A Glossary of terms

Abstract (compositional approach): involves defining relationships, implicit or explicit, between different forms of data, both musical and non-musical, in order to explore musical possibilities.

Algorithmic Music System (AMS): music algorithm that consists of a large network of smaller musical algorithms.

Analytic (music algorithm): an algorithm which extracts data with a low musical predisposition from data with a high musical predisposition.

Agent (AI): an automated process, designed for a particular task.

Atonicity: Lack of tonal centre.

A Capella: Without backing. A Cappella Hip-Hop is voice only rapping and is usually intended to be remixed.

Backbeat: the 'two' and 'four' of 4/4 metre.

Backwards (in Nearest Neighbour dissimilarity): the average dissimilarity of each note in the target and its nearest neighbour in the source.

Beat-class: the class of all beats with the same onset within a meter or cycle.

Breakbeat (BB): rhythmic style based on drum fills with emphasis on variation.
Bridge: intermediate section.

Broad context (see contextual breadth):

Cento: a piece (poem or music) composed from many segments of other pieces.

Centonization: composition through recombination of segments.

Chick-A-Chick (CAC): a rhythmic event consisting of two strongly emphasised syncopated beats, each one directly on each side of a weakly emphasised beat.

Circle of Chroma (CC): the circle of all pitch-classes, in chromatic order.

Circle of Fifths (CF): the circle of all pitch-classes, in order of fifth intervals.

Coherence (musical): the degree to which the music sounds as though the composer intended it to sound the way that it sounds.

Contextual breadth (of music algorithm): the amount of data available and typically used the music algorithm.

Contrast (*Markov Morph* parameter): parameter which exaggerates the level of discretisation in the *Markov Morph* similarity matrix.

Degree and Passing notes (DePa): representation of pitch which includes scales, scale degrees and passing notes.

Depth: see Markov order.

Earmark: an element of the music which serves as a structural indicator.

Electronic Dance Music (EDM)

Effectiveness (musical): the degree to which the music is able to affect listeners in a way that was intended by the composer.

Evolutionary (computing): techniques that involve mutation and selection.

Fill (drum): rhythmic deviation in the percussion, often at the end of a cycle.

Fitness function: evaluates which candidates will be selected from a pool.

Foreshadowing: hinting at a future event.

Forward calculation (in Nearest Neighbour dissimilarity): the average dissimilarity of each note in the source and its nearest neighbour in the target.

Four-on-the-Floor (FF): rhythmic style, characterised by a kick on each beat.

Frames (in *TraSe*): a list of note sequences leading from source to target.

Frame-limit (*TraSe* parameter): number of frames at which *TraSe* aborts.

Function (music algorithm): how the algorithm relates to musical data, on a continuum from analytic through transformational to generative.

Garbage collection (Java): a system within the Java Virtual Machine which automatically disposes of unused memory.

Generative (music algorithm): music algorithm which generates data with a high level of music predisposition from data with a low level of music predisposition.

Heuristic (compositional approach): involves implicit estimation and application of rules to fulfil a musical intention.

Heuristic: a “rule of thumb”, that is, a possibly sub-optimal, but effective rule.

Hypermeter (music): a cyclic pattern of emphasis spanning multiple bars.

Interpolation (morphing technique): see parametric morph.

Key modulation: the art of changing from one key to another.

Key profile: the set of pitch classes within a particular key, along with weightings which indicate the different strengths of each pitch class.

Macroperiod: from the start of a polyrhythmic cycle to the point where the differently sized rhythmic periods converge.

Mainstream Electronic Music (MEM): popular, mostly instrumental electronic music, characterised by looped layers of rhythmic, tonal and sonic parts.

Markov Morph: a morphing algorithm I developed involving weighted selection of source or target, extraction of similarity with the recent output and probabilistic generation of notes in realtime from the similarity measurements.

Markov order: when predicting the value of a future variable from a sequence of past variables, the order is the number of past variables which are used.

Markov depth: see Markov order.

Mashup: a style of electronic music involving the juxtapositioning of existing tracks.

Meta-smoothness (musical): continuity of musical expectations for the listener.

Metric Modulation: see temporal modulation.

Musical Instrument Digital Interface (MIDI): a protocol for musical sound synthesis data.

Modulus: mathematical function for wrapping numbers within a range. While input may be negative, output is always positive, as with a clock face.

Modulation: see key modulation.

Morph: a section of music that is a hybrid transition between a source and a target.

Morph index: parameter controlling the influence of the source or target during the morph.

Mutation rate (*TraSe* parameter): specifies how many transformations may occur on each iteration of the transformation chain.

Musical neutrality: for a music software environment to have no stylistic influence.

Narrow context: see contextual breadth.

No-change variable (*TraSe* parameter): a weighting for the “bypass” or “no-change” parameter configuration of each transformation in the chain.

Note-level (music algorithm): dealing primarily with note events and data such as pitch, onset, duration and dynamic rather than sound waveforms.

Note sequence: a list of notes, ordered in sequence according to their onsets.

Note group: a vertical grouping of notes. All notes with the same onset will occupy the same note group.

N-source morphing: morphing between more than two note sequences (multiple sources, rather than a source and target).

Null prediction (in *Markov Morph*): when it is impossible to predict a note because all elements in the probability distribution equal 0.

Open Sound Control (OSC): a customisable protocol for sound synthesis data.

Order: see Markov order

Octavised scale degree: the scale degree, plus the number of octaves multiplied by the number of steps per octave.

Parametric morphing: morphing through conversion of source and target note sequences into multidimensional parameter envelopes; combination of source and target envelopes, weighted on the morph index; and conversion of the combined envelopes back into note sequences.

Perfect transformation : In *TraSe*, a perfect transformation is a theoretical transformation that has the capacity to produce an infinite number of patterns in the selection pool, with an even spread of dissimilarity to the target throughout. In a perfect transformation, when the **transform speed** is $\frac{1}{3}$ there will be 3 cycles before convergence.

Pitch to Noise Ratio (PNR): the degree to which tuned pitches are apparent within the music, relative to untuned sounds or noise.

Pivot chords: chords which are constructed from pitches that occur in both the source and target keys.

Pivot notes: notes with pitches that occur in both source and target keys.

Play cycle: the play cycle is a function that is constantly iterated, usually at intervals of a quarter beat (an eighth beat if the tempo is lower than 60 BPM, or a half beat, when higher than 160 BPM) to produce notes in realtime. Other functions are called to produce the notes.

Polyrhythm: supposition of contrasting rhythms, often with different periods.

Predisposition (musical): the ease with which a data representation may be converted into audible music.

Recombinant (music algorithm): an algorithm which generates music through combining of segments of existing music in new ways.

Remix: producing a new piece of music from the audio of a source track (often the multi-track masters), with techniques including: rearranging, adjusting effects, adding material, mixing and mastering.

Simple Musical Algorithm (SMA): music algorithm which exists as a single, simple component or function.

Smoothness (musical): the level of perceived moment to moment continuity within a piece of music.

Syncretism (music): when new styles or cultures of music are created from a blend of existing cultures or music.

Textural (music): music in which the continuous sonic texture, spectrum or timbre more noticeable than discrete events. Such textures are often created from a complex combination of many elements.

Tetrachord: the four pitches spanned by the interval of a perfect fourth. For example, the first, second, third and fourth scale degrees.

Temporal Modulation: proportional changes between different tempi. A technique pioneered by Elliot Carter.

Tonal Change (TC): the rate at which the tonality changes, from constant drone through to unpredictable solo.

Tonal Stability (TS): the strength of the sense of tonality, primarily with reference to the tonic, fourth and fifth, but also to enculturated pitch schemas.

Transformational (music algorithm): music algorithm where the content of the input is transformed to generate the output, however, the data representations used for input and output have the same level of musical predisposition.

Transform speed (*TraSe* parameter): influences the number of frames that will occur in *TraSe*, by defining the level of dissimilarity with target that will be aimed for by the transformation to which the transform speed refers.

Transform-Select (TraSe): a morphing algorithm I developed involving an iterative process of transformation and selection. The source is transformed into a pool of potential candidates from which a single candidate is selected according to similarity with target. The transformation is repeated with each new candidate until it becomes the target.

Trial (compositional approach): involves generating many potential patterns and searching to find the ones that best fit an explicit criteria or goal.

Triangle inequality: property of all 'metric' spaces, whereby the combined distance of two sides of a triangle in the space is always larger than or equal to the third side of the triangle.

Turing test: a test whereby a machine and a human engage in a natural language conversation with a human judge, who decides which of them is the machine. If the judge is unable to distinguish them, the machine has passed the test.

Turntablism: the practice of using the turntables and mixer as a musical instrument, rather than simply a playback device.

Urlinie: in Schenkerian analysis, the 'fundamental line', reduced from analysis of the pitch content and representing the underlying tonal changes in the music.

Veridical (music psychology): a form of expectation that arises from repeated listening to a particular piece of music.

Weighted-selection: a morphing technique developed by Daniel Oppenheim in which individual notes from either the source or target are selected for playback, weighted on the morph index.

Xenochrony: the juxtapositioning of different layers from different recordings. Term coined by Frank Zappa.

