Roads to Chimacum

for mandolin quartet or string quartet

17 variations on an arrangement of a fiddle tune by Patricia Spaeth

Larry Polansky
1992
Roads to Chimacum

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Roads to Chimacum
(First draft, November 10, 1992)

for string quartet or mandolin quartet

"No beginning, middle, or end (process, not object)" — John Cage

for the Modern Mandolin Quartet
and dedicated to David Mahler

Seventeen variations on an arrangement of the fiddle tune "Road to Chimacum" by Patricia Spaeth.

The seventeen variations may be played in any order. The Source arrangement should be played first. In general the tempo should be fast, like a fiddle tune, but may vary slightly for individual variations.

Many of the double stops in the piece are quite difficult, especially for a string quartet at fast tempi. Several contain a parenthetical note which may be considered optional, and at other points the lower or higher notes of a double-stopped passage are designated as optional. Occasionally, I have notated a double stop as a "triple-stop" with the high note in parentheses. This means: play this as a double stop, using either the lower note or the (octave higher) more difficult higher note. Wide double stops may be executed by the string quartet "across the strings" by fingering the chord on non-adjacent strings, rolling the bow, and deadening the middle note. Several of the more obvious occurrences (like 10ths in the cello) are marked with the reminder: roll bow.

Dynamics are left up to the quartet, but each variation should be played at only one general dynamic level. In other words, if the variation is to be played pp, then all four instruments should play at that dynamic level. Phrasing, small dynamic variations, and tempi fluctuations within variations are up to the quartet. The string quartet should play arco. The mandolin quartet may use tremolo, "at the bridge" or "at the neck" playing at their discretion. Accidentals, in general, follow the usual convention. In general, a note retains its accidental from its appearance until the end of a measure, but I have put in a great many "courtesy" accidentals as well.

The score was generated in HML, converted to a MIDIFile, and printed out directly from Finale. Thanks to Phil Burk for valuable help with the software. My deep appreciation to David Soldier for his valuable and important suggestions regarding the difficulty of several passages. David Fuqua was invaluable in making edits and formatting the Finale score.


The quote from John Cage is from Themes and Variations, Station Hill Press, 1982.

Larry Polansky
Lebanon, NH
Nov. 1992
Theoretical Notes

*Roads to Chimicum* is composed entirely by the computer, with the exception of the source arrangement. Each variation consists of *mutations* of the four parts, or source melodies, into computer-generated target melodies, using computer-chosen data. For each variation, the computer generates the following information for each voice: a target melody, a minimum and maximum mutation index ($\Omega$), a mutation trajectory, a mutation function and a *DOOM* value.

**Target Melody**
A target melody is generated for each variation, each voice. The rhythms are the same as the source melody, but the pitches are different. The computer chooses between several simple algorithms to generate the target, such as “shuffling” the pitches of the source, or generating pitches in a Gaussian distribution around the mean pitch of the source melody. In other words, each target is different for every voice and every variation, but is formally similar in that all are more or less “random” melodies, statistically similar to their respective sources.

**Minimum and maximum mutation index ($\Omega$).**
The mutation index ($\Omega$) ranges from 0 to 1000 (an integer representation of 0.0 to 1.0). A maximum and minimum value for $\Omega$ are generated for each voice, each variation. Minima tend toward the lower part of the range, maxima toward the higher. A mutation index of 0 indicates that the source melody is not mutated at all, and a mutation index of 1000 yields the target exactly. Intermediary values will produce some mutation “between” the source and the target (by the chosen mutation function). These maxima and minima are used to scale the mutation trajectory function (described below).

**Mutation Trajectory**
A mutation trajectory is specified for each voice, each variation, as a three-part ternary contour. By ternary contour, I mean that each of the three points in the trajectory can be equal to, greater than, or less than each other point. The mutation trajectory determines the value for $\Omega$ over the course of the variation for each voice, or the “betweeness” of the mutated melody. The trajectory shape is scaled to range from the minimum to the maximum mutation index. Values for $\Omega$ are then interpolated over the course of the variation. In other words, if the minimum is 100 and the maximum 900, and the trajectory is a straight ascending line, the particular voice will begin the variation close to the source and gradually and steadily mutate towards the target by the end of the variation, but never quite reach it.

