Live Coding a Chorale of Sounds Using MIRLCa: State of Affairs and Implications

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ABSTRACT

In this paper, I introduce the state of affairs of the development of MIRLCa, a self-built tool in SuperCollider. The ongoing SC extension is a user-friendly live coding environment that allows the live coder to query crowdsourced sounds from the Freesound online database using MIR techniques together with interactive machine learning based on the FluCoMa library. This results in a crafted sound-based music style governed by a diverse chorale of sounds that the live coder attempts to tame. Both technical developments and artistic outcomes of using the tool are presented.

1. INTRODUCTION

The MIRLCAuto (MIRLCa) system is a self-built tool in SuperCollider [1] started in 2020 (Figure 1). The tool brings a user-friendly live coding environment to query sounds from the online database of sounds Freesound.org [2] using Music Information Retrieval (MIR) techniques and enhanced with interactive machine learning algorithms adapted from the Fluid Corpus Manipulation (FluCoMa) toolkit [3]. A detailed technical account of MIRLCa and some early findings were published in 2021 [4].

The system was built on top of MIRLCRep [5], a project that started in 2016. Both MIRLC and MIRLCa aim at fulfilling the overall mission of providing an easy-to-use and customisable worldwide sampler with sounds retrieved from the collective online Creative Commons (CC) database Freesound in a live coding fashion, with MIRLC adding other MIR features such as listening and reacting to an audio source, which can be combined with the digital sampler. The development of MIRLCa has been done using co-design methodologies such as workshops, work-in-progress sessions, impromptu performances and concerts, which has been reported in depth in [6], as part of the special issue of Live Coding Sonic Creativities [7].

The system is in ongoing development, principally because new needs keep emerging from artistic and research demands. The two most recent publications look into, on the one hand, human-machine agencies that emerge from the use of live coding systems empowered with machine learning [8], and, on the other hand, the process of building a dataset of personal live coding style [9]. Still, the intention of this paper is to present the current status of the code, bearing in mind that currently, it is an independent research-artistic project mainly developed by one person in available free time. Hence, it is adapted to specific needs, namely developing a tool suitable for live performance.

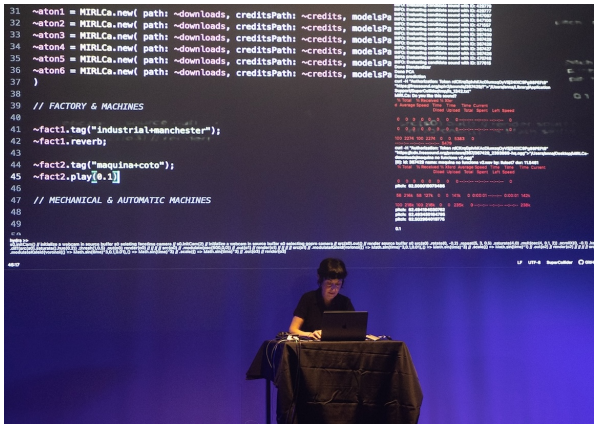

Figure 1. The author live coding with MIRLCa at the +RAIN Film Fest, 14 June 2023, Barcelona. Photo by +RAIN Film Fest.

2. TECHNICAL DEVELOPMENTS

The latest version of the code discussed in this paper can be found at https://github.com/axambo/MIRLCa.

The code repository comprises two main SuperCollider libraries: `MIRLC 2.0` and `MIRLCa`. This includes four SuperCollider classes: `MIRLCRep2` and `MIRLCRew2` within the `MIRLC 2.0` group; and `MIRLCa` and `MIRLCaproxy` within the `MIRLCa` group. `MIRLCa` inherits from `MIRLCRep2` and `MIRLCaproxy` inherits from `MIRLCa`.

- `MIRLCRep2` is a follow-up work-in-progress of the class `MIRLCRep`, [1] which provides a high-level approach to using MIR techniques in live coding. The `MIRLCRep2` class is designed for repurposing audio samples from Freesound using and expanding the Freesound quark [2] for SuperCollider. This version includes effects, more automatic behaviours, and a better organisation of the code.

- `MIRLCRew2` is a follow-up work-in-progress of the class `MIRLCRew`, [3] which also provides a high-level approach to using MIR techniques in live coding.

[1] https://github.com/axambo/MIRLC/blob/master/MIRLCRep.sc
[2] https://github.com/g-roma/Freesound.sc
[3] https://github.com/axambo/MIRLC/blob/master/MIRLCRew.sc

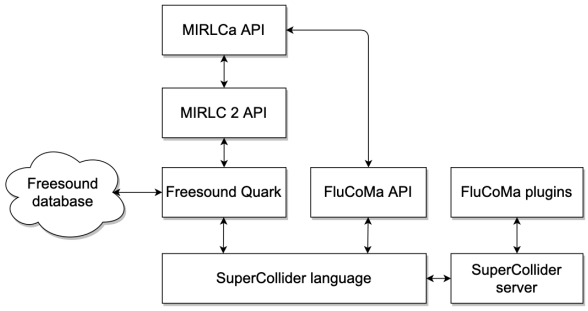

Figure 2. Diagram of the system's architecture.