B Pseudocode of methods for combining envelopes and generating notes

```
// GET-MORPHED-ENVELOPE-NOTE generates notes for the current play-cycle by combining
source and target envelopes
// Inputs:
ES,ET   hold envelopes for each dimension. ES is from source, ET from target. For example,
        ES.pitch is the pitch envelope from the source.
t       the time, in beats, since system playback started
s       the loop length, in beats (smallest common multiple of source and target lengths).
res     the play-cycle resolution, in beats. Usually 0.25.
mi      the morph index, ranging from 0 to 1.
v       the time, in beats, since the last note was played
rec     user switch, to recalculate the area under the onset envelope  since the last note
        was played (onset area tracker) each frame or not.
resco   user switch, to reset the onset area tracker to zero on the first beat or not.
pc      user switch, to constrain the result of the pitch interpolation or not.
firstFrame      parameter indicating wether or not this is the first frame of the morph.
// global parameters:
a       'inter-onset area tracker', the current area under the onset envelope since a note
        was last played. Is used to decide whether to create a note for this play cycle.
inc     user parameter that influences the incidence of note generation
rem     user switch, whether to leave the remainder when updating the onset area tracker
// functions:
GET-VALUE       Takes an envelope and a time, returning the envelope value at that time.
SIMULATE-PLAY-CYCLES   Calculates 'a', for a given mi and t. Described in detail below.
QUANTIZE        snaps the first input the nearest multiple of the second input
// output:
N       The note that is to be played at the current time. N = null is a rest
GET-MORPHED-ENVELOPE-NOTE(envelope ES, envelope ET, double t, double s, double res,
                          double mi, double v, 282oolean rec, 282oolean firstFrame) {

        IF(firstFrame == true || rec == true) {
                a = SIMULATE-PLAY-CYCLES(ES, ET, t, mi, v, res, a) // described below
        }

        phase =    mi  *  GET-VALUE(ES.phase, MOD(t,s)) +    // morphed phase offset
                  (1-mi) *  GET-VALUE(ET.phase, MOD(t,s))
        QUANTIZE(phase, res)
        ct = MOD(t-phase + s, s) // current position in envelopes, given the phase offset

        IF(resco == true && ct == 0) { a = v*v }

        IF( v - inc >= a/v) {  // check to create a note
                N.pitch =    mi * GET-VALUE(ES.pitch, ct) +
                           (1 - mi)* GET-VALUE(ET.pitch, ct)
                IF(pc == true) { N.pitch = LOCK-TO-KNOWN-PITCHES(ES, ET, N) }
                N.duration = mi  *  GET-VALUE(ES.duration, ct) +
                           (1 - mi) *  GET-VALUE(ET.duration, ct)
                N.dynamic =  mi  *  GET-VALUE(ES.dynamic,  ct) +
                           (1 - mi) *  GET-VALUE(ET.dynamic,  ct)
                IF(rem == false) {     // if not leaving a remainder
                        a = 0          // reset the area to 0
                } ELSE { a = MOD(a, v*v) }    //leave a remainder

        } ELSE { N = null }    // don't make a note, make a rest

        v =    mi  *  GET-VALUE(ES.onset, ct) +      // update the inter-onset value
               (1 - mi) *  GET-VALUE(ET.onset, ct)
        a = a + v*res          // update the onset area tracker
        return N
}
```

Figure B-1 **Pseudocode for GET-MORPHED-ENVELOPE-NOTE, which generates notes by morphing the source and target note envelopes together.**

```
// SIMULATE-PLAY-CYCLES simulates the effect of play cycles on the onset area tracker
// Inputs:
ES,ET   hold envelopes for each dimension. ES is from source, ET from target. For example,
        ES.pitch is the pitch envelope from the source.
t       the target beat that the simulation will proceed up to.
mi      the morph index.
v       the time, in beats, since the last note was played.
res     the frame resolution in beats.
a       'inter-onset area tracker'. the current area under the onset envelope since a note
        was last played.
// Global parameters:
inc     user parameter that influences the incidence of note generation.
rem     user switch, to leave a remainder when updating a or not.
SIMULATE-PLAY-CYCLES(envelopes ES, envelopes ET, double t, double mi, double v,
                     double res, double a) {
        tr = 0  // initialise a tracker, starting from the beginning
        v =    mi  *  GET-VALUE(ES.onset, tr) +      // initialise inter-onset value
              (1 - mi) *  GET-VALUE(ET.onset, tr)
        a = v*v         // initialise the area tracker to simulate first frame note

        WHILE(tr < t) {
                // update current value of the inter-onset and the area
                v = mi  *  GET-VALUE(ES.onset, tr) +
                (1-mi) *  GET-VALUE(ET.onset, tr)

                //simulate the creation of a note
                IF( v*v - inc <= a) { // update the onset area tracker:

                        IF(rem == false) {// if not leaving a remainder
                                a = 0   //reset the area to 0
                        } ELSE {
                                a = MOD(a, v*v) // leave a remainder
                        }
                }

                a = a + v*res  // increment the area tracker since last note

                tr = tr + res  // increment the current simulated position

        }
}
```

Figure B-2 **Pseudocode for SIMULATE-PLAY-CYCLES, which simulates a number of play cycles, in order to calculate the value of the inter-onset area tracker for the current point.**

C Printed output from the Markov Morph algorithm

Notes on print out symbols: The "<<<<" indicates the beat at which a note was generated. The integer beneath the double array indicates which note was selected as a match for the seed by the random process during that quarter-beat. The position under the array visually indicates which slot in the array was selected. Where this integer is followed directly by "L", stream loss has occurred and the double directly following "L" is the position of the segment within the 16 beat loop that is used as note data.

```
beat 40.0   = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.1, 0.3, 0.9, 1.0, 0.5, 0.0, 0.0, } total = 3.26 m_avg = 2.16
sel note                                                          12<<<<
beat 40.25  = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.1, 1.0, 0.7, 0.1, 0.0, } total = 2.35 m_avg = 2.16
sel note                                                                15<<<<
beat 40.5   = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.1, 1.0, 0.8, 0.4, } total = 2.45 m_avg = 2.16
sel note                                                                15<<<<
beat 40.75  = { 0.2, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.1, 1.0, 0.7, } total = 2.19 m_avg = 2.16
sel note        1<<<<
beat 41.0   = { 1.0, 0.8, 0.1, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.2, 0.9, } total = 3.16 m_avg = 2.16
sel note             2<<<<
beat 41.25  = { 0.2, 0.5, 1.0, 0.1, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total = 2.05 m_avg = 2.16
sel note                           5<<<<
beat 41.5   = { 0.0, 0.0, 0.1, 1.0, 0.5, 0.1, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total = 1.88 m_avg = 2.16
sel note                      4<<<<
beat 41.75  = { 0.0, 0.0, 0.0, 0.1, 1.0, 0.3, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total = 1.66 m_avg = 2.16
sel note                           5<<<<
beat 42.0   = { 0.0, 0.0, 0.0, 0.0, 0.1, 1.0, 0.3, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total = 1.61 m_avg = 2.16
sel note                                6<<<<
beat 42.25  = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.1, 1.0, 0.3, 0.1, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total = 1.70 m_avg = 2.16
sel note                                     7<<<<
```

Figure C-1 **Print out of the similarity matrix, the total sum of similarity values, the moving average of this sum and the selected note for each quarter beat of a variation on a short chromatic run from tonic to dominant and back. Circle of Chroma pitch similarity is the only similarity measure used. Markov order is 5, contrast is moderately low. Only the last portion of the entire print out has been presented here, the final value of the moving average being the important piece of information.**

```
beat 48.75  = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total = 1.02 m_avg = 1.14
sel note                                                 9<<<<
beat 49.0   = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total = 1.11 m_avg = 1.14
sel note                                                    10<<<<
beat 49.25  = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total = 1.11 m_avg = 1.14
sel note                                                       11<<<<
beat 49.5   = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total = 1.02 m_avg = 1.14
sel note                                                          12<<<<
beat 49.75  = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, } total = 1.04 m_avg = 1.14
sel note                                                             13<<<<
beat 50.0   = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, } total = 1.05 m_avg = 1.14
sel note                                                                14<<<<
beat 50.25  = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, } total = 1.05 m_avg = 1.14
sel note                                                                15<<<<
beat 50.5   = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, } total = 1.04 m_avg = 1.14
sel note                                                                   16<<<<
beat 50.75  = { 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total = 1.02 m_avg = 1.14
sel note        1<<<<
```

Figure C-2 **Print out of the similarity matrix, the total sum of similarity values, the moving average of this sum and the selected note for each quarter beat of a variation on a short chromatic run from tonic to dominant and back. Circle of Fifths pitch similarity is the only similarity measure used. Markov order is 5, contrast is moderately low. This is the last portion of the complete print out, the final value of the moving average being the key piece of information.**

```
beat 22.0   = { 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.1, 0.0, 0.1, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total
= 1.34 m_avg = 1.84
sel note                      4<<<<
beat 22.25  = { 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.3, 0.0, 0.1, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total
= 1.54 m_avg = 1.84
sel note                           5<<<<
beat 22.5   = { 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.3, 0.0, 0.1, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total
= 1.54 m_avg = 1.84
sel note                                6<<<<
beat 22.75  = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.1, 0.0, 0.1, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total
= 1.36 m_avg = 1.84
sel note                                     7<<<<
beat 23.0   = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.1, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total
= 1.25 m_avg = 1.84
sel note                                                                  13<<<<
beat 23.25  = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.1, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.9, 0.0, 0.1, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total
= 2.32 m_avg = 1.84
sel note                                                                      14<<<<
beat 23.5   = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.2, 0.0, 0.0, } total
= 1.53 m_avg = 1.84
sel note                                                                                                                                22<<<<
```

Figure C-3 **Print out of the similarity matrix, the total sum of similarity values, the moving average of this sum and the selected note for each quarter beat of a variation on the complete chromatic scale. Circle of Fifths pitch similarity is the only similarity measure used. Markov order is 5, contrast is moderately low. This is the last portion of the complete print out, the final value of the moving average being the key piece of information.**

```
beat 11.75  = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.2, 1.0, 0.6, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total
= 2.03 m_avg = 1.93
sel note                                     7<<<<
stream loss this bar : 0.0 rate: 0.0
beat 12.0   = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.2, 1.0, 0.6, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total
= 2.05 m_avg = 1.93
sel note                                           9<<<<
beat 12.25  = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.2, 1.0, 0.6, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total
= 2.02 m_avg = 1.93
sel note                                                10<<<<
beat 12.5   = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.2, 1.0, 0.6, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total
= 2.02 m_avg = 1.93
sel note                                           9<<<<
beat 12.75  = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.2, 1.0, 0.6, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, } total
= 2.04 m_avg = 1.93
```