I use two types of notation for these contours: graphic and ternary numbers. Graphic descriptions of the mutation trajectories for each voice are given on the first page of each variation. These graphic ternary notations, and their numerical equivalents, given at the end of this introduction (in the “data” used to generate the piece) indicate the possible “combinatorial ternary contours” for a three-element sequence. There are thirteen possible such ternary contours. In the numerical description, 0 means “is less than,” a 1 means “is equal to,” and a 2 means “is greater than.” For example, the ternary contour (012), (indicated in the score as a line down and then a line up to the first point) means that the first value is less than the second, equal to the third, and that the second value is greater than the third. The line drawings at the top of each variation are simple graphic representations of these contours. For each variation, each voice, the computer picks one of the thirteen possible contours, scales it to the maxima and minima, and uses that as the mutation trajectory. For a numerical and graphic list of the possible trajectories, see the chart at the end of these notes.

**Mutation Functions**
Five mutation functions are used in the piece, selected at random for each variation, each voice. The mutations used are LCM/IIIIIM, ISIM, USIM, UIOH, and UUIIIM/LCM. These mutations have been described in detail elsewhere (see the papers and pieces cited below for more detailed information), but I will describe them briefly here.
Two of the mutations used (LCM/UIIM and UIIIM/LCM) are concatenations of other mutations. Individually, the LCM, UIIIM, and UIIIM will not produce, with $\Omega = 1000$, an exact image of the target, but rather an image which is completely identical to the target in either the direction or magnitude of its intervals. For this reason, I often use the concatenations, which will produce complete, unique “crossfades.”

**LCM (Linear contour mutation):** "Inverts" a certain percentage of the source intervals (determined by the value of $\Omega$) so that they have the same direction as the corresponding target intervals. In other words, the LCM pastes the target’s contours onto the source’s magnitudes.

**UIIIM (Irregular unsigned interval magnitude):** "Swaps" a certain percentage (determined by $\Omega$) of the magnitudes of the target intervals with those of the corresponding source intervals, while retaining the direction of the source intervals. The UIIIM could be said to be the “complement” of the LCM. In other words, the UIIIM pastes the target’s magnitudes onto the source’s contours.

**UIIIM (Uniform unsigned interval magnitude):** Similar to the UIIIM, but instead of an interval’s magnitude being “swapped,” it is gradually crossfaded into the magnitude of the corresponding target interval. The contour of the source intervals are retained. Unlike the UIIIM, every interval is changed to some extent; in every mutation. In other words, the UIIIM pastes “crossfading” magnitude values of the target onto the sign of the source.

**ISIM (Irregular signed interval magnitude):** "Swaps" a certain percentage (determined by $\Omega$) of the target intervals with the corresponding source intervals.

**LCM/UIIIM:** A concatenation of these two mutations. With $\Omega = 1$, this mutation produces an exact duplicate of the target, since all intervals are then affected by both the LCM and the UIIIM. With intermediate values for $\Omega$, a wide variety of mutations, related closely to the source and target, are possible. This concatenated mutation might be described as a "non-linear," or very awkward crossfade. At any given time, some of the intervals of the mutated morphology have the directionality of the corresponding target intervals, some have the magnitude, some have both.

**UIIIM/LCM:** A concatenation of these two mutations, which, with $\Omega = 1$, produces an exact duplicate of the target. Unlike the LCM/UIIIM, magnitudes of the mutated intervals will change smoothly while their contour changes more "jaggedly."

**USIM (Uniform signed interval magnitude):** "Crossfades" (by the value of $\Omega$) the source intervals into the corresponding target intervals. This is perhaps the simplest and most conventional "sounding" of all of the mutations.

**UOH (Uniform octave harmonic):** The UOH is one of a set of harmonic mutations. The harmonic mutations use user-defined lookup tables which rank the possible chromatic intervals from harmonically "closest" to "most distant." For instance, in *Roads to Chimacum*, unison and octaves are closest and the minor second is most distant. This mutation “crossfades” the intervals of the source melody into those of the target through this lookup table. For instance, if the source interval is a unison, and the target interval is a minor seventh, with $\Omega = 500$ (or halfway), the mutation will produce an interval halfway between the unison and the minor seventh in terms of harmonic distance, which might be a major third (depending on the composer’s ranking of harmonic distance). In addition, the UOH also crossfades the octave difference between intervals. That is, the octave reduced form of the interval is crossfaded independently from the octave distance of the interval. Other harmonic mutations treat octave and interval type in different ways.

**DOOM**
One more simple mutation is used in this piece (for the first time), called the *Drop Out Only Mutation*, which is a simple density function. The DOOM simply replaces notes with rests, using $\Omega$ as the probability of doing so. DOOM values range from 0 to 1000, with 1000 equal to

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100%. With a high value for $Q$, the DOOM produces sparse melodies, as in the later variations. A new value for DOOM is chosen for each voice, but these values tend to increase in the higher variations. This is the only large scale formal shape to the piece: the higher the variation, the sparser it will tend to be.