The `MIRLCRew2` class is designed for rewiring audio in signal as both a control signal or audio signal using MIR techniques in SuperCollider. This version has more effects, more control over how to rewire the signal, and a better organisation of the code. This class can be typically used in combination with `MIRLCRep2` and `MIRLCa` in performance.

- `MIRLCa` is a follow-up work-in-progress from the code published originally in 2020–2021.[4] The `MIRLCa` class (or subclass of `MIRLCRep2`) is designed for bringing some interactive machine learning capabilities using the FluidCorpusManipulation library when interacting with audio samples from Freesound.

- `MIRLCaproxy` is a work-in-progress subclass of `MIRLCa`, which provides a high-level approach to save sessions of live coding using MIRLCa to use later for training.

2.1 Outline of the System

In a nutshell, the system leverages several technologies using the SuperCollider language. As reported in [4], it builds on the `MIRLC 2` module (`MIRLCRep 2` class) as the live-coding user interface to interact with the Freesound quark, which in turn allows for querying and retrieving sounds and the indexed data analysis information from the Freesound online database using the Freesound API.[5] The FluCoMa library[6] is used to provide the machine learning functionality. Figure 2 illustrates the general architecture.

The neural network used in `MIRLCa` consists of an MLP model with dimensionality reduction from the 26 Mel Frequency Cepstral Coefficients (MFCCs) audio descriptors, which were reduced to 20 dimensions via Principal Component Analysis (PCA) and values were standardised to zero mean and unit variance. The architecture of the MLP that was finally used consisted of one hidden layer of 14 nodes, with ReLU activations [4].

2.2 Refactoring and Code Improvements

Each of the four classes contains several functions (class and instance methods). To enhance readability and improve maintainability, the functions have been organised in separate files. The functions in `MIRLCa` have been grouped by:

- **Performance methods**, which are instance methods used in performance. Two files distinguish between the public functions (the methods available to the live coder) and the private functions (the methods used behind the scenes by other functions).

- **Training methods**, which are instance methods used in training. Two files distinguish between the public functions (the functions available to the live coder) and the private functions (used behind the scenes).

- **Utils methods**, which are instance methods classified between public and private. They relate to helpful functions to complete the tasks while performing or training.

The functions in `MIRLCRep2` have been grouped similarly by:

- **Play methods**, which are instance methods used in performance to play the groups of sounds.

- **Retrieval methods**, which are instance methods used in performance to retrieve sounds.

- **Automatic play methods**, which are instance methods used in performance to play the groups of sounds automatically.

- **Automatic retrieval methods**, which are instance methods used in performance to retrieve sounds automatically.

- **Effects**, which are instance methods used in performance to apply effects to the existing sounds.

- **Utils methods**, which are instance methods that work as utils that can be used during performance e.g. to retrieve contextual data.

The functions in `MIRLCRew2` have been grouped similarly by:

- **Basic methods**, which are the core instance methods that perform the logic of the audio engine.

- **Play methods**, which are instance methods used in performance to play the groups of sounds.

- **Effects**, which are instance methods used in performance to apply effects to the existing sounds.

- **Tracking methods**, which are instance methods used in performance that apply MIR techniques.

- **Utils methods**, which are instance methods that work as utils that can be used during performance e.g. to retrieve contextual data.

The functions in `MIRLCaproxy` are included in the same file. They include performance methods and editing/informative methods.

[4] https://github.com/mirlca/code
[5] https://freesound.org/docs/api/
[6] https://www.flucoma.org

Figure 3. Dirty Dialogues album cover. Album art and design by Angela Guyton.

2.3 Documentation

An effort has been made to provide self-contained HelpSource files for each of the four classes within the SuperCollider environment. The currently unmaintained website https://mirlca.dmu.ac.uk is still a valuable account of the development of the tool during 2020–2023 that includes blog posts, tutorials, concerts and publications. For an updated account, refer to the GitHub repository presented in this paper.

3. ARTISTIC OUTCOMES

Apart from the academic outcomes reported in the introduction (Section 1), there have been several artistic outcomes including performances and music albums. A selection is presented here.

3.1 Albums

- *H2RI* [7] by Anna Xambó (pan y rosas, 2018). H2RI is an instance of a generative album with 20 tracks of 1 minute each that have been generated using MIRLC. A basic rule has shaped the audio sources of the album: the only use of sounds of short duration from the crowdsourced online sound database Freesound. Each track is complemented with the code in SuperCollider and the attribution to the authors of the original sounds.

- *Beacon* [8] by Anna Weisling and Anna Xambó (Carpal Tunnel, 2019). This EP contains two live performances of the evolving piece Beacon. Anna Weisling performs with her bespoke system Distaff whereas Anna Xambó performs with her bespoke system MIRLC. The live concerts were at the Root Signals Festival (RSF) 2017, Georgia Southern University, Statesboro, Georgia, USA, and the New Interfaces for Musical Expression (NIME) 2018, Moss Arts Center: Anne and Ellen Fife Theatre, Blacksburg, Virginia, USA.

