



ERCIM "ALAIN BENSOUSSAN"
FELLOWSHIP PROGRAMME



Scientific Report

First name / Family name

Marinos

Nationality

Koutsomichalis

Name of the *Host Organisation*

NTNU

First Name / family name of the *Scientific Coordinator*

Björn Gambäck

Period of the fellowship

01/05/2017 to 30/04/2018

I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

The research conducted during the fellowship period broadly concerns computational creativity and data-inspired/data-driven algorithmic art. It can be summarised in five focused categories: (i) sonification of complex decentralised optimisation systems (ii) computational solid modelling employing Natural Language Understanding and 3D data (iii) Evolvable Media Repositories (iv) algorithmic audio mashups and synthetic soundscapes employing Evolvable Media Repositories (v) reworking and exhibiting relevant prior research. Moreover, I was involved in a series of student research projects, co-supervising E. Sandberg's thesis on generating blues solos employing variational autoencoders, and E. Hov and A. Weisethaune thesis on evolving creative behaviour in multi-agent environments employing Neuroevolution of Augmenting Topologies (NEAT), as well as discussing research affairs and projects with other MA students (e.g. V. Zoric, B. Alvestad, and E. Larsen). An overview of the main research activities follows.

I. Sonification of complex decentralised optimisation systems.

Research in this direction concerned audio sonification as the means for both experts and the general public to conceive complex decentralized systems that are too complex, or non-intuitive, for standard visualisation methods. Research pivots on I-EPOS, a system for fully decentralized combinatorial optimization using collective intelligence that may be deployed over crowdsourced IoT devices. (I-EPOS was designed and implemented by Dr. E. Pournaras at the Department of Computational Social Science, ETH Zürich, CH). I have focused on two particular instances of I-EPOS output data concerning (a) the Hubway bicycle sharing system in Paris and (b) the PNW Smart Grid Demonstration Project regarding energy consumption of 493 households. These comprise a total of six datasets employing three different optimisation strategies over several hundreds of iterations. I have designed and implemented two different sonification systems for (a) and (b), respectively, that generate audio in either real, or non real, time. The resulting audio is intended as an informative auditory display probing the overall performance of the combinatorial optimisation process, and foregrounding the complex inter-dependencies between locally generated data and their system-wide effects.

II. Computational solid modelling employing Natural Language Understanding and 3D data.

Research in this direction concerned the conceptualisation, design, and implementation of an experimental system for the computational production of 3D-printable models inspired by

arbitrary textual input. Utilizing a transliteration pipeline, the system pivots on Natural Language Understanding and 3D data available via online repositories to result in a bag of retrieved 3D models that are then concatenated in order to produce original designs. Such artefacts celebrate a post-digital kind of objecthood, as they are concretely physical while, at the same time, incorporate the cybernetic encodings of their own making. I have led two different small scale surveys, asking a total of twelve individuals to reflect on some of the 3D-printed artefacts. Their responses suggest that the generated artefacts succeed in triggering imagination, and in accelerating moods and narratives of various sorts.

III. Evolvable media repositories

Research in this direction addresses the question of evolvable media repositories, *i.e.*, local pools of media files that are retrieved over the Internet and that are ever-renovated with new, related files in an evolutionary fashion. I have implemented an evolutionary system that encodes genotypic space by virtue of simple undirected graphs of natural language tokens representing web queries, and that does not employ fitness functions or other evaluation/selection schemata. Once a first population is seeded, a series of modular crawlers query the particular WWW repositories of interest for both media content and assorted metadata. Then, a series of attached intelligent comprehenders analyse the retrieved content in order to eventually generate new genetic representations, and the cycle is repeated. Such a method is generic, scalable and modular, and can be made to fit the purposes of a wide array of applications in all sorts of disparate contextual and functional scenarios.