Some further references
Roads to Chimacum was written using the computer music language HMSL (Hierarchical Music Specification Language), written by the composer, Phil Burk and David Rosenboom. This piece is so far the most extended application of a large body of software written by the composer in HMSL for morphologic metrics and mutations, functions described in the following four papers:


Three recent computer-composed scores, all available from Frog Peak Music (A Composers' Collective), use the mutation/metric software, and a similar process of composition. Each contains notes on the processes and mutations used.

- 51 Melodies ("Pride holds the multitudes in a continual, habitual process of readornment"), for two electric guitars and rock band, or solo electric guitar and rock band. 1991.
- Two Children's Songs, for tuba and trombone, or any two bass or baritone wind instruments, 1992.
- Bedhaya Sutra, Bedhaya Guthrie, for voices, kemanak, melody instruments and accompanimental gamelan, 1989-1992. This score includes extensive theoretical notes on early work with mutation functions.

Larry Polansky
Lebanon, New Hampshire
October, 1992
ROADS TO CHIMACUM

8/27/92

(HMSL generated data used to generate the four parts).

(DOOM values range from 0 to 1000, with 1000 equal to 100%).

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**Mutation 10**

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**Mutation 13**

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<td>989</td>
<td>660</td>
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<tr>
<td>Viola</td>
<td>T-222</td>
<td>7</td>
<td>833</td>
<td>598</td>
<td>UUIM/LCM</td>
</tr>
<tr>
<td>Cello</td>
<td>T-002</td>
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**Mutation 15**

<table>
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<th>Min:</th>
<th>Max:</th>
<th>DOOM</th>
<th>UUIM/LCM</th>
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**Mutation 16**

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<td>796</td>
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<td>Cello</td>
<td>T-111</td>
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<td>USIM</td>
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**Mutation 17**

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<th>UUIM/LCM</th>
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</thead>
<tbody>
<tr>
<td>Vln 1</td>
<td>T-012</td>
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<tr>
<td>Vln 1</td>
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<tr>
<td>Viola</td>
<td>T-200</td>
<td>256</td>
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<td>826</td>
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<tr>
<td>Cello</td>
<td>T-222</td>
<td>936</td>
<td>991</td>
<td>812</td>
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</table>
The Thirteen Possible Ternary Forms
Used in *Roads to Chimacum*
Roads to Chimacum

for string quartet or mandolin quartet

Larry Polansky
17 Variations on an arrangement of a fiddle tune by Patricia Spaeth
Roads to Chimacum: Variation 1

Mandolin/Vln I
Min: 67
Max: 979
DOCM%: 0
UUIM/LCM

Mandolin/Vln II
Min: 115
Max: 902
DOCM%: 0
LCM/UUM

Mandola/Vla
Min: 1
Max: 977
DOCM%: 0
UUIM/LCM

Mandola/Vlc
Min: 404
Max: 1000
DOCM%: 0
UUIM/LCM
Roads to Chimacum: Variation 3

Mndln/Vln I
Min: 1
Max: 940
DOOM% 102
LCM/LLIM

Mndln/Vln II
Min: 11
Max: 902
DOOM% 107
UOH

Mndla/Vla
Min: 468
Max: 850
DOOM% 83
UUIM/LCM

Mndlc/Vlc
Min: 30
Max: 853
DOOM% 95
UOH

Mandolin I/Violin I
Mandolin II/Violin II
Mandola/Viola
Mandocello/Cello

(roll box)

