STUDIO REPORT: COMPUTER MUSIC ACTIVITIES AT THE INTERDISCIPLINARY NUCLEUS OF SOUND COMMUNICATION

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ABSTRACT

Part of the University of Campinas (UNICAMP, www.unicamp.br), the Interdisciplinary Nucleus of Sound Communication (NICS, www.nics.unicamp.br) was founded in 1983 by the composer Raul do Valle and collaborators. Since then, NICS has maintainined a longstanding list of participations in the academic and artistic musical scenario, specially the ones concerning the application of mathematical models and computing technology in sound synthesis methods and electro-acoustic music composition. Here we describe the major activities that NICS has been recently engaged with, specially in the areas of interactive performance, computer music, robotics, evolutionary computation applied to musical creation and, recently, physiologic signals acquisition for the retrieval of cognitive and emotive musical features.

INTRODUCTION

Interdisciplinary research and free exchange of concepts, ideas and projects, between Arts and Science, is the ideological foundation and main goal of the Interdisciplinary Nucleus of Sound Communication (NICS), located at the University of Campinas (UNICAMP), one of the major universities of Brazil. This way of directing research at NICS comes from the liberal academic philosophy of UNICAMP. In addition to several faculties and institutes, UNICAMP also has 23 interdisciplinary centres developing research in a broad range of scientific and artistic knowledge. Akin to them, NICS represents a centre for the study of sound communication with special interest on digital audio processing and inter-modal expression, combining music, dance and multimedia. NICS was founded in 1983, fruit of the interaction of researchers, composers and professors from the Music Department, School of Electrical and Computer Engineering. Since 1994, NICS has become more focused on Computer Music techniques, which led to the development of mathematical and computational models applied to gesture interfaces, interactive performances, evolutionary composition and sound synthesis. In addition to its scientific production, NICS also has a longstanding tradition on the creation and performance of artworks. Currently, the research at NICS is mainly led by: Prof. Jônatas Manzolli, Prof. Adolfo Maia Jr., Dr. José Fornari, 05 graduate students and close collaborators, such as: Dr. Artemis Moroni, from the Federal Centre for Technology and Informatics (CTI), Prof. Furio Damiani, Prof. Rafael Santos Mendes, Prof. Joana Lopes, all from UNICAMP, and Prof. Paul Verschure, from SPECS, ICREA & Universitat Pompeu Fabra, Barcelona, Spain. NICS has been working in close relation with other departments of UNICAMP, such as the Institute of Arts, School of Electric Engineering, Centre for Logic and Epistemology, as well as the outside institutions: CTI and SPECS.

We present in the following sections an overview of the recent activities at NICS, mostly reporting its infra-structure, educational programmes, recent projects and major research guidelines; artworks created and performed in collaboration with local and international groups, and, lastly, some of our forthcoming activities.

RESEARCH

Sound Design and Evolutionary Computation

We have used Evolutionary Computation (EC) methodology for the design of soundscapes, mostly using Genetic Algorithms to manipulate symbolic data (MIDI), waveforms (digital audio files), to create new musical timbres with artificial immune systems [1] and with

perceptual acoustic descriptors (psychoacoustic curves). In this approach, individuals' genotype are given by sonic representations, such as waveforms or acoustic features descriptors. There is a population set of individuals that undergo evolution in generation steps, guided by a fitness function and the action of genetic operators. Out of this non-supervised methodology, soundscapes are naturally created. More details can be found in [2].

Textures Control with Granular Synthesis

Due to the great capacity of commercial computers, it is now possible to control streams of sonic grains for the composition of sonic textures with granular sound synthesis. At NICS our task is to apply some formal (mathematical) methods, such as: bio-inspired computation, Fuzzy sets and Markov chains, in different contexts, in order to offer new tools to contemporary composer for the creation musical pieces using granular synthesis. We have been working on an interface that enables the achievement of higher levels of sonic textures controllability in an extended *Gabor* space. [3].

Aural Project

This project integrates EC and physical devices, such as mobile robots and an omni directional vision equipment. Starting with an EC composition system named VOX POPULI and its Java integration, named JaVOX, a hybrid environment named AURAL was developed. It uses trajectories produced by mobile robots that modify the fitness function of a real time sonic composition. More information about Aural project can be found in [4].