Figure C-4 **Print out of the similarity matrix, the total sum of similarity values, the moving average of this sum and the selected note for each quarter beat of a variation on the complete chromatic scale. Circle of Chroma pitch similarity is the only similarity measure used. Markov order is 5, contrast is moderately low. This is the last portion of the complete print out, the final value of the moving average being the key piece of information.**

```
beat 169.5 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 169.75 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 170.0 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 170.25 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 170.5 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 170.75 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 171.0 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 171.25 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 171.5 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 171.75 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 172.0 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 172.25 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 172.5 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 172.75 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 173.0 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 173.25 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
stream loss this bar : 0.0 rate: 0.0
beat 173.5 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 173.75 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 174.0 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 174.25 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 174.5 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 174.75 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 175.0 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 175.25 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 175.5 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 175.75 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, }
beat 176.0 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, }
beat 176.25 = { 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 176.5 = { 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 176.75 = { 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 177.0 = { 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 177.25 = { 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
stream loss this bar : 0.0 rate: 0.0
beat 177.5 = { 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 177.75 = { 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 178.0 = { 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 178.25 = { 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 178.5 = { 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 178.75 = { 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 179.0 = { 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 179.25 = { 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 179.5 = { 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 179.75 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 180.0 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 180.25 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 180.5 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 180.75 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 181.0 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
beat 181.25 = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
```

Figure C-5 **The similarity matrix generated at each 0.25 beat during the rendering of the *Take On Me* variation. The section in blue is when the additional similarity measure of modulus 3 beat space was incorporated to increase the accuracy; while the section following this uses only modulus 8 beat space.**

```
beat 12.0   = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
seL note                                                                                                                  18
beat 12.25  = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
seL note                                                                                                                  18
beat 12.5   = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
seL note                                                                                                                  18<<<<
beat 12.75  = { 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
seL note             2
beat 13.0   = { 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
seL note                                                                                                                  19
beat 13.25  = { 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
seL note                                                                                                                  19
beat 13.5   = { 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
seL note                                                                                                                  19<<<<
beat 13.75  = { 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, }
seL note                                                                                                                     20
beat 14.0   = { 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, }
seL note                   4
beat 14.25  = { 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, }
seL note                                                                                                                     20
beat 14.5   = { 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, }
seL note                                                                                                                     20
beat 14.75  = { 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, }
seL note                   4L14.75
beat 15.0   = { 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, }
seL note                   4L15.0
beat 15.25  = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, }
seL note                                                                                                                        23
beat 15.5   = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, }
seL note                                                                                                                        23<<<<
beat 15.75  = { 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, }
seL note                         6
```

Figure C-6 **Example print out of the similarity matrix for each quarter beat during the generation of the variation of the *Take On Me* loop using modulus 3 and 4 space as the similarity measure, Markov depth of 1 and maximal contrast.**

```
beat 16.0   = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                                                                 14<<<<
beat 16.25  = { 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 1.0, }
sel note                                                                 15
beat 16.5   = { 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 1.0, }
sel note                   7
beat 16.75  = { 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 1.0, }
sel note                         6
beat 17.0   = { 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 1.0, }
sel note                                                                                                                  22
beat 17.25  = { 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 1.0, }
sel note                                                                 1511.25
beat 17.5   = { 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 1.0, }
sel note                                                                 1511.5
beat 17.75  = { 0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                   4
beat 18.0   = { 0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                   4
beat 18.25  = { 0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                         5
beat 18.5   = { 0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                   4<<<<
beat 18.75  = { 0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                         5
beat 19.0   = { 0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                         5
beat 19.25  = { 0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                   4
beat 19.5   = { 0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                   4<<<<
beat 19.75  = { 0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                         5
```

Figure C-7 **Example print out of the similarity matrix for each quarter beat during the generation of the variation of the *Take On Me* loop using linear pitch as the similarity measure, Markov order of 1 and maximal contrast.**

```
beat 16.0   = { 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.1, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, }
sel note                                                                                                                  2210.0
beat 16.25  = { 0.5, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.2, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, }
sel note                                                                                                                        23
beat 16.5   = { 0.5, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.2, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, }
sel note                                                                                                                        23<<<<
beat 16.75  = { 0.0, 0.9, 0.1, 0.0, 0.0, 0.2, 0.1, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.4, 0.0, 0.2, 0.0, 0.0, 1.0, }
sel note               2
beat 17.0   = { 0.0, 0.9, 0.1, 0.0, 0.0, 0.2, 0.1, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.4, 0.0, 0.2, 0.0, 0.0, 1.0, }
sel note               2<<<<
beat 17.25  = { 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.1, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                     3
beat 17.5   = { 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.1, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                     3<<<<
beat 17.75  = { 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                           4
beat 18.0   = { 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                           4
beat 18.25  = { 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                           4
beat 18.5   = { 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                           4<<<<
beat 18.75  = { 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                                 5
beat 19.0   = { 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                                 5
beat 19.25  = { 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                                 5
beat 19.5   = { 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, }
sel note                                 5<<<<
beat 19.75  = { 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.1, }
sel note                                       6
```

Figure C-8 **Print out of the similarity matrix for each quarter beat during the generation of the variation of the *Take On Me* loop weighting pitch at 100, circle of fifths space at maximum, start time at 66, Markov depth of 1 and moderate contrast. It should be noted that some similarity values that are smaller than 0.1 could not be represented easily within this space and were rounded to 0 for the print out.**

D TraSe algorithm

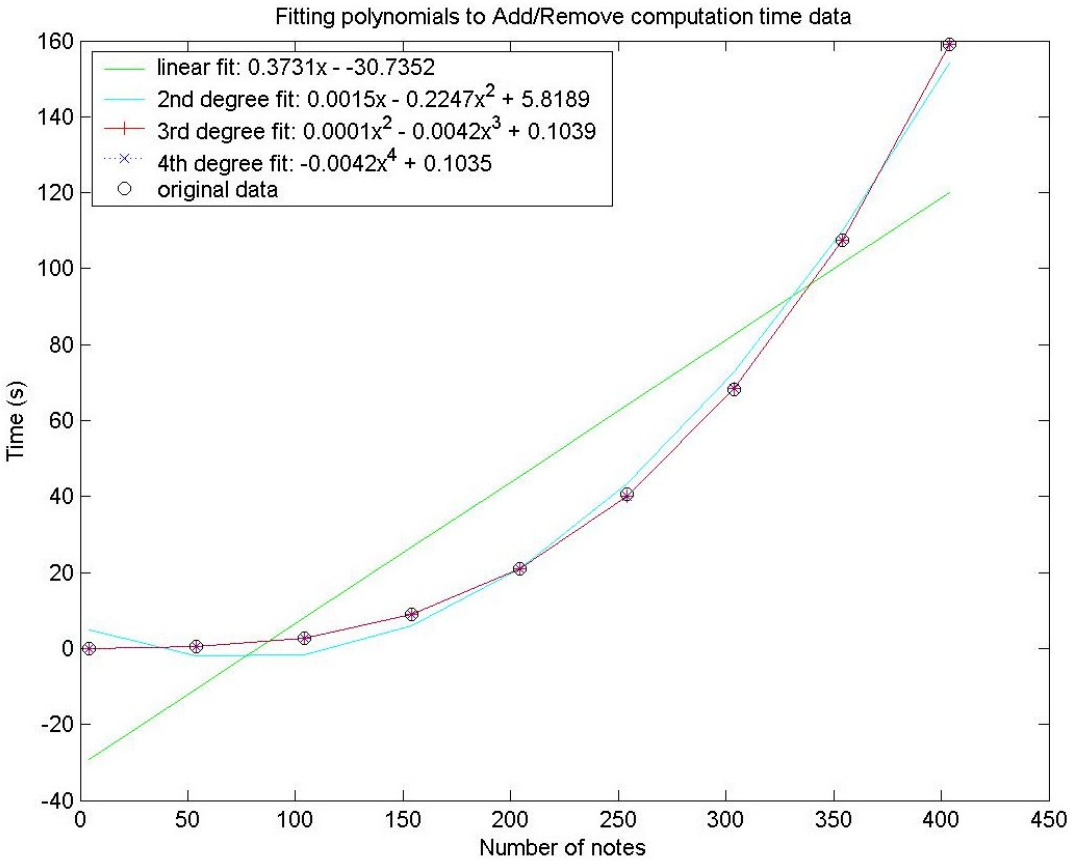

Figure D-1 **Degrees 1-4 of polynomial fittings to the curve generated by the *add/remove* computation time. The curves generated by degrees 3 and 4 are overlaid on the original, demonstrating the closeness of their fit.**