(please High G for drum)
Roads to Chimacum: Variation 4

Mandolin/Violin I
Min: 20
Max: 999
DOOM%: 134
LCM/IIUM

Mandolin/Violin II
Min: 7
Max: 977
DOOM%: 160
LCM/IIUM

Mandola/Viola
Min: 351
Max: 911
DOOM%: 132
USIM

Mandocello/Cello
Min: 663
Max: 664
DOOM%: 152
USIM

(if no D-sharp in cello)
Roads to Chimacum: Variation 5

Mandolin/Violin I

Min: 30  
Max: 999  
DOOM% 216  
UUIM/LCM

Mandolin/Violin II

Min: 136  
Max: 998  
DOOM% 170  
UOH

Mandola/Viola

Min: 0  
Max: 952  
DOOM% 216  
ISIM

Mandocello/Cello

Min: 12  
Max: 965  
DOOM% 52  
ISIM
Roads to Chimacum: Variation 6

Mndln/Vln I
Min: 39
Max: 934
DOOM% 269
USIM

Mndln/Vln II
Min: 14
Max: 995
DOOM% 127
UUM/LCM

Mndla/Vla
Min: 17
Max: 1000
DOOM% 267
UUM/LCM

Mndle/Vlc
Min: 326
Max: 1000
DOOM% 245
USIM
Roads to Chimacum: Variation 7

Mandolin/Violin I
Min: 285
Max: 984
DOOM% 287
USIM

Mandolin/Violin II
Min: 130
Max: 830
DOOM% 320
UOII

Mandola/Viola
Min: 5
Max: 668
DOOM% 240
LCM/UIIM

Mandocello/Cello
Min: 198
Max: 789
DOOM% 302
ISIM
Roads to Chimacum: Variation 8

Mndln/Vln I
Min: 233
Max: 1000
DOOM% 374
UOH

Mndln/Vln II
Min: 25
Max: 1000
DOOM% 374
UUIM/LCM

Mndla/Vla
Min: 2
Max: 1000
DOOM% 277
USIM

Mndle/Vlc
Min: 282
Max: 994
DOOM% 352
UUIM/LCM

MaNdolv I/Violin I

MaNdolv II/Violin II

Mandola/Viola

Mandocello/Cello

5

1
Roads to Chimacum: Variation 9

Mndln/Vln I
Min: 85
Max: 348
DOOM% 417
UULM/UCM

Mndln/Vln II
Min: 3
Max: 1000
DOOM% 412
UULM/UCM

Mndla/Vla
Min: 32
Max: 900
DOOM% 432
UULM/UCM

Mndlc/Vlc
Min: 40
Max: 907
DOOM% 374
UCM/UCM

(low A optional)
Roads to Chimacum: Variation 10

Mndln/Vln I
Min: 30
Max: 338
DOOM% 471
ISIM

Mndln/Vln II
Min: 473
Max: 956
DOOM% 484
ISIM

Mndla/Vla
Min: 28
Max: 957
DOOM% 389
LCM/IJIM

Mndlc/Vlc
Min: 138
Max: 982
DOOM% 426
ISIM

Mandolin I/Violin I

Mandolin II/Violin II

Mandola/Viola

Mandocello/Cello
Roads to Chimacum: Variation 11

Mndln/Vln I
Min: 394
Max: 873
DOOM% 533
USIM

Mndln/Vln II
Min: 11
Max: 999
DOOM% 528
USIM

Mndla/Vla
Min: 215
Max: 1000
DOOM% 477
USIM

Mndle/Vlc
Min: 249
Max: 679
DOOM% 534
USIM

Mandolin I/Violin I
Mandolin II/Violin II
Mandola/Viola
Mandocello/Cello
Variation 11
Roads to Chimacum: Variation 12

Mandln/Vla I
Min: 24
Max: 756
DOOM: 467
ISM

Mandln/Vla II
Min: 0
Max: 700
DOOM: 581
ISM/LCM

Mandln/Vla
Min: 391
Max: 991
DOOM: 873
ISM

Mandlc/Vlc
Min: 46
Max: 997
DOOM: 427
ISM/LCM
Roads to Chimacum: Variation 13

Mndln/Vln I
Min: 151
Max: 982
DOOM% 597
LCM/UIIM

Mndln/Vln II
Min: 282
Max: 961
DOOM% 533
USIM

Mndla/Vla
Min: 10
Max: 865
DOOM% 454
USIM

Mndlc/Vlc
Min: 9
Max: 674
DOOM% 648
UOH
Roads to Chimacum: Variation 14

Min: 18
Max: 999
DOOM% 589
LCM/UIIM

Min: 55
Max: 989
DOOM% 660
UIIM/LCM

Min: 7
Max: 833
DOOM% 698
UIIM/LCM

Min: 197
Max: 950
DOOM% 662
UIIM/LCM

(Play D if not in cello)

(D opt., or 8va down)
Roads to Chimacum: Variation 15
Roads to Chimacum: Variation 17

Mndln/Vln I
- Min: 7
- Max: 991
- DOOM% 863
- UOH

Mndln/Vln II
- Min: 84
- Max: 467
- DOOM% 658
- USIM

Mndla/Vla
- Min: 256
- Max: 985
- DOOM% 826
- LCM/UIIM

Mndlc/Vlc
- Min: 936
- Max: 991
- DOOM% 812
- USIM