- *Dirty Dialogues* [9] by Dirty Electronics Ensemble, Jon.Ogara, and Anna Xambó (pan y rosas, 2021). Dirty Dialogues is an encounter between Dirty Electronics Ensemble, Jon.Ogara and Anna Xambó in a free music improvisation session after a long pandemic lockdown. Thirteen musicians on stage combining analogue and digital instruments, acoustic and electronic materials, live coding and DIY soundmaking techniques. Anna Xambó performs with MIRLCa and Jon.Ogara includes MIRLCa in his ensemble of instruments. This album was recorded on May 17, 2021, at PACE (De Montfort University) with no audience due to COVID-19 restrictions. The event was organised by MTI^2, De Montfort University in collaboration with l'ull cec. It was funded by the EPSRC HDI Network Plus Grant. Figure 3 shows the album cover.

3.2 Performances

- *Different Similar Sounds: A Live Coding Evening "From Scratch"*, [10] Sala Aranyó (Campus UPF Poblenou), Barcelona, Spain. April 29, 2021. Organised by Phonos in collaboration with TOPLAP Barcelona and l'ull cec. In this session, four live coders associated with TOPLAP Barcelona (Ramon Casamajó, Roger Pibernat, Iván Paz, and Chigüire) used MIRLCa "from scratch", adapting the library to their particular approaches and aesthetics. It was funded by EPSRC HDI Network Plus Grant.

- *4 boxes* [11] by Anna Xambó as part of *Performing Critical AI I: feedback, noise, corpus, code*, MusAI conference, Cafe OTO, London, UK. November 27, 2022. The performance consisted of a live coding session using the self-built SuperCollider extensions MIRLCa, MIRLCRep2 and MIRLCRew2 and a DIY box. This event was sponsored by the ERC-funded project *Music and AI: Building Critical Interdisciplinary Studies*.

- *Ceci n'est pas une usine* [12] by Anna Xambó as part of the +RAIN Film Fest, Sala Polivalent, Universitat Pompeu Fabra/Sónar+D, Barcelona, Spain. June 14, 2023. Machine listening and machine learning algorithms were used through the self-built SuperCollider extensions MIRLCa and MIRLCRew2, combining sounds from the Freesound database with personal sounds in a sound-based music style. Olivia Jack's Hydra [13] was used for the visuals.

[7] https://panyrosasdiscos.bandcamp.com/album/h2ri
[8] https://carpal-tunnel.bandcamp.com/album/detuning-a-tuning
[9] https://panyrosasdiscos.bandcamp.com/album/dirty-dialogues
[10] https://youtu.be/lDVsawECK2Y
[11] https://youtu.be/eGSjD-K3bg4
[12] https://youtu.be/IQHcSbkJK5k
[13] https://hydra.ojack.xyz

4. NEXT STEPS

Future development plans include continue improving the MIRLCa tool according to artistic needs. The next forthcoming performance, *Sensing the Alice Holt Forest*, [14] involves the analysis and use of a custom dataset of natural soundscape recordings that we are building as part of the AHRC-funded project Sensing the Forest. [15] The challenge here is working with a large dataset of long sounds and identify meaningful patterns related to climate change. Finishing the task of learning from a dataset of personal live coding style [9] is also in the pipeline. The challenge here is achieving a stable result so that it can be incorporated into the MIRLCa code.

Future plans also include improving the documentation with standalone files including a complete list of functions, a more detailed getting started file, and additional tutorial examples. The code needs to be polished too. There is an endless list of features to be improved or implemented. Ultimately, the goal is to publish the code as a SuperCollider quark.

5. CONCLUSION

This paper presented a summary of the history, code improvements, artistic outcomes and plans of MIRLCa, a self-built tool in SuperCollider. An accompanying new code repository with the latest version of the code has been introduced. The development of this tool aligns with slow research principles and "The Slow Science Manifesto" [16] combined with fast-prototyping techniques such as code sprints, hackathons, or deadlines for workshops/performances/presentations to help push the development of this research forward. The project also aligns at present and in the long term with open research and open source principles.

Acknowledgments

The project *MIRLCAuto: A Virtual Agent for Music Information Retrieval in Live Coding* was funded by the EPSRC HDI Network Plus Grant (EP/R045178/1) – Art, Music and Culture Theme led by Prof Atau Tanaka from April 2020 until October 2021. The performance *4 boxes* was funded by the MusAI project (European Union's Horizon 2020 research and innovation programme Grant agreement No. 101019164) led by Prof Georgina Born. Thanks to both research projects for their support. I am thankful to the livecoding, LivecoderA, SuperCollider, Freesound, FluCoMa, MusAI and NIME communities for their direct or indirect help in the development of MIRLCa. My special thanks to Gerard Roma for his constant mentoring and guidance in SuperCollider, Freesound, FluCoMa and MIRLCa matters. Also thanks to the MIRLCAuto research project team and collaborators for believing in the project and propelling it that far.

[14] https://iclc.toplap.org/2025/

[15] https://sensingtheforest.github.io

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