# MAKING ELECTRONIC MUSIC WITH EXPERT MUSICAL AGENTS

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## ABSTRACT

This demo describes a collection of intelligent musical agents that act and react to real-time manipulation. We report on a number of probabilistic approaches that address the generation of rhythm, harmony and texture idioms that exist in electronic music today. The presentation combines these individual components into a virtual orchestra that can play synchronously in time.

## 1. INTRODUCTION

Electronic dance music (EDM) is a category of popular music that encompasses styles such as techno, house, trance, and dubstep, and utilises electronic instruments such as synthesizers, drum machines, sequencers, and samplers. EDM has become one of the most important and influential music genres of our time, spreading and crossing-over with generic and formulaic pop forms, including contemporary rock, r&b and rap music.

As a consequence of the research done in the GiantSteps project, [1] we have developed some musical agents that take advantage of the knowledge gained when analysing rhythm, tonality, timbre and structure of EDM tracks [1] [2] [4] [3]. The agents have some genre-specific musical knowledge embedded in their inner workings, in a way that facilitates the creation of music that follows some of the relevant conventions assumed by listeners, dancers, creators and performers of EDM.

## 2. AGENT DESCRIPTIONS

### 2.1 Rhythmic Patterns and Variation

Two distinct methods of generating and varying rhythmic patterns draw from recent research exploring syncopation and similarity in symbolic representations [1] [2]. Our first system, the *Markov Rhythm Generator*, builds n-order Markov models of existing MIDI corpora containing various drum styles. Using those models it generates new loops in the style of the analyzed MIDI corpora. This system is packed with a real time control where for a single loop the "commonness" within a style, the density and the syncopation values can be modified. These three controllers add much plasticity and reversibility to the transformation of a single loop so a loop can be easily explored and modified to fit specific aspects of a live performance or an offline composition.

The second system, *GenDrum*, takes a different approach, applying a Genetic Algorithm to iteratively evolve new patterns based on a fitness function that determines the rhythmic similarity of the evolved patterns to an initial target pattern. At present two distance measures are provided, the Hamming distance and the directed-swap distance. The Hamming distance simply counts the number of onsets that differs while the more complex direct-swap attempts to capture the horizontal displacement more acutely by using graph representations. However, our listening suggests the Hamming distance correlates more closely with perceptual impressions of similarity. [4]

### 2.2 House Style Bass Generation

An agent for the generation of bass lines in the Deep House style is also implemented. It is based on the analysis of a dataset of 400 MIDI bass lines and the reproduction via an order 1 Markov chain. The output of the agent is a 16 step pattern of onsets which is generated controlling its "commonness" with a bandpass filter. Its pitch is informed by the chord algorithm generator which we explain in the next section.

### 2.3 Stylistic Chord Generation

The *House Harmonic Filler* is a tentative model for chord variation that could be used in contexts of live electronic music performance. Despite harmony not being a prominent aspect of many electronic popular music genres, it is still prevalent in those evolving directly from the song tradition, such as electro-pop and disco variants. Furthermore, certain sub-styles of house, especially so-called deep house, make use of chord loops borrowed from African-American musical traditions, such as soul, rhythm-and-blues or even jazz, using extended chords other than simple triads (especially major and minor 7ths and 9ths, but also 13ths, suspensions and alterations).

House harmonic loops normally consist of sequences of 2 or 4 bars, with a tendency to have a single chord per bar. Currently, the House Harmonic Filler is limited to operating with 2-bar loops. The application takes one reference loop, which is analyzed in terms of density, legato

[1] www.giantsteps.eu

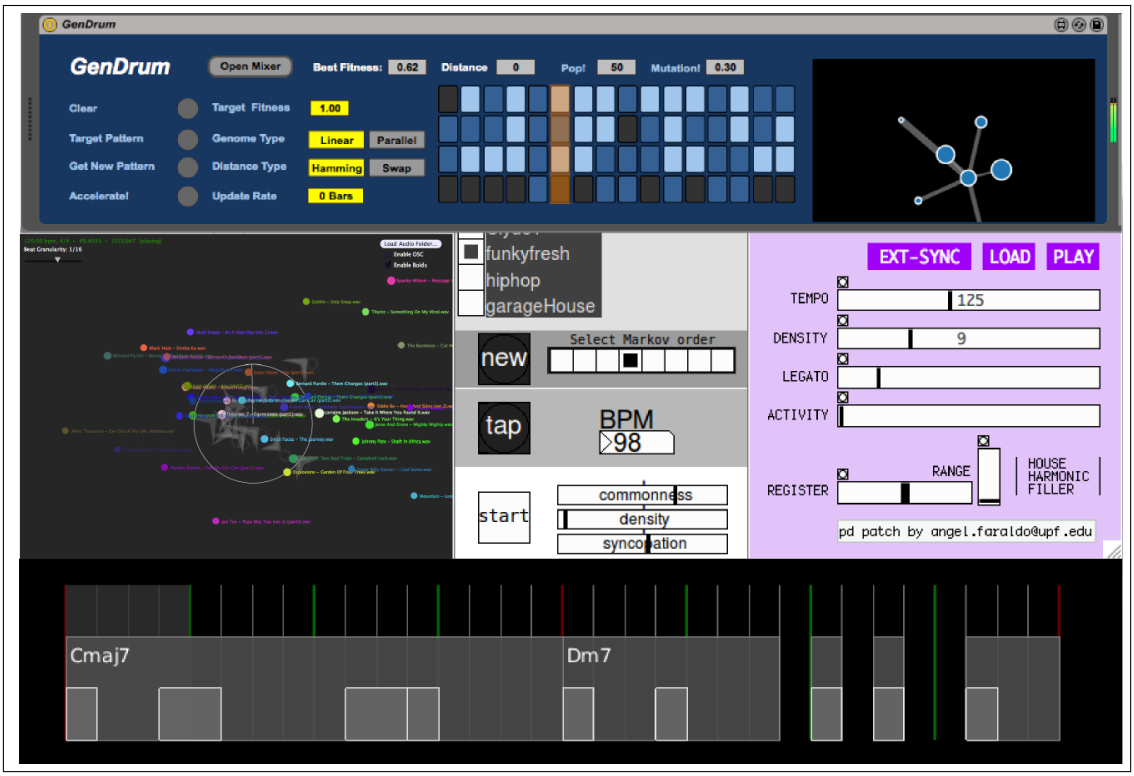


**Figure 1**. Collection of some agent interfaces.

and chord configuration, parameters that can be modified in real-time according to corpus analysis and music theoretical knowledge [3].

### 2.4 Concatenative Rhythm Synthesis

*RhythmCAT* is a VST-based software instrument that creates new sounds and patterns through rhythm-driven concatenative/granular synthesis. Granular synthesis creates new sounds by stitching together small snippets (or "grains") of sounds together. Concatenative synthesis can be considered a larger-scale granular synthesis where longer length "phrases" of sound are combined in interesting ways. RhythmCAT operates by grouping sounds together in 2D space according to their timbral similarity (do groups of sounds sound "alike"). Slices of these sounds are then combined and played back according to a metronome. Working with drum material, new beats and patterns can be generated in a similar fashion to breakbeats.

## 3. PERFORMANCE AND SYNCHRONISATION

For testing, we have prepared a session in *Ableton Live* where all instruments can be loaded and affected simultaneously. We include a Max For Live patch that sends and receives OSC with basic transport information (start, stop and tempo) across devices or programs running in one or more computers. This way, different users should be able to jam together driving different musical processes onto a single piece of music.


### Acknowledgements

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