Note: In the print out below, the notes in the note sequences are either described in the form **onset:pitch** (DePa pitch, including octave), or, for more detail, with **s** for start time (onset), **p** for pitch and **D** for duration. **difnn** is the result of the Nearest Neighbour dissimilarity measure. **step** is the current iteration of the transform chain. The text immediately after **transearch** is the name of the transformation in the transformation chain that is being applied. **bypass** specifies whether or not that transformation is being bypassed.

```
original part
 0.0:70,
0.75:76,
1.5:70,   2.0:72,
2.75:68,
3.5:72,

target part =
 0.0:70,
0.5:72,   1.5:78,
2.25:74,
2.5:84,
3.25:82,
difnn          =
0.20754280833333
333

transform step 1



at step : 1

part
 0.0:70,
0.75:76,
1.5:70,   2.0:72,
2.75:68,
3.5:72,
transforming
chain  0  Divide
and Merge
find... bypass =
false



transearch
Divide and Merge
 selected = 4 .
mid = 2   result
=



s  0.0  p:70  D:
0.05624999999999
9994,     s  0.75
p:76  D:  0.225,
s  1.5  p:70  D:
0.225,
  s  2.0  p:72  D:
0.225,    s  2.75
p:68  D:  0.225,
s  3.5  p:72  D:
0.225,    s  0.0
p:70
D: 0.16875,
transforming
chain 1 Rate
find... bypass =
false
```

```
transearch Rate
 selected = 3 .
mid = 3   result
=



s  0.0  p:70  D:
0.16875,   s 0.0
p:70          D:
0.05624999999999
9994,     s  0.75
p:76 D: 0.22
5,    s  1.5  p:70
D: 0.225,  s 2.0
p:72  D:  0.225,
s  2.75  p:68  D:
0.225,    s  3.5
p:7
2 D: 0.225,
transforming
chain 2 Phase
find... bypass =
false



transearch Phase
 selected = 16 .
mid = 16  result
=



s  0.0  p:70  D:
0.05624999999999
9994,     s  0.0
p:70 D: 0.16875,
s  0.75  p:76  D:
0.22
5,    s  1.5  p:70
D: 0.225,  s 2.0
p:72  D:  0.225,
s  2.75  p:68  D:
0.225,    s  3.5
p:7
2 D: 0.225,
transforming
chain          3
harmonise
find... bypass =
false
 harda =    0[,0
,0 ],
 1[,0 ],
 2[,0 ],
 3[,0 ],
 4[,0 ],
 5[,0 ],
 6 null
}

transearch
harmonise
```

```
 selected = 6 .
mid = 6   result
=



s  0.0  p:70  D:
0.16875,   s 0.0
p:70          D:
0.05624999999999
9994,     s  0.75
p:76 D: 0.22
5,    s  1.5  p:70
D: 0.225,  s 2.0
p:72  D:  0.225,
s  2.75  p:68  D:
0.225,    s  3.5
p:7
2 D: 0.225,
transforming
chain  4  Pitch
Stretch
find... bypass =
false



transearch  Pitch
Stretch
 selected = 14 .
mid = 7   result
=



s  0.0  p:70  D:
0.05624999999999
9994,     s  0.0
p:70 D: 0.16875,
s  0.75  p:82  D:
0.22
5,    s  1.5  p:70
D: 0.225,  s 2.0
p:74  D:  0.225,
s  2.75  p:66  D:
0.225,    s  3.5
p:7
4 D: 0.225,
transforming
chain          5
inversions
find... bypass =
false



transearch
inversions
 selected = 6 .
mid = 6   result
=



s  0.0  p:70  D:
0.16875,   s 0.0
p:70          D:
```

```
0.05624999999999
9994,     s  0.75
p:82 D: 0.22
5,    s  1.5  p:70
D: 0.225,  s 2.0
p:74  D:  0.225,
s  2.75  p:66  D:
0.225,    s  3.5
p:7
4 D: 0.225,
transforming
chain 6 Octave
find... bypass =
false



transearch
Octave
 selected = 3 .
mid = 3   result
=



s  0.0  p:70  D:
0.05624999999999
9994,     s  0.0
p:70 D: 0.16875,
s  0.75  p:82  D:
0.22
5,    s  1.5  p:70
D: 0.225,  s 2.0
p:74  D:  0.225,
s  2.75  p:66  D:
0.225,    s  3.5
p:7
4 D: 0.225,
Trans
forming  chain  7
add remove



transearch   add
remove
 selected = 12 .
mid = 7   result
=



s  0.0  p:70  D:
0.16875,   s 0.0
p:70          D:
0.05624999999999
9994,     s  0.75
p:82 D: 0.22
5,    s  1.5  p:70
D: 0.225,  s 2.0
p:74  D:  0.225,
s  2.75  p:66  D:
0.225,    s  3.5
p:7
4  D:  0.225,   s
2.5   p:84   D:
```

```
1.38186274509803
87,


transearch    add
remove
 selected = 10 .
mid = 8   result
=


s  0.0  p:70  D:
0.16875,   s  0.0
p:70          D:
0.05624999999999
9994,     s  0.75
p:82 D: 0.22
5,    s  1.5  p:70
D: 0.225,   s 2.0
p:74   D:  0.225,
s  2.5  p:84  D:
1.38186274509803
87
,    s  2.75  p:66
D: 0.225,   s 3.5
p:74   D:  0.225,
s  0.5  p:72  D:
1.32303921568627
36
,
  chaco = 3

part 1 =
 0.0:70,
0.5:72,
0.75:82,
1.5:70,   2.0:74,
2.5:84,
2.75:66,
3.5:74,

target   =
 0.0:70,
0.5:72,   1.5:78,
2.25:74,
2.5:84,
3.25:82,

transform step 2



at step : 2

part
 0.0:70,
0.5:72,
0.75:82,
1.5:70,   2.0:74,
2.5:84,
2.75:66,
3.5:74,
transforming
chain  0  Divide
and Merge
find... bypass =
false



transearch
Divide and Merge
 selected = 0 .
mid = 2   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:72  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:74 D
: 0.225,   s 2.5
p:84  D:  0.475,
s  3.5  p:74  D:
0.225,
transforming
chain 1 Rate
find... bypass =
false


transearch Rate
 selected = 3 .
mid = 3   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:72  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:74 D
: 0.225,   s 2.5
p:84  D:  0.475,
s  3.5  p:74  D:
0.225,
transforming
chain 2 Phase
find... bypass =
false


transearch Phase
 selected = 16 .
mid = 16   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:72  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:74 D
: 0.225,   s 2.5
p:84  D:  0.475,
s  3.5  p:74  D:
0.225,
transforming
chain          3
harmonise
find... bypass =
false
 harda =    0[,0
],
 1[,0 ],
 2[,0 ],
 3[,0 ],
 4[,0 ],
 5[,0 ],
}

transearch
harmonise
 selected = 6 .
mid = 6   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:72  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:74 D
: 0.225,   s 2.5
p:84  D:  0.475,
s  3.5  p:74  D:
0.225,
transforming
chain  4  Pitch
Stretch
find... bypass =
false


transearch  Pitch
Stretch
 selected = 12 .
mid = 7   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:76 D
: 0.225,   s 2.5
p:94  D:  0.475,
s  3.5  p:76  D:
0.225,
transforming
chain          5
inversions
find... bypass =
false


transearch
inversions
 selected = 6 .
mid = 6   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:76 D
: 0.225,   s 2.5
p:94  D:  0.475,
s  3.5  p:76  D:
0.225,
transforming
chain 6 Octave
find... bypass =
false


transearch
Octave
 selected = 3 .
mid = 3   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:76 D
: 0.225,   s 2.5
p:94  D:  0.475,
s  3.5  p:76  D:
0.225,
transforming
chain   7   add
remove


transearch    add
remove
 selected = 12 .
mid = 6   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:76 D
: 0.225,   s 2.5
p:94  D:  0.475,
s  3.5  p:76  D:
0.225,    s  3.25
p:82          D:
1.440686274
5098032,


transearch    add
remove
 selected = 12 .
mid = 7   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:76 D
: 0.225,   s 2.5
p:84          D:
1.13700980392156
81,  s 3.25 p:82
D:
1.44068627450980
32,
 s  3.5  p:76  D:
0.225,
  chaco = 3

part 2 =
```

```
 0.0:70,
0.5:74,   1.5:70,
2.0:76,   2.5:84,
3.25:82,
3.5:76,

target   =
 0.0:70,
0.5:72,   1.5:78,
2.25:74,
2.5:84,
3.25:82,

transform step 3



at step : 3

part
 0.0:70,
0.5:74,   1.5:70,
2.0:76,   2.5:84,
3.25:82,
3.5:76,
transforming
chain  0  Divide
and Merge
find... bypass =
false


transearch
Divide and Merge
 selected = 4 .
mid = 2   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:76 D
: 0.225,   s 2.5
p:84          D:
1.13700980392156
81,  s 3.25 p:82
D: 0.3601715,  s
3.5 p:
76 D: 0.225,   s
3.5   p:82   D:
1.08051470588235
25,
transforming
chain 1 Rate
find... bypass =
false


transearch Rate
 selected = 3 .
mid = 3   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:76 D
: 0.225,   s 2.5
p:84          D:
1.13700980392156
81,  s 3.25 p:82
D: 0.3601715,  s
3.5 p:
82            D:
1.08051470588235
25,  s 3.5 p:76
D: 0.225,
transforming
chain 2 Phase
find... bypass =
false


transearch Phase
 selected = 16 .
mid = 16  result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:76 D
: 0.225,   s 2.5
p:84          D:
1.13700980392156
81,  s 3.25 p:82
D: 0.3601715,  s
3.5 p:
76 D: 0.225,   s
3.5   p:82   D:
1.08051470588235
25,
transforming
chain          3
harmonise
find... bypass =
false
 harda =   0[,0
],
 1[,0 ],
 2[,0 ],
 3[,0 ],
 4[,0 ],
 5[,0 ],
 6[,6 ,0 ],
 7 null
}

transearch
harmonise
 selected = 4 .
mid = 6   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:76 D
: 0.225,   s 2.5
p:84          D:
1.13700980392156
81,  s 3.25 p:82
D: 0.3601715,  s
3.5 p:
76 D: 0.225,
transforming
chain  4  Pitch
Stretch
find... bypass =
false


transearch  Pitch
Stretch
 selected = 8 .
mid = 7   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:76 D
: 0.225,   s 2.5
p:86          D:
1.13700980392156
81,  s 3.25 p:84
D: 0.3601715,  s
3.5 p:
76 D: 0.225,
transforming
chain          5
inversions
find... bypass =
false


transearch
inversions
 selected = 6 .
mid = 6   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:76 D
: 0.225,   s 2.5
p:86          D:
1.13700980392156
81,  s 3.25 p:84
D: 0.3601715,  s
3.5 p:
76 D: 0.225,
transforming
chain 6 Octave
find... bypass =
false


transearch
Octave
 selected = 3 .
mid = 3   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:70  D:
0.225,    s  2.0
p:76 D
: 0.225,   s 2.5
p:86          D:
1.13700980392156
81,  s 3.25 p:84
D: 0.3601715,  s
3.5 p:
76 D: 0.225,
transforming
chain   7   add
remove


transearch   add
remove
 selected = 10 .
mid = 7   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:78  D:
1.19833333333333
33,
 s  2.0  p:76  D:
0.225,    s  2.5
p:86          D:
1.13700980392156
