Techniques for automated and interactive note sequence morphing of mainstream electronic music

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Abstract

Note sequence morphing is the combination of two note sequences to create a ‘hybrid transition’, or ‘morph’. The morph is a ‘hybrid’ in the sense that it exhibits properties of both sequences. The morph is also a ‘transition’, in that it can segue between them. An automated and interactive approach allows manipulation in realtime by users who may control the relative influence of source or target and the transition length. The techniques that were developed through this research were designed particularly for popular genres of predominantly instrumental electronic music which I will refer to collectively as Mainstream Electronic Music (MEM). The research has potential for application within contexts such as computer games, multimedia, live electronic music, interactive installations and accessible music or “music therapy”. Musical themes in computer games and multimedia can morph adaptively in response to parameters in realtime. Morphing can be used by electronic music producers as an alternative to mixing in live performance. Interactive installations and accessible music devices can utilise morphing algorithms to enable expressive control over the music through simple interface components.

I have developed a software application called *LEMorpheus* which consists of software infrastructure for morphing and three alternative note sequence morphing algorithms: parametric morphing, probabilistic morphing and evolutionary morphing. Parametric morphing involves converting the source and target into continuous envelopes, interpolation, and converting the interpolated envelopes back into note sequences. Probabilistic morphing involves converting the source and target into probability matrices and seeding them on recent output to generate the next note. Evolutionary morphing involves iteratively mutating the source into multiple possible candidates and selecting those which are judged as more similar to the target, until the target is reached.

I formally evaluated the probabilistic morphing algorithm by extracting qualitative feedback from participants in a live electronic music situation, benchmarked against a live, professional DJ. The probabilistic algorithm was competitive, being favoured particularly for long morphs. The evolutionary morphing algorithm was formally evaluated using an online questionnaire, benchmarked against a human composer/producer. For particular samples, the morphing algorithm was competitive and occasionally seen as innovative; however, the morphs created by the human composer typically received more positive feedback, due to coherent, large scale structural changes, as opposed to the forced continuity of the morphing software.

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List of abbreviations

Note: for definitions, see the Glossary in Appendix A

AMS: Algorithmic Music System
ANN: Artificial Neural Network

BB: Break-Beat
BCBT: Binary Copy Buffer Transform
BPM: Beats Per Minute

CAAC: Computer Assisted Algorithmic Composition
CAC: Chick-A-Chick
CC: Circle of Chroma
CD: Compact Disc
CF: Circle of Fifths
CONCERT: CONnectionist Composer of ERudite Tunes
CPU: Central Processing Unit
CT: Central Tonic

DePa: Degree and Passing notes
DJ: Disc Jockey
DSP: Digital Signal Processing
DMP: Direct Music Producer

EDM: Electronic Dance Music
EMI: Experiments in Musical Intelligence

FF: Four on the Floor
FIFO: First In First Out

GenJam: Genetic Jammer
GRIN: GRaphical INput
GUI: Graphical User Interface

HMSL: Hierarchical Music Specification Language

IBM: International Business Machines
IGA: Interactive Genetic Algorithm
IPS: Independent Pitch Streams
ILLIAC: ILLinois Automated Computer

JMSL: Java Music Specification Language
jMusic: Java Music

LED: Light Emitting Diode
LEMu: Live Electronic Music
LEMorpheus: Live Electronic Morpheus
LFO: Low Frequency Oscillator

MAX/MSP: MAX (Mathews) Signal Processing
MEM: Mainstream Electronic Music
MIDI: Musical Instrument Digital Interface
MUSICOMP: MUSIc Composition language

NN: Nearest Neighbour

OO: Object Oriented
OS: Operating System
OSC: Open Sound Control

PNR: Pitch to Noise Ratio

QUT: Queensland University of Technology

SARA: Simple Analytic Recombinant Algorithm

SMA: Simple Musical Algorithm

SPEAC: Statement, Preparation, Extension, Antecedent, Consequent

TC: Tonal Change

TraSe: Transform-Select

TS: Tonal Stability

UML: Unified Modelling Language

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

_____

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