Percussion, Electronics and Gesture Interfaces

This project is about the interpretative perspective in contemporary works with live electronics and real time processing. It focuses on musical interpretation and musician's interaction mediated by technological processes. This was achieved with interactive performance sessions in which percussion instruments, such as Marimba, together with interactive mallets generated rich soundscapes through a gesture interface with live digital sound processing [5].

Musical Interaction with Multi-Agent Based Network Game

This joint research was settled in 2008 with the Information Technology Center, at the Nagoya University, Japan, leaded by Prof. Kenji Mase. Here, a digital game was designed to be used as a model for musical network interaction. This is a multi-agent system that processes information and interacts with human players and a set of game rules to produce a collective sound-sculpting experience [6].

Anticipation, Self-Organization and Music Meaning

This project focuses on the study of how the acquisition of knowledge from experience works in music. As an important evolutionary accomplishment, this one helps organisms in predicting future outcomes within an environment that changes constantly. Musicology usually refers to it as *anticipation*, known to be a prominent aspect of musical communication. This project studies music expressivity and aesthetic pleasure and affection as important components of the artistic appreciation, which is considered to be an emergent feature of a self-organized musical cognitive process. For more information, see [7].

Acoustic Descriptors and Biosignals

We consider very enticing the study of the influence of music listening in the human mind, in terms of its cognition and emotional arousal. This project approaches this problem by studying in listeners, immersed in a sonic environment, their discrete variations on the involuntary mechanisms of physiologic reactions, also know as biosignals. Some of them are: heart beating variations, breathing rhythm variation, galvanic skin response, pupil dilatation, and so forth. The development of descriptors already started under the previous development of Dr. Fornari in 2007, during the Braintuning project (www.braintuning.fi). In 2008, we have already started a participation with Prof. Roque Magno, from University of Brasilia (UnB) on the study of the relation of music listening with the variation of the individual circadian cycle.

Generation of Affective Musical Sounds using Roboser

This project is being developed in collaboration with the SPECS researching group, from the Audiovisual Institute (IUA) of the Pompeu Fabra University, Barcelona. With the advent of new human-computer interaction (HCI) technologies, it is now possible to retrieve emotional information from physiological data and use it as an input to interactive music systems. Here we explore the potential of *Roboser* [8] as part of a generative systems controlled by HCI. So, we aim to find a correlation between sound generative parameters to guide music interaction based on human emotional states [9].

ARTWORKS

Lately at NICS we have explored the role of improvisation in interactive pieces of music as a tool to expand their conceptual space. This is in accordance with our academic viewpoint, which assumes that self-organized processes can be a paradigm for the creation of compositional systems. Materials and agents may develop interrelations within a musical system and, in turn, those agents may modify, integrate and develop new organizational

structures within a musical performance scenario. Here, improvisation and multi-modality are faced as a strategic way of developing emergent processes of musical meaning within interactive performance.

Figure 1. Snapshot of a player's movement, during *continuaMENTE* performance (top). Improvisation in an interactive musical piece for percussions and objects (left). Performers playing a musical piece for: "*Pandeiro*", "*Cajon*" and body percussion (right).

Elementaridades

We have collaborated with the Interdisciplinary Group of Theater and Dance of the Institute of Arts, at UNICAMP, led by Prof. Joana Lopes with her project on approach of Art of the Movement. This is inspired by the physical movement of particles of matter, and its application of Rudolf Laban´s principles of movement in dance. We have composed soundscapes for the homonym theater piece *"Elementaridades"* which was presented at the Theatre San Marino, and at the University of Bologna. We are now writing a monography on a theoretical framework derived from our experiences with art of movement and soundscape composition.

continuaMENTE

This is an interactive audiovisual piece composed for tape, texts, video, interactive percussion and live electronics. It was commissioned by the Itaú Cultural Foundation, São Paulo, and created by NICS. It was premiered in August 2007 during the exhibition "*Memória do Futuro*" (Memory of the Future), *continuaMENTE* integrated several materials with real-time sounds and musician's gestures, acquired from three percussionists by three gestural interfaces: interactive mallets, gloves and a carpet, that were used to control a Disklavier Yamaha piano, hence generating complex sonic timbral textures, as further described in [10].