81,  s 3.25 p:84
D: 0.36017
15,   s 3.5 p:76
D: 0.225,


transearch   add
remove
 selected = 11 .
mid = 7   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:78  D:
1.19833333333333
33,
 s  2.0  p:76  D:
0.225,    s  2.5
p:86          D:
1.13700980392156
81,  s 3.25 p:84
D: 0.36017
15,   s 3.5 p:76
D:  0.225,    s
2.25   p:74   D:
1.42107843137254
86,
  chaco = 4

part 3 =
 0.0:70,
0.5:74,   1.5:78,
```

```
2.0:76,
2.25:74,
2.5:86,
3.25:84,
3.5:76,

target   =
 0.0:70,
0.5:72,   1.5:78,
2.25:74,
2.5:84,
3.25:82,

transform step 4



at step : 4

part
 0.0:70,
0.5:74,   1.5:78,
2.0:76,
2.25:74,
2.5:86,
3.25:84,
3.5:76,
transforming
chain  0  Divide
and Merge
find... bypass =
false


transearch
Divide and Merge
 selected = 0 .
mid = 2   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:78  D:
0.725,   s 2.25
p:74
D:
1.38700980392156
81,  s 3.25 p:84
D: 0.475,
transforming
chain 1 Rate
find... bypass =
false


transearch Rate
 selected = 3 .
mid = 3   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:78  D:
0.725,   s 2.25
p:74
D:
1.38700980392156
81,  s 3.25 p:84
D: 0.475,
transforming
chain 2 Phase
find... bypass =
false


transearch Phase
 selected = 16 .
mid = 16  result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:78  D:
0.725,   s 2.25
p:74
D:
1.38700980392156
81,  s 3.25 p:84
D: 0.475,
transforming
chain          3
harmonise
find... bypass =
false
 harda  =   0[,0
],
 1[,0 ],
 2[,0 ],
 3[,0 ],
 4[,0 ],
}

transearch
harmonise
 selected = 6 .
mid = 6   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:78  D:
0.725,   s 2.25
p:74
D:
1.38700980392156
81,  s 3.25 p:84
D: 0.475,
transforming
chain  4  Pitch
Stretch
find... bypass =
false


transearch  Pitch
Stretch
 selected = 8 .
mid = 7   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:80  D:
0.725,   s 2.25
p:74
D:
1.38700980392156
81,  s 3.25 p:86
D: 0.475,
transforming
chain          5
inversions
find... bypass =
false


transearch
inversions
 selected = 6 .
mid = 6   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:80  D:
0.725,   s 2.25
p:74
D:
1.38700980392156
81,  s 3.25 p:86
D: 0.475,
transforming
chain 6 Octave
find... bypass =
false


transearch
Octave
 selected = 3 .
mid = 3   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:80  D:
0.725,   s 2.25
p:74
D:
1.38700980392156
81,  s 3.25 p:86
D: 0.475,
transforming
chain  7  add
remove


transearch  add
remove
 selected = 11 .
mid = 5   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:80  D:
0.725,   s 2.25
p:74
D:
1.38700980392156
81,  s 3.25 p:82
D:
1.17995098039215
64,


transearch  add
remove
 selected = 10 .
mid = 5   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:74  D:  0.475,
s  1.5  p:80  D:
0.725,   s 2.25
p:74
D:
1.38700980392156
81,  s 3.25 p:82
D:
1.17995098039215
64,  s 2.5 p:84
D: 1.3818
627450980387,
  chaco = 3

part 4 =
 0.0:70,
0.5:74,   1.5:80,
2.25:74,
2.5:84,
3.25:82,

target   =
 0.0:70,
0.5:72,   1.5:78,
2.25:74,
2.5:84,
3.25:82,

transform step 5



at step : 5

part
 0.0:70,
0.5:74,   1.5:80,
2.25:74,
2.5:84,
3.25:82,
transforming
chain  0  Divide
and Merge
find... bypass =
false


transearch
Divide and Merge
 selected = 2 .
mid = 2   result
=
```

```
s 0.0 p:70 D: 0.16875, s 0.5 p:74 D: 0.475, s 1.5 p:80 D: 0.725, s 2.25 p:74
D:
1.38700980392156
81, s 2.5 p:84
D:
1.38186274509803
87, s 3.25 p:82
D: 1.1799
509803921564,
transforming
chain 1 Rate
find... bypass =
false


transearch Rate
 selected = 3 .
mid = 3 result
=


s 0.0 p:70 D: 0.16875, s 0.5 p:74 D: 0.475, s 1.5 p:80 D: 0.725, s 2.25 p:74
D:
1.38700980392156
81, s 2.5 p:84
D:
1.38186274509803
87, s 3.25 p:82
D: 1.1799
509803921564,
transforming
chain 2 Phase
find... bypass =
false


transearch Phase
 selected = 16 .
mid = 16 result
=


s 0.0 p:70 D: 0.16875, s 0.5 p:74 D: 0.475, s 1.5 p:80 D: 0.725, s 2.25 p:74
D:
1.38700980392156
81, s 2.5 p:84
D:
1.38186274509803
87, s 3.25 p:82
D: 1.1799
509803921564,
transforming
chain 3
harmonise
find... bypass =
false
 harda = 0[,0
],
 1[,0 ],
 2[,0 ],
 3[,0 ],
 4[,0 ],
 5[,0 ],
}

transearch
harmonise
 selected = 6 .
mid = 6 result
=


s 0.0 p:70 D: 0.16875, s 0.5 p:74 D: 0.475, s 1.5 p:80 D: 0.725, s 2.25 p:74
D:
1.38700980392156
81, s 2.5 p:84
D:
1.38186274509803
87, s 3.25 p:82
D: 1.1799
509803921564,
transforming
chain 4 Pitch
Stretch
find... bypass =
false


transearch Pitch
Stretch
 selected = 6 .
mid = 7 result
=


s 0.0 p:70 D: 0.16875, s 0.5 p:74 D: 0.475, s 1.5 p:78 D: 0.725, s 2.25 p:74
D:
1.38700980392156
81, s 2.5 p:82
D:
1.38186274509803
87, s 3.25 p:80
D: 1.1799
509803921564,
transforming
chain 5
inversions
find... bypass =
false


transearch
inversions
 selected = 6 .
mid = 6 result
=


s 0.0 p:70 D: 0.16875, s 0.5 p:74 D: 0.475, s 1.5 p:78 D: 0.725, s 2.25 p:74
D:
1.38700980392156
81, s 2.5 p:82
D:
1.38186274509803
87, s 3.25 p:80
D: 1.1799
509803921564,
transforming
chain 6 Octave
find... bypass =
false


transearch
Octave
 selected = 3 .
mid = 3 result
=


s 0.0 p:70 D: 0.16875, s 0.5 p:74 D: 0.475, s 1.5 p:78 D: 0.725, s 2.25 p:74
D:
1.38700980392156
81, s 2.5 p:82
D:
1.38186274509803
87, s 3.25 p:80
D: 1.1799
509803921564,
transforming
chain 7 add
remove


transearch add
remove
 selected = 11 .
mid = 6 result
=


s 0.0 p:70 D: 0.16875, s 0.5 p:74 D: 0.475, s 1.5 p:78 D: 0.725, s 2.25 p:74
D:
1.38700980392156
81, s 2.5 p:84
D:
1.38186274509803
87, s 3.25 p:80
D: 1.1799
509803921564,


transearch add
remove
 selected = 8 .
mid = 6 result
=


s 0.0 p:70 D: 0.16875, s 0.5 p:72 D: 1.09406862745097
97, s 1.5 p:78
D: 0.725,
 s 2.25 p:74 D:
1.38700980392156
81, s 2.5 p:84
D:
1.38186274509803
87, s 3.25 p
:80 D:
1.17995098039215
64,
  chaco = 2

part 5 =
 0.0:70,
0.5:72, 1.5:78,
2.25:74,
2.5:84,
3.25:80,

target =
 0.0:70,
0.5:72, 1.5:78,
2.25:74,
2.5:84,
3.25:82,

transform step 6



at step : 6

part
 0.0:70,
0.5:72, 1.5:78,
2.25:74,
2.5:84,
3.25:80,
transforming
chain 0 Divide
and Merge
find... bypass =
false


transearch
Divide and Merge
 selected = 2 .
mid = 2 result
=


s 0.0 p:70 D: 0.16875, s 0.5 p:72 D: 1.09406862745097
```

```
97,   s 1.5 p:78
D: 0.725,
 s 2.25 p:74 D:
1.38700980392156
81,   s 2.5 p:84
D:
1.38186274509803
87,  s 3.25 p
:80           D:
1.17995098039215
64,
transforming
chain 1 Rate
find... bypass =
false


transearch Rate
 selected = 3 .
mid = 3   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:72          D:
1.09406862745097
97,   s 1.5 p:78
D: 0.725,
 s 2.25 p:74 D:
1.38700980392156
81,   s 2.5 p:84
D:
1.38186274509803
87,  s 3.25 p
:80           D:
1.17995098039215
64,
transforming
chain 2 Phase
find... bypass =
false


transearch Phase
 selected = 16 .
mid = 16   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:72          D:
1.09406862745097
97,   s 1.5 p:78
D: 0.725,
 s 2.25 p:74 D:
1.38700980392156
81,   s 2.5 p:84
D:
1.38186274509803
87,  s 3.25 p
:80           D:
1.17995098039215
64,
```

```
transforming
chain          3
harmonise
find... bypass =
false
 harda =    0[,0
],
 1[,0 ],
 2[,0 ],
 3[,0 ],
 4[,0 ],
 5[,0 ],
}

transearch
harmonise
 selected = 6 .
mid = 6   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:72          D:
1.09406862745097
97,   s 1.5 p:78
D: 0.725,
 s 2.25 p:74 D:
1.38700980392156
81,   s 2.5 p:84
D:
1.38186274509803
87,  s 3.25 p
:80           D:
1.17995098039215
64,
transforming
chain   4   Pitch
Stretch
find... bypass =
false


transearch  Pitch
Stretch
 selected = 7 .
mid = 7   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:72          D:
1.09406862745097
97,   s 1.5 p:78
D: 0.725,
 s 2.25 p:74 D:
1.38700980392156
81,   s 2.5 p:84
D:
1.38186274509803
87,  s 3.25 p
:80           D:
1.17995098039215
64,
```

```
transforming
chain          5
inversions
find... bypass =
false


transearch
inversions
 selected = 6 .
mid = 6   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:72          D:
1.09406862745097
97,   s 1.5 p:78
D: 0.725,
 s 2.25 p:74 D:
1.38700980392156
81,   s 2.5 p:84
D:
1.38186274509803
87,  s 3.25 p
:80           D:
1.17995098039215
64,
transforming
chain 6 Octave
find... bypass =
false


transearch
Octave
 selected = 3 .
mid = 3   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:72          D:
1.09406862745097
97,   s 1.5 p:78
D: 0.725,
 s 2.25 p:74 D:
1.38700980392156
81,   s 2.5 p:84
D:
1.38186274509803
87,  s 3.25 p
:80           D:
1.17995098039215
64,
transforming
chain   7   add
remove


transearch   add
remove
 selected = 12 .
mid = 6   result
=
```

```
s  0.0  p:70  D:
0.16875,   s 0.5
p:72          D:
1.09406862745097
97,   s 1.5 p:78
D: 0.725,
 s 2.25 p:74 D:
1.38700980392156
81,   s 2.5 p:84
D:
1.38186274509803
87,  s 3.25 p
:82           D:
1.37028774509803
86,


transearch   add
remove
 selected = 6 .
mid = 6   result
=


s  0.0  p:70  D:
0.16875,   s 0.5
p:72          D:
1.09406862745097
97,   s 1.5 p:78
D: 0.725,
 s 2.25 p:74 D:
1.38700980392156
81,   s 2.5 p:84
D:
1.38186274509803
87,  s 3.25 p
:82           D:
1.37028774509803
86,
  chaco = 0

part 6 =
 0.0:70,
0.5:72,   1.5:78,
2.25:74,
2.5:84,
3.25:82,

target   =
 0.0:70,
0.5:72,   1.5:78,
2.25:74,
2.5:84,
3.25:82,

target part =
 0.0:70,
0.5:72,   1.5:78,
2.25:74,
2.5:84,
3.25:82,
```