IV. Algorithmic audio mashups and synthetic soundscapes employing media repositories.

Research in this direction concerned the conceptualisation, design, and implementation of a system for the real time algorithmic composition of audio mashups and synthetic soundscapes. The system involves four different modules: a specialised Evolvable Media Repository, a sophisticated Soundscape Generator (drawing on prior research work in the context of the Sound Design Accelerator (So.D.A.) project), a context aware Composer to parametrise the former, and a Machine Listening unit performing onset detection and spectral profiling in non-real time. The soundscape generator relies on pattern-based generators to spawn complex and contingent audio sequences in both deterministic and non deterministic fashion, and is also capable of sophisticated 3-dimensional acoustic spatialisation, and multi-channel rendering, with respect to virtual listeners and sonic sources.

V. Reworking and exhibiting relevant prior research.

Research in this direction concerned reworking, and extending, prior relevant research work, eventually exhibiting research results, or leading relevant workshops. In particular, in the context of the *Inhibition* project (revolving around Brain-Computer-Interfacing and audio synthesis) I have made certain modifications to the AI software part and I have re-designed some hardware elements, subsequently presenting it publicly at three different occasions, and also leading one workshop. Moreover, I reworked parts of the data-visualisation algorithm in the context of the *Oiko-nomic Threads* project (revolving around the physicalisation of financial data and the algorithmic production of textile artefacts), and I have publicly exhibited the work on one occasion.

II – PUBLICATION(S) DURING YOUR FELLOWSHIP

During the tenure of the fellowship, my research has resulted in: one refereed book chapter, two refereed publications in conference proceedings, two talks in conference/symposia, one conference poster, four invited talks, and two full-length papers to be submitted promptly after the end of my contract. In detail:

Refereed book chapters (1)

- Koutsomichalis, M. & Gamba ck Bjo rn (2018)*Generative Solid Modelling Employing Natural Language Understanding and 3D Data*. In A. Liapis et al. (Eds.) *Evolutionary and Biologically Inspired Music, Sound, Art and Design. EvoMUSART 2018*. Lecture Notes in Computer Science, vol 10783. pp. 95-111. Springer. DOI: 10.1007/978-3-319-77583-8_7

Refereed publications in conference proceedings (2)

- Koutsomichalis, M. (2018). *Objektivisering: Text Physicalization and Self-introspective Post-digital Objecthood*. In Proceedings of the Twelfth International Conference on Tangible, Embedded and Embodied Interactions (Stockholm, SE). ACM. DOI: 10.1145/3173225.3173301
- Koutsomichalis, M. & Pournaras, E. (2017). *The Sound of Decentralisation: Sonifying Computational Intelligence in Sharing Economies*. In Proceedings of the International Symposium on Electronic Art (Manizales, CO).

Conference talks (2)

- Koutsomichalis, M. & Gamba ck Bjo rn (2018)*Generative Solid Modelling Employing Natural Language Understanding and 3D Data*. 7th International Conference on Computational Intelligence in Music, Sound, Art and Design (Parma, IT).
- Koutsomichalis, M. & Pournaras, E. (2017). Making sharing economies more sustainable. Scientifica (Zurich, CH).

Conference posters (1)

- Koutsomichalis, M. & Gamba ck Bjo rn (2018)*Generative Solid Modelling Employing Natural Language Understanding and 3D Data*. 7th International Conference on Computational Intelligence in Music, Sound, Art and Design (Parma, IT).

Invited talks (4)

- Koutsomichalis, M. (2018). *Computational Creativity, Data, Art*. Department of Computer Science, Norwegian University of Science and Technology. Trondheim, NO.
- Koutsomichalis, M. (2018). *Computational Creativity, Data, Art*. Research Institutes of Sweden (RISE). Stockholm, SE.
- Koutsomichalis, M. (2018). *Art & Technology, Computational Aesthetics, Computational Creativity, Dataesthetics*. Foundation For Research and Technology. Heraklion, GR.
- Koutsomichalis, M. (2017). *Listening Data – Composing Data – Generating Data*. Audio Engineering Society. Birmingham, GB.

Papers to be submitted (2)

- Koutsomichalis, M. & Gambäck, B. (to be submitted). *Algorithmic Audio Mashups and Synthetic Soundscapes Employing Evolving Media Repositories*. AudioMostly 2018 conference (Wrexham, UK).
- Koutsomichalis, M. & Gambäck, B. (to be submitted). *Evolvable Media Repositories: An Evolutionary System to Retrieve and Ever-Renovate Related Media Web Content*. 5th International Conference on Digital Libraries for Musicology (Paris, FR).