re(PER)curso

This project is being developed from the international collaboration of NICS with SPECS and Pompeu Fabra University. *re(PER)curso* can be seen as a mixed reality performance that artistically explores the interaction between the virtual and the real. This is generated by two human performers who are immersed within it and interact with an autonomous installation. It was first performed in July of 2007, at the MACBA Museum, in Barcelona. Its system has a number of input devices, in particular: the visual active tracking of the ongoing performance; two sensor-carpets connected with MIDI devices; microphones; controllers, such as the synthetic composition engine in *RoBoser* for the interactive real-time soundscape generation, moving cameras, and moving lights, as described in [11].

Figure 2. Percussion over an interactive sensor-carpet, developed at NICS, for the piece *continuaMENTE.*

Figure 3. Dancer performing *re(PER)curso*, at MacBA, Barcelona.

REFERENCES

[1] Caetano, Marcelo ; Manzolli, J. ; Zuben, Fernando Von . Application of an Artificial Immune System in a Compositional Timbre Design Technique. *Artificial Immune Systems, Lecture Notes in Computer Science.* Berlin: Springer-Verlag, 2005, v. 3627, p. 389-403.

[2] Fornari, J., Maia Jr, A., Manzolli, J. "Soundscape Design through Evolutionary Engines". *Special Issue of "Music at the Leading of Computer Science".* JBCS - Journal of the Brazilian Computer Society - ISSN 0104-6500.

[3] Falci, F., Maia Jr., A. *"Evolutive Processes for Granular Synthesis in Extended Gabor Spaces"*, in Proceedings of the 7th Audio Engineering Congress, São Paulo, Brazil, May 2009.

[4] Moroni, A. ; Cunha, S. ; Ramos, J. ; Manzolli, J. ."*Sonifying Robotic Trajectories with a Spherical Omnidirectional Vision System in the Aural Environment*". In: International Conference on Simulation, Modeling and Programming for Autonomous Robots, 2008, Veneza. Proceedings of SIMPAR 2008, 2008.

[5] Campos, C., Traldi, C. Oliveira, L.F., Manzolli, J. "*Anticipation, Improvisatqion and Multimodality: Musical Meaning on Interactive Performance*". *EMUS - Expressivity in MUsic and Speech. Poster presentation*. Paris, France. AGORA contemporary music festival. June 17th-18th, 2008.

[6] Furlanete, F., Manzolli, J. Mase, K. "*Musical Interaction with Multi-Agent Based Network Game*". IPSJ SIG Technical Report, pg 205-210, Japan, 2008.

[7] Oliveira, L.F., Haselager, W.F.G., Manzolli, J. Gonzalez. (2008) "*Musical meaning and logical inference from the perspective of Peircean pragmatism*". Proceedings of the IV Conference on Interdisciplinary Musicology (CIM08), C. Tsougras, R. Parncutt (Eds.), Thessaloniki, Greece, July 2008.

[8] Manzolli, J. and Verschure PFMJ. "*Roboser: a Real-World Composition System*". Computer Music Journal, 29: 55-74, 2005.

[9] Groux, S. L. ; Valijamae, A. ; Manzolli, J. ; Verschure, P. ."*Implicit Physiological Interaction for the Generation of affective Musical Sounds*". In: International Computer Music Conference (ICMC 2008), 2008, Belfast. Proceedings of the ICMC 2008. Belfast : Queens University, 2008.

[10] Manzolli, J. "*continuaMENTE: integrating percussion, Audiovisual and Improvisation*". In: Internacional Computer Music Conference (ICMC 2008), 2008, Belfast. Proceedings of the ICMC 2008. Belfast : Queens University, 2008.

[11] Mura, A. ; Behdad, R. ; Armin, D. ; Manzolli, J. ; Groux, S. L. ; Mattew, Z. ; Verschure P.F.M.J. ; Wierenga, S. ; Bernardet, U. ."*re(PER)curso: an interactive mixed reality chronicle*". In: SIGGRAPH 2008, 2008, Los Angeles. Proceedings of the SIGGRAPH 2008. Los Angeles : ACM Multimedia, 2008.