Figure D-2 An example of printed output from the *TraSe* algorithm.

E Results from the online morphing questionnaire

Participants →	One	Two	Thee	Four
Example one				
Techniques	break into tracks and riffs, look at ways to do substitution. tempo change, maybe associated with a time signature or key change.	breakdown. Consistent pulse. Harmonic steps.	Pull out the hats and bass of the source, because these elements are producing the swing. Pull out the hats of the target, which is producing the 'straightness', crossfading the whole pattern back and forth a few times, then introducing the full target sounds.	Gauge distance. Because distance is large, cut in chunks
Factors	tempo, timbre, groove are the main problems	Rhythm density, texture and pace different and require reduction. Timbre, pulse common and can be maintained.	rhythm	tempo, style and feel are different, requiring a simple cut
Example two				
Techniques	\	\	Resolving note that lingers, intro to target (roll), then kick in completely.	Slow down. Write bridge with similar materials. Thicken texture with reverb. Key modulation. 2-4 bar intro to target. Rapid switch to full target. Emphasise groove (*bass and drums) in target - dry.
Factors	\	all elements	none, with the proposed technique	vibes inspired modal oscillation and thickening of texture.
Example three				
Techniques	\	\	drop guitar (cause it sucks) and bring in dark blips.	dump source quickly. Focus on the irregular target.
Factors	\	\	rhythms are close. Synth pads are close (sound-wise) and could sound dark in a different context.	the whole source makes it harder.."It sounds like it was written by the owner's 10 year old kid whose world experience is MacDonald's. The target was composed by someone who has visited other planets."
Example four				
Techniques	\	\	straight cut with a roll to pre-empt it.	drop melody. Focus on rhythm.
Factors	\	\	none	rhythmic stylistic differences

Figure E-1 **Compositional techniques and specific factors for each example from participants one to four. "\" indicates that the participant used the same techniques and perceived the same factors as in the previous example. "(* …)" contains interpretative remarks from the author. Most of the comments have been condensed in order to be presented easily here. Continued below.**

Participants →	five	Six	Seven	eight	Nine
Example one					
Techniques	sync the rhythm. Pull sounds out.	Integrate beat and metre first, then evolve harmony. slow tempo change. No worries with metre. Find instruments with similar timbre to cross with. Sustained notes and long loop of keys would be shorteded to match target. Aux sounds of first could be shortened into a honk, and timbre could be changed at same time.	experiment with tempo shift or complete rhythm cut. Analyse which elements are compatible. break-down. Thinning. Change tempo, fade in new beat. Merge stripped elements, let source elements go and add target.	evolve rhythms and timbres. Fade in, fade out.	Merge snare in src and organ in trg on same beat. Layer the changes one at a time. Tempo switch. Timbre switch. Swap patterns/timbre of lead. use honk sound from target. circle of fifths modulation. Breakdown source. High-pass on bass. Introduce target riff. Build drums. Loop half of target riff in a build up.
Factors	identify the regular beat in the target and just use that during the transition.	strong sounds are most noticeable. The shared dominance of the bassline could be exploited. Chord of source and odd sounds of target could be integrated interestingly.	tempo. Also metre 4/4 to swung (*4/4 triplets to 4/4 straight). Pitch is different, but less an issue if removed completely.	rhythms, timbres	mood makes it hard.
Example two					
Techniques	transpose source up. Discordise it. Speed it up slowly.	speed up tempo. Evolve timbre. Mod key. Exchange instruments one at a time, (*layering the new sounds into the current patterns) change the bass and drums slowest of all.	try for double time. thin to basic elements. Drop beat out of source. Bring in beat of target, replace other elements.	\	foreshadow excepts from target at slow tempo. transposition. use vibes in source to bridge to target. Have a bridging sound. Switch to target.
Factors	Na	minor to major will be difficult	Na	\	timbre and tempo make it difficult
Example three					
Techniques	subvert the bright sounds. Turn source piano into the precussion line.	evolve string into bass. Increase bass density and staccato. Guitar evolve into strings.	loose melodic content. Would be too difficult to merge.	\	connect drums. Guitar down an octave into bass of target. introduce cymbal from target early on. Build drums. Evolve strings to target.
Factors	mood and density makes it harder.		melody difficult.	\	tempo and mode difficult. Density and articulation different (* but not difficult)
Example four					
Techniques	merge bass lines.	strip quickly, then change timbre and melody for slow evolution	Melodies could be continuated into a sudden and immediate change. Rhythm be replaced gradually.	\	jump transition. Maybe a few overlaps. They are similar. short build up and then straight cut
Factors	Easy		easy. Similar tempo	\	no problems with differences

Figure E-2 Continuation of the previous table, participants five to nine.

Paritipant:	Music 1 Lemu	Music 1 Human	Music 2 Lemu	Music 2 Human
one: response	Smooth. diffuse. low integrity.	not morph. transition.	odd, OK. Smooth attempted.	good interpart focus shifts.
Effect	smoothness negative.	NA	smoothness ineffective	NA
smooth/effective	y/n	NA (R: n/y)	y/n	NA
two: response	OK. Too dense. Intense.	Better	movement perceived.	better and smoother
Effect	No smth, too busy. Fade smth	NA	smooth and not smooth.	NA
smooth/effective	n/n	?/y	?/?	y/?
three: response	bad. Blend very forced.	good.	good. Sounds blend well.	structure not smooth. Bad
Effect	not smooth. Forced.	not smth. Natrl. commn elmts.	Smoothness good	start smooth, good. Mid not.
smooth/effective	n/n (R: almost y/n)	n/y	y/y	n/n
four: response	boring - predictable	OK. good detail, contour.	"intense negative"	nice. Too long
Effect	smoothness dull	surprise more important.	no smooth. Rnd substitution	stable metre more important
smooth/effective	y/n	n/y	n/n for meta. (R: y/n for local)	n/y
five: response	middle not coherent	gd meta, foreshdw, beat, brk.	excellent. Natural.	exel. less natrl, sbtle, contins
Effect	unsmooth, chaotic, inhuman.	smooth, beat gd. Too empty.	smoothness positive.	most smooth (R: meta), good.
smooth/effective	n/n	y/y	y/y	y/y
six: response	functional. hard to dance to.	nice. Brk smooth, coherent.	good. Used quirky target.	lead bad, spoils whole morph
Effect	smoothness good.	meta smoothness good	smooth, gd. bits not smooth	no smoothness, bad effect
smooth/effective	y/y	y/y (R: meta-smoothness)	y/y	n/n
seven: resp.	evil chaos.Pitch, rhythm clash	stonger. Drop in excellent.	weak - no highlights.	OK. Not solid with melody
Effect	partly smooth, effective.	not smooth can be effective.	smooth, not pleasing.	lead smth, bad. Rhythm switches not smh, gd.
smooth/effective	y/n, n/n for different elements.	n/y	y/n	y/n for lead & n/y for rhythm
eight: response	Too long.	mystical. Ugly at the end	ugly then too high. Spacious.	good happy music
Effect	smthnes stoppd fst transition	smooth switches were good	smoothness was effective	smoothness was good.
smooth/effective	y/n disliked long opening.	y/y (R: meta smoothness)	y/y	y/y Small changes good
nine: response	gd brk, mode shift. call & resp. Rhythm bad.	lost direction. dislike break, honk, dissonance.	Surprisingly good. Interesting.	gd drum ovrlay, foreshdw.
Effect	Jarring in bass and kick bd.	not smooth, bad break. From break to target good.	smthness gd, bizarre.	long length helped smoothness
smooth/effective	n/n	n/n in 1st half, n/y in 2nd half	y/y	y/y

Figure E-3 **Condensed summary of participants' responses to both LEMorpheus and human-composed morphs for the musical examples 1 and 2. (R: …) is an interpretative comment that clarifies an ambiguous response. Abbreviations are: gd- good, smth – smooth, natrl – natural, commn – common, elmts – elements, rnd – random, brk – break, foreshdw - foreshadow, contins – continuous, excel – excellent, resp – response, stoppd – stopped, fst – fast, ovrlay – overlay. Responses to examples three and four are continued below.**