To boot, my research has also resulted in three public art exhibitions, three public audio/music performances, and two workshops. In detail:

Public performances (3)

- Koutsomichalis, M. (03.02.2018). *Inhibition*. Spektrum society for Art and Science (Berlin, DE).
- Koutsomichalis, M. (25.11.2017). *Inhibition*. Electroacoustic Music Days, Hellenic Electroacoustic Music Composers Association (Rethymnon, GR).
- Koutsomichalis, M. (19.09.2017). *Inhibition*. DA_Fest, National Academy of Fine Arts (Sofia, BU).

Public exhibitions (3)

- Koutsomichalis, M. (20-03-2018). *Objektivisering*. Twelfth International Conference on Tangible, Embedded and Embodied Interactions (Stockholm, SE).

- Koutsomichalis, M. (02-04.02.2018). *Inhibition*. Spektrum society for Art and Science (Berlin, DE).
- Koutsomichalis, M. (03-29.10.2017). *Oiko-nomic Threads*. TETRAMATYKA Festival. National Academy of Fine Arts (Lviv, UK).

Public workshops (2)

- Koutsomichalis, M. (03-04.02.2018). *Inhibition*. Spektrum society for Art and Science (Berlin, DE).
- Koutsomichalis, M. (20-22.09.2017). *Inhibition*. DA_Fest, National Academy of Fine Arts (Sofia, BU).

III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

During the tenure of the fellowship, I have attended four conferences/symposia, three art exhibitions, and one invited talk. In detail:

- Henrik Boström, *Interpretable machine learning* [invited talk]. RISE SICS (Stockholm, SE). 25.04.2018.
- Evostar 2018 Conference on Bio-inspired Computation, University of Parma (Parma, IT). 4-6.04.2018.
- Twelfth International Conference on Tangible, Embedded and Embodied Interactions, KTH Royal Institute of Technology (Stockholm, SE). 18-21.03.2018.
- Sonic Vibrations – Alien Organs, Spektrum society for Art and Technology (Berlin, DE). 02-04.03.2018.
- TETRAMATYKA Festival, National Academy of Fine Arts (Lviv, UK). 07-10.10.2017.
- Scientifica 2017, ETH Swiss Federal Institute of Technology (Zurich, CH). 01-03.09.2017.
- DA_Fest International Festival of Digital Art. National Academy of Fine Arts (Sofia, BU). 19-23.09.2017.
- International Symposium on Electronic Arts 2017 & Sixteenth Image festival joint conference (Manizales, CO). 11-18.06.2017.

IV – RESEARCH EXCHANGE PROGRAMME (REP)

During my fellowship, I visited two research centres in the context of the Research Exchange Programme. In detail:

REP at RISE SICS, Stockholm, SE 23-28 April 2018.

During my visit in RISE SICS, I met with Dr. Per Kreuger, Dr. Olof Görnerup, and Dr. Björn Bjurling, discussing aspects of my research and opportunities for future collaboration. To boot, I gave an invited talk entitled '*Computational Creativity, Data, Art*', which was followed by a broad discussion on interdisciplinarity, materialism in art, and the limits of the scientific method. I also attended Henrik Boström's talk on '*Interpretable machine learning*', which was followed by a brief discussion on the question of interpretability and its scientific/philosophical ramifications.

REP at FORTH, Heraklion, GR 09-13 April 2018.

During my visit in FORTH, I met with Prof. and head of the Information Systems Lab Dimitris Plexousakis, Prof. and head of the Signal Processing Laboratory Athanasios Mouchtaris, and Researcher Nikolaos Stefanakis, discussing aspects of my research and opportunities for future collaboration. In particular, we discussed the possibility of jointly applying for European grants to pursue research on novel audio generators employing AI and ML techniques. I also gave an invited talk entitled '*Art & Technology, Computational Aesthetics, Computational Creativity, Dataesthetics*' which was followed by an interesting discussion with FORTH researchers on interdisciplinarity and AI-driven art making.