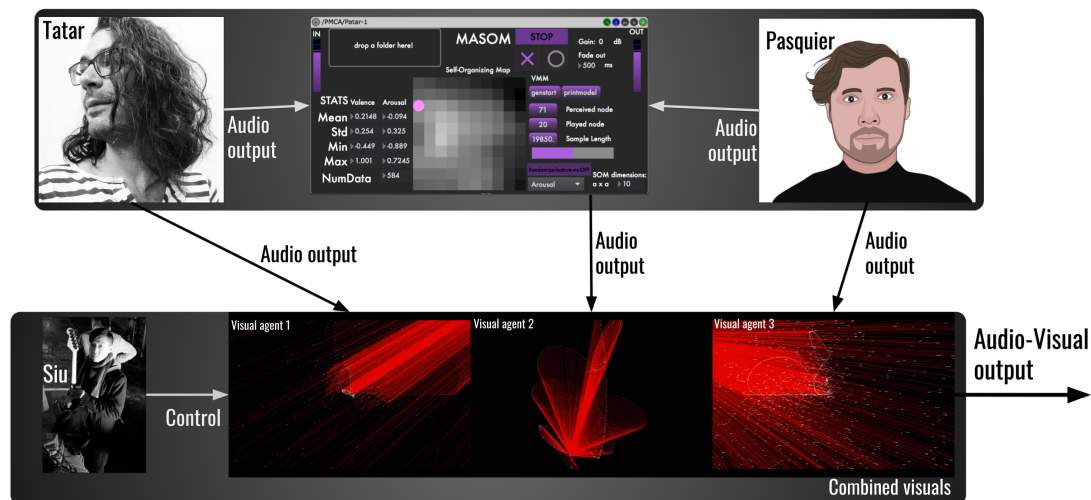
Figure 3: The performance setup of REVIVE, including MASOM and the three visual agents.

agents emphasize the actions of audio agents and make it easier for the audience to comprehend the connection between sonic gestures and the sonic agents' actions.

Previous Performances of MASOM

MASOM has performed in nine venues between October 2016 and January 2018. For the first performance of MA-SOM in Vancouver, BC, Canada, called *A Conversation with AI* [5], MASOM was trained on an improvised noise music album of Kıvanç Tatar. During the freely improvised performance, MASOM acted as a clone of Tatar's improvisation style.

The second performance of MASOM was a collaboration of Metacreation Lab and the New Orchestra Workshop (NOW) Society in Vancouver, BC, Canada. The collective concert, called *madMethod*, included acoustic instruments of piano,

drums, double bass, trumpet, saxophone, and electronics; as well as live visuals. MASOM was trained on the previous performances of NOW Society Ensemble for this performance.

The third performance of MASOM was a trio of Tatar and two MASOM agents. As in *A Conversation with AI*, both MASOM agents learned from the noise album of Tatar. The performance was an act in the collective concert *Take the AID Train* by İstanbul based noise collective *A.I.D*. The fourth performance included the same trio, and presented within the collective concert *RE-UN-SOLVED* in Vancouver, BC, Canada.

The fifth performance was the first performance of the project *PATAR*, by Kıvanç Tatar, MASOM, and Philippe Pasquier. For this project, the agent was trained on a corpus of elec-

Figure 4: A scene from the performance at the Deep Space 8k at the Ars Electronica Festival 2017.

troacoustic music. The act (in the collective concert *Barely Constrained* in Vancouver, BC, Canada) was an exploration of improvised acousmatic music. The sixth performance of MASOM (and the second performance of *PATAR*) was a part of Musical Metacreation Concert 2017 in Atlanta, Georgia, USA.

The seventh, eight, and ninth performances of MASOM were collaborations of the Metacreation Lab and two İstanbul based media art companies: Ouchhh and Audiofil. The first performance of this collaboration was performed three times at the Ars Electronica 2017 Festival in Linz, Austria (Figure 4); and MASOM was trained on the previous compositions of Mehmet Ünal from *Audiofil*. The second performance of this collaboration was presented as a part of iMapp Bucharest 2017. For this performance, MA-

SOM learned from the Audio-Visuals (AV) compositions of Ouchhh and Audiofil, and generated both audio and visuals. The generated AV was mapped on the façade of the Palace of Parliament in Bucharest, Romania. This collaboration ended with the performance at the Circle of Light Festival in Moscow, Russia. MASOM generated AV on the façade of the Bolshoi Theater.

The research and development of MASOM continue and the authors plan to present new versions and iterations of MASOM in future projects, collaborations, festivals, and exhibitions.

BIOs

Kıvanç Tatar is a musician playing trumpet and electronics, a composer interested in experimental music, and a researcher studying artificial intelligence on the applications of music. As of 2017, his work has been exhibited in Germany, Italy, Romania, Austria, Brazil, Australia, USA (New York and Atlanta), Canada (Vancouver and Montreal), and Turkey; including the events Mutek_IMG, the cultural program at Rio Olympics 2016, and the Ars Electronica Festival 2017 (with the theme Artificial Intelligence). Currently, he is a Ph.D. candidate at the School of Interactive Arts and Technology, Simon Fraser University. In the Metacreation Lab, he is working on musical performance with artificial intelligence, Musical Metacreation, audio synthesis, audio programming, machine learning, generative art, and musical composition.

Philippe Pasquier works on creative processes and generative systems. He is both a scientist specialized in artificial intelligence, a multidisciplinary artist, an educator, and a community leader. His contributions range from theoretical research in multi-agent systems, computational creativity and machine learning to applied artistic research and

practice in digital art, computer music, and generative art. Philippe is an associate professor in the School for Interactive Arts + Technology at Simon Fraser University.

Remy Siu 蕭逸南 is a composer and new media artist based in Vancouver, BC. Recently, his work has involved the construction of automated and variable performance apparatuses that employ light, sound, software, and the body. He is interested in creating friction and stakes between the performer, the interface, and the system through the use of game mechanics and failure. His output spans chamber music, dance, theatre, installations, and audio-visual work. He actively creates with Hong Kong Exile (interdisciplinary arts company) and Mahaila Patterson-O'Brien (choreographer), and has worked with Vicky Chow, Turning Point Ensemble, Quatuor Bozzini, Centre A Gallery, Pi Theatre, Theatre Replacement, the Western Front, and others.

Acknowledgements

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