Paritipant:	Music 3 LEMorpheus	Music 3 Human	Music 4 LEMorpheus	Music 4 Human
one: response	very effective	subtle but effective.	slowly pulled back in energy	NA
Effect	NA	Smth envelopment of mood.	medium smthnss, dull morph.	NA
smooth/effective	NA	NA	NA	NA
two: response	gd, shifting timbres, harmony	abrupt rhythms, bad	v. smth, dvlpmnt not switch	nice feel.
Effect	positive effect	no smth, cause rhythm dense	smoothness positive	smoothness positive
smooth/effective	y/y	n/n	y/y - cmmn elmnts maintained	y/y
three: response	bad cross-fade. Guitar sucks.	strong. rhythm switch too early Sound x-over is good.	not like.	better, but too much blend. Don't blend - cut.
Effect	smthnss bad. Gtr too dom	y/y (R: meta).Could be smther	smoothness bad. Should cut	smoothness bad, weak
smooth/effective	(R: y/n)	(R: n/y)	y/n pitch issues	y/n
four: response	"churns my innards"	primitive	gd. sim of src and trg helped	chaotic
Effect	NA	predictable, less annoying	smoothness was good	smthnss bad. Malformd
smooth/effective	(NA) / n	n/y	y/y	y/n smth but haphhazard
five: response	excel. Strngs subvrtd cleverly	unpleasant, tense, forced. Obvious tempo increase.	excellent. Maintained feel of source. Smooth cross-over.	clean. Bass draws attention
Effect	smoothness was positive.	no smthnss discomforting.	smoothness was positive	v transparent. bit jarring
smooth/effective	y/y effectively turned mood	n/n - discontinuous. bad	y/y - cause of track styles	y/y smth chnges effective.
six: response	bad. Middle bettr thn expectd.	not right, OK . Frshdw gd.	OK. Smoothness expected	OK. Happy mood throughout
Effect	no smoothness = negative	Meta-smoothness good	smoothness was positive	good. Drums are smooth
smooth/effective	n/n altered flow, density.	y/y smthness helped a little	y/y	y/y
seven: resp.	weak, chaos, sad, Dischord	mel weak beat drp gd. Strong	gd. Subtle. Needs pnctuation	great. improvement on prev.
Effect	too smooth	Smth mel gd, abrupt beat gd	smth, works.	smth, needs drops, enrgy.
smooth/effective	y/n smoothness negative	y/OK for melody, n/y for beat.	y/y	y/y
eight: response	morph better than originals.	disjointed	smoothness was good.	unsettling cross-rhythms.
Effect	smthnss had a good effect.	lack of smthnss was ugly.		smoothness was good
smooth/effective	y/y smthnss was effective.	n/n	y/y	y/y
nine: response	bad. No clever integration.	OK. Odd bits. part shift good.	good. Happy. Distinct parts.	gd. Happy. Start out of sync.
Effect	smoothness was bad	Smth gd. Start weak. end gd	smthnss gd, series of loops	out of sync was not smooth.
smooth/effective	y/n end smooth, start weak.	y/y chord modulation smooth.	y/y(R: mybe n/y, unrel loops)	n/n and then y/y

Figure E-4 Condensed summary of participants' responses to both LEMorpheus and human-composed morphs for the musical examples 3 and 4. Additional abbreviations are: Gtr – guitar, dom – dominant, strngs – strings, subvrtd – subverted, bttr – better, thn – than, expectd – expected, discord – dischordant,

Participant	Change in example 1 LEMorpheus		Changes in example 1 Human	
one: chng1	:5	var/lay: bad. Abrupt. (R: general shift)	:9	sound: Odd/bad. Too obvious (donkey)
change 2	:12	var/lay: bad. lack enrgy. (R: muddiness in the mix)	:14	layer: sudden tempo and shuffle change
change 3	:21	var/layer: target reached	:21	layer: drums
two: chng1	:4	rhythmic changes act as forshadowing	:11	sound - distraction from changes (R: and forshdow)
change 2	:7	sound	:14	layers: bringing out the organ is good
change 3	:11	focus from sound to keys	:20-1	lay: drum brk gd: leavs spce, fulfills rhythm chnge
change 4	:22	auxilliary perc hits	:23	sound: distraction from chngs, completes premption
three: ch1	:3	aux: cowbell. Not enough space.	:3	var: dissipation of high end sound pre-empts change.
change 2	:6	lay/key var: pitch clash (R: bass and the pads)	:7	lay/var: organ. Foreshadow.
change 3	:14	var: bass transition is nice	:14	lay: rhythm cut to kick, tempo gained.
change 4	:17	var/lay: new rhythm emerges. Stops awkwardness	:21	lay: new rhythm. not forced as it is at orignl tempo.
four: ch1	:4	var/lay: unexpected change overall	:8	var: good step. (R: harmonic change?)
change 2	:08	var: simple substitution	:14	layer: good but organ should go.
change 3	:14	var: predictable (R: either the chords or the sound)	:19	layer: took too long
change 4	:19	var: predictable (R: probably the sound?)	:21	layer: good entry
five: ch1	:7	var: ovrall chnge forshdwd. Imprtnt bass note enters	:8	snd: bckgrnd snds bit messy. Lay: orgn preemptive
change 2	:10	var: incompatible beats were mixed	:14	layer: cut is full of pleasant expectation, but too long
change 3	:14	var: less incomparible but still too busy	:18	var: no variation. too empty. Redundant.
change 4	:20	var: complete	:21	lay: good kick to new track. Could have been ealier
six: chng1	:0	var: bass (R: he obviously means the chords/lead)	:0	over all changes
change 2	:7	var: bass; aux: the descending sound	NA	
change 3	:14	var: bass	NA	
change 4	:21	bass	NA	
seven: ch1	:7	sound: nightmareish	:14	lay: gd - basic elements that warp well only remain
change 2	:24	var/lay: good. beat completes it.	:21	lay: great! New beat drop in, just at the right time.
eight: ch1	:9	var: bad rhythm.	:10	sound: honk good
change 2	:17	var: keys not work with other sounds	:17	lay/struct: bad. Took too long
change 3	:20	sound: good. Hooter	:23	lay: bad too silent.
change 4	:23	lay: latin riff sounds out of place.	:25	lay: too much all at once.
nine: ch1	:7	var: interest. Range, metre. (R: and key)	:8-10	var: bd. bass chng w/o lead, tonl cntre ambiguous.
change 2	:18	var: bad. Bass too high in mix. Dynamics too high	:14	lay: good. Back to tonal centre
change 3	:13	var: gd. Rhythmic bridge. Phrasing, texture, timbre.	:21	lay: good. Cut to target
change 4	:3	var/lay:+ new drm:snd pace, mtre signl mode chnge	NA	

Figure E-5 (cont) Important perceived changes in LEMorpheus and human morphs of the first example. Var means variation, lay means layer. Other abbreviations continued from previous tables. Rows with NA responses deleted to help fit.

Participant	Change in example 2 LEMorpheus		Changes in example 2 Human	
one: chng1	:5	Var: odd notes. Beginning of key mod.	:2	layer: keys unexpectd, but forshdw change.
change 2	:14	Lay/var: odd perc. Hits. Target coming in.	:18	layer: drums set up strong change in momentum
change 3	:22	Var: weird. Combination doesn't fit. Too busy.	:23	layer gap: drums drop. Unexpected. new enrgy entrs
change 4	NA			
two: chng1	:4	focus to bass ®	:17	layers: drums added partially. Preempts change
change 2	:18	layers: fade in of piano good transition intro	:22	layers: synth timbre shifts the focus
change 3	:27	focus: "farty" synth highlights chaos	:28	var: the var on the vibes gives nice continuity
change 4	:32	layers: flutey lead confirms new pattern	:33	layer(intrapart): add complemntry rhodes finalises
three: ch1	:13	Lay/var: hints of double time entering the drums	:08	lay/var: forshad/intro of target lead successful
change 2	:23	lay/var:gd w/o cliche dble-tme, clvr rhythm intgrtion	:17	lay: double-time clichéd
change 3	:27	var/lay: gd bass snd of trg emrges. Fits either rhythm	:26	lay: not matching up
change 4	:30	var/lay: gd, unexpected rhythm integration, like ch2.	:30	focus: source is gone
four: ch1	:6	var: interesting triplets in vibes	:2	lay: subtle intro of Rhodes
change 2	:14	var: loss of rhythm in keys	:8, :13	lay/var: well formed.
change 3	:16	var: too random	:17	lay: good. Metric shift in place befre harmonic chnge.
change 4	:32	var: unexpected endpoint, given transition.	:23	lay: bas well set (groove works)
five: ch1	:9	var: harmonic and pattern changes. Signl chnge.	:8	lay/var: lead foreshadow. Bit jarring
change 2	:19	var: tempo inc. Ovrll effect signals middle of transitn	;19	lay: drums too quick
change 3	:28	var: integration. Experimental but cool.	:23	lay: great break. Puts focus on the bass.
change 4	:32	lay/var: high-pitched sample really completes it.	:26	lay/var: good bridge - elements from both
six: chng1	:12	var: increase in density	:0	layer: rhodes distrated
change 2	:20	var: timbre change a bit rough	:17	lay: good drums
change 3	:30	var: tempo up.	:22	lay: bass timbre
change 4	NA			
seven: ch1	:18	sound/lay: bad. synthy squelch doesn't work	:17	good. Beat drops in well.
change 2	:16	var: OK. bits of drums enter.	:22	good. Second drop in solidifies it's presence.
change 3				
change 4	NA			
eight: ch1	:7	var: odd. Key change	:3	lay: Ok. Synth intro.
change 2	:15	var/lay/focus: bad. Bass sustain.	:24	sound: odd. squelchy bass
change 3	:20	var/lay: bad. unusual timbre/rhythm. Lead	:45	lay: piano drops out (R: aft-shadowed)
change 4	:30	var/lay: cymbals highlight drums		
nine: ch1	:12	var: good. Key change, bass.	:8	lay: good. Foreshadow rhodes.
change 2	:16	var/lay: interesting. Rhodes/vibes	:11	var/lay: good. Counter melody from target lead
change 3	:23	var/lay: dnse tonl texture and key chnge. tempo up	:17	lay: good. Drums interesting
change 4	:30	var/lay: tempo, overall intensity increase.	:22	lay/var: good. Break.

Figure E-6 Important perceived changes in LEMorpheus and human morphs of the second example. Abbreviations continued from previous figures.

Participant	Change in example 3 LEMorpheus		Changes in example 3 Human	
one: chng1	:10	layers:new timbre, more aggressive	:8	layr/var: melody doubling timbre is subtly introduced
change 2	:18	layers: stabilises due to bass.	:17	layers: sudden alteration of drum part
change 3	NA		:26	layers: bass clearly announces new section
change 4	NA			
two: chng1	:13	layers:high lead with same pattern	:9	var: rhythmc chnge (R: shuffle to straight)
change 2	:17	layers: bass – also shifts focus to the rhythm	:12	layers/variation: intro of lead
change 3	:19	lay/var: upwd transp of stretched pads nice.	:17	layers: rhtyhm drops in
change 4	:24	variation: lead melody converges and is appealing	:24	layers: full groove (R: bass added)
three: ch1	:12	layer: target comes in	:5	layer: lead
change 2	:15	fade: source guitar fades weakly.	:9	layer: gtr ends. Logical and impactful place to end it
change 3	:18	target reached (R: actually, fair bit to go!)	:15	var: pads transition well, darkening whole piece
change 4	NA		:17	layer: drums enter too early
four: ch1	:11	lay/var: good that the guitar sound has changed	:7	layer: foreshadow
change 2	:17	lay/var: harmny reslvd. Tempo shift. Textre open	:10	var: glitch is annoying
change 3	:25	lay:var: reduction of src was gd. Thinning. Good.	:15	var: harmonic shift
change 4	NA		:18	layer: full drums fixes metre
five: ch1	:9	var: shrtr loops in pads take focus from guitar	:6	lay: lead fits natually
change 2	:12	var/focus: drum pat of targ shift focus from guitar	:11	var: shuffle to straight was too abrupt
change 3	:17	var: more bass pulls towards the target	:17	lay: good intro, but tempo increase too overt
change 4	:26	var/lay: staccato (R: lead) finalises target pattern	:27	var: lead pattern splicing is excellent and creative
six: chng1	:11	lay: new timbre	:6	layer: lead overlay. Unexpected. OK.
change 2	:18	lay: liked this bit (R: bass kicking in was good)	:14	var: confusing overall.
change 3	:28	var: bass notes lengths (R: subtle tempo change)	:18	layer: reduction and addition of drums adds stability.
change 4	NA		:24	layer: bass added. OK.
seven: ch1	:10	lay: bad. target lead. Dischordant (R:?)	:9	good. (R:swing to straight)
change 2	:20	var/lay: good. lead of srce ends, conflict released	:16	good. New beat drops in propely
change 3	:26	var/lay: good. Convergence.	:14	bad: melodic elements don't have to be here.
change 4	NA			
eight: ch1	:12	var: sour key change in bass (R: muddiness)	:9	var: bad glitch
change 2	:18	var: good. Lead	:13	lay/var: bad. lead drops int.
change 3	:21	var: good. High perc.	:15	var: bad. tempo increase .
change 4	:30	var: tempo. Out of control	:20	var: too much repetition
nine: ch1	:7	lay/var: odd bad. Harmony	:6	lay: bass conflicts
change 2	:11	lay/var: odd bad. Harmony, density	:13	var: harmony key modulation good
change 3	:16	lay/var: OK. Overall clearing up	:7	lay: good. Synth intro through cross-over good.
change 4	:17	lay/var: gd. Bass riff stdy rhythm. ovrall coherence	:14	var: gd. Bass intrdced. Solid cause of space for it

Figure E-7 Important perceived changes in LEMorpheus and human morphs of the third example.

Participant	Change in example 4 LEMorpheus		Changes in example 4 Human	
one: chng1	:7	var/lay: marimba "enters", but does not fit	NA	
change 2	:15	var: continuous change in many parts is unsettling	NA	
change 3	:22	new feel is finally settled on.	NA	
change 4	NA		NA	
two: chng1	:5	var/lay: high frequency introdcs new marmba pattrn	:7	aux: fills destabilise rhythmic focus
change 2	:11	aux: fill smooths rhythmic transition (R:at :11 ??)	:15	var/focus: offbeatsynth (R: hocketing with drums)
change 3	:15	var/lay: higher frequency shifts focus to new bass	:21	var/focus: marimba (higher pitches)
change 4	:25	var: offbeat creates new rhythmic focus	:26	var/layer: marimba solidifies
three: ch1	:8	var/lay: two conflicting keys (R: not like key shift)	:12	var: rhythm is stripped to make room for target.
change 2	:15	var: switch to 4/4 needs more pnctuatn, eg kick roll	:16	var: kick resolves
change 3	:22	var: 3/4 element have gone	:18	var: bass changes key and rhythm
change 4	NA		:22	var: source rhythm dissappear
four: ch1	:7	var: marimba. First hint	:11	var: pitches are random
change 2	:11	var: harmony bumpy	:18	var: overall change was too late
change 3	:17	var: rhythm thinning, had to be done	:22	var: simplification/reduction is good
change 4	:24	var: clarification of rhythm/meter	NA	
five: ch1	:8	var: extension of source. Highlights change	:6	non-existent jarring?
change 2	:13	var: denser drums signal change	:11	var: good change in marimba riff
change 3	:15	var: effectve bridge via creation of new mrmba mel	:18	var: clunky change in melody
change 4	:23	var: bassline completes the morph nicely	:22	var: mrimba ovr bass effectve (R: trg converged)
six: chng1	:8	var: key/melody change. Bit jumbly	:12	var: melody. OK
change 2	:16	var: key/mel change. OK	:14	var: drums. OK
change 3	:23	var: reduction. Good	:22	var: melody change smoother
change 4	NA			
seven: ch1	:16	var: good. Melodic elements sit well	:11	var/lay: gd. Change suddn. Natural, not forcd blend.
change 2	:23	var: good. Target beat settles in	:18	var/lay: good. Beat revealed
change 3	NA		:22	var/lay: good. Stripped back. Beat emphasised.
change 4	NA			
eight: ch1	:11	var: gloomy. key change	:0	nochange: bad. Polyrhythms
change 2	:14	var: thin. Melody drops out (R: shiftd off first beat)	:17	var: gd. upwd transposition brings out new pattern
change 3	:26	var: good. Marimba drops out.	:20	var: boring. Melody too repetitive
change 4	NA		:25	var: boring. Melody too repetitive
nine: ch1	:8	var: good. interesting key change	:0	nochange: bad. Rhythm out.
change 2	:16	var: natural	:11	var: rhythm lining up. Overall changes good.
change 3	:22	var: bad. Harmony too simple.	:16	lay: cool riff (R: from target?)
change 4	:4bars	change evry four bars	:21	var/lay: drums highlight melody.

Figure E-8 Important perceived changes in LEMorpheus and human morphs of the fourth example.

	Example 1 LEMorpheus
one	keep drums steady. changes in chunks. Write new material
two	remove dense activity in transition. Make a contrapuntal movement
three	chunks (series of hard cuts), not gradual changes, and pull out sounds.
four	No substitution - cut to original bridge, increase complexity to make trg less predictable. Cut to target
five	thin it. Fade out the saw lead. Fade in organ later
six	thin out notes in transition. Make transition longer
seven	thin the synth. They don't warp well and aren't necessary. Longer. Marry rhythm better
eight	change timbre early. Use new timbres to develop rhythm (R: unclear wether "as" rhythm, or to "punctuate" it)
nine	attenuate bass (already too loud in target). Explore the interesting key changes for longer.
	Example 2 LEMorpheus
one	use a number of more distict change points (chunking) rather than a continual smooth transition.
two	consciously establish patterns rather than change too much. Reduce texture and activity of both sections
three	chunkify fade of source material so it cuts out at 20 seconds.
four	extend the source to make the transition shorter. Too meandering during transition. Rewrite whole thing.
five	No improvements.
six	make it slower
seven	(R: chunkify) more succinct. Less fade, more drops.
eight	leave some of the old timbres going until end, speed them up to new tempo. Not much else.
nine	bring lead in earlier, to reference the final melody
	Example 3 LEMorpheus
one	drum fills to punctuate change in feel.
two	Same as before
three	Kill the guitar at 0:4 and let cross-fade the rest.
four	Cut source early. Long fade up of target.
five	No changes
six	solo bass & drums. extends melody based on existing middle section.
seven	Chunkify
eight	fade in, fade out. Change tempo gradually throughout, rather than right at the end
nine	tidy up the start. Remove clutter in the bottom end.
	Example 4 LEMorpheus
one	less subtle movements, more stepped changes.
two	NA
three	straight cut with a roll just before hand.
four	Thin the source melody/harmony sooner to work with the shifting groove
five	None
six	remove marimba. Longer, work with less instruments in parallel.
seven	make it longer. Strip it back to only beat and one other element, to make it phat.
eight	NA
nine	De-chunkify. "put in a few overlapping sections to move away from the group of loops put together feel"

Figure E-9 Proposed modifications to each of the four LEMorpheus morphs from each of the nine participants.

	Example 1 Human morph
one	smooth out brkdwn w/ src & trg material to reduce shock. not need to be extreme - can be more parts in it.
two	maintain common elements. Decrease the intensity of their activity. Smooth out texture and harmony
three	not much. Small sounds from source to appear over the target.
four	faster cut. Addition of new sound just for bridge.
five	shift the entry of target forward. Strip back some of the overlapping sounds early on.
six	stretch out the length
seven	No change
eight	take out the break. Keep honk. Changes too dramatic, too short (nothing to hang on to).
nine	thin back in first half. Cut honk until target. Build it up more to the breakdown.
	Example 2 Human morph
one	maintain momentum of drums. Fix tonality of early snippet of trg to be that of src so there is more stability.
two	approach is not particularly dependent on the specific music - maintain continuous elements, thin it out
three	move target back half a bar.
four	possibly add new element that will disappear. Make source fatter, make target leaner and meaner.
five	remove second half of the lead loop (first half is OK). Or, reduce the dynamics of the second half.
six	pull out the rhodes. Total rewrite
seven	No change
eight	(R: introduce target sooner) put more techno into it, because it doesn't change sufficiently
nine	remove notes from target vibes, post breakdown for clearer harmony
	Example 3 Human morph
one	NA
two	not as acceptable as previous (Lemu)
three	hold off target rhythm just for a little bit.
four	change cheezy organ. Smooth the source. Rewrite the ET theme.
five	Fix the suffle to straight problem. Stretch the tempo increase so it isn't as extreme
six	introduce drums earlier, reduce instruments. Different source material.
seven	loose the melodic elements in the middle. Thin it.
eight	speed up slower. Introduce timbre more gradually
nine	tidy up bas conflictions
	Example 4 Human morph
one	NA
two	NA
three	No segueing
four	delete elements, not exchange them. Simplify for clarity. Reduction then addition, rather than substitution.
five	would not change the marimba at 12. thin it out
six	reduce the hats. Thin out data sooner.
seven	No changes
eight	add more melody at the end. Change cross-rhythms and use them as a feature.
nine	tidy up the snare (R: an artifact from the high EQ of the composer's mixing)

Figure E-10 Proposed modifications to each of the four human morphs from each of the nine participants.