Use of Fib. Proportions in Retracements for Percussion Quartet

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Abstract

This performance proposal features a performance of *Retracements* (2021) for percussion quartet commissioned by Kevin von Kampen, at University of South Florida (USF) percussion ensemble. *Retracements* uses Fibonacci numbers and Phi proportions that mirror percentages used by stock market traders to predict corrections of trends in the market. Fib. numbers used in *Retracements* dictate the length of short sections in the work, while larger sections emerge organically and less predictably with regard to Phi (GS). In short, the work unfolds structurally through the impetus of determinate decisions combined with intuitive and indeterminate factors [1]. In this light, the work is a musical realization of the retracement principle.

I am indebted to Kevin von Kampen, assistant professor of Music at the University of South Florida, and members of the Percussion Ensemble at USF: Katie McCarty, Jacob Barber, David Grullon, and Wyatt Hatch for their careful preparation of the work.

Key words: musical form, algorithmic composition, Fib., Phi, Golden Section

Use of Fib. proportions in *Retracements* for Percussion Quartet:

Retracements for Percussion Ensemble was commissioned by Kevin von Kampen who requested the work for his percussion ensemble at the University of South Florida. The group is featured in the video performance presented on Generative Art 2021.

The concept of retracement (market correction) refers to a rise or fall in the stock market that is followed by continued a continued trend upward or downward. They are the point where an adjustment or retracement occurs. Retracement calculations use percentages based on GS or Phi proportions such as: 23.6% ($1/\phi^3$), 38.2% (complement of 61.8%, $1/\phi^2$), 61.8% ($1/\phi$), and 78.6% to predict the percentage of a rise, or fall in the market [2] [1, 2]. They are used by traders to predict market corrections and set goal levels (support and resistance) during a trend and are integral to other forms of technical analysis such as Gartley Patterns, or Elliott Wave Theory [3] [4]. Further, they reveal a broad picture of

trends and are often paired with Fundamental Analysis which can influence calculated predictions [5].

Though I often use Fib. numbers and Phi (ϕ) proportions to dictate various structural levels in my work, in *Retracements*, I applied Fib. numbers to the musical surface and allowed larger proportions to emerge freely in the compositional process. The musical surface is structured primarily around Fib: 2, 3, 5, 8, and 13, and though larger proportions emerging from the use of Fib. numbers exhibited accord with retracement (Phi) percentages, the structural unfolding of the work "resisted" a preponderance of Golden Section relationships which is unexpected given the fact that the musical surface strongly correlates with the Fibonacci Sequence (GS-1/ϕ = .681, or powers of GS). Further, it was difficult to predict where Phi proportions would arise, though in the end, many of the elapsed time proportions exhibited Phi at key structural points, correlating with the conceptual basis of retracement techniques which use Phi as a "best guess" at which changes in the market will occur.

The following discussion focuses on proportions generated by the number of beats, measures, phrase cycles (26 beats), or elapsed time of sections of the work. All proportions are within <2% of GS or powers thereof.

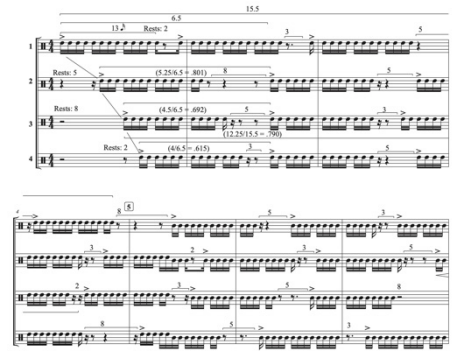
At opening of the work, all percussionists play 3.25 beat phrases (13 sixteenth notes) on wood blocks separated by a palindromic cycle of sixteenth note rests 2, 3, 5, 8, 5, 3 in each part (Example 2). The cycle of rests is rotated (e.g. 235853, 358532, 585323, etc.) in each part generating imitative phrases between them, and one complete cycle (performance + rests) is 26.25 beats in length. This cycle is used in the first 100 measures of the piece.

Example 1: *Retracements* (mm. 1-10)
Cycle of rests (# of sixteenth notes):

P1	0	2	3	5	8	5	3	2	3	5
P2	5	8	5	3	2	3	5	8	5	3
P3	8	5	3	2	3	5	8	5	3	2
P4	(8)	2	3	5	8	5	3	2	3	5

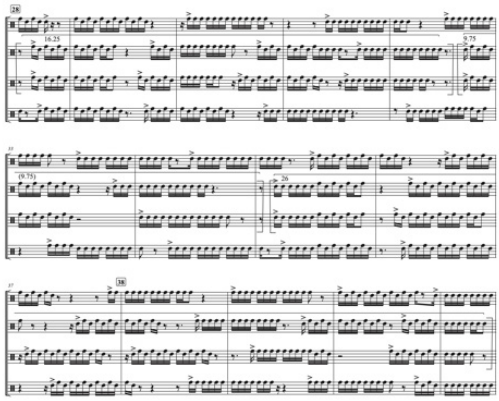
The example below shows the thirteen sixteenth note pattern, the cycle of rests shown in example 1, and demonstrates GS proportions in the opening seven measures. In mm. 1-2, parts 2 and 4 each have a GS proportion with part 1 (1 and 2 .801; 1 and 4 .615). Part 3 forms a GS proportion with part 1 between mm. 1-5 (1 and 3 .790) [2]. the number of beats is used to calculate proportions as the example shows. Also note the correspondence of part 2-4 in m. 2. This will be explored in Ex. 3.

Example 2: *Retracements* (mm. 1-7)



Example 3 (mm. 28-41) shows parts 2-3 coordinating phrases of 16.25, 9.75, and 26 beats in length. During the phrase, the parts drift apart as a result of the rest cycle (Ex. 1) until they come together again. Phi proportions are 9.75/16.25 (.6), 9.75/26 (.375), 16.25/26 (.625). The 26 beat phrase between parts 2-3 repeats until m. 61.

Example 3: *Retracements* (mm. 28-41)



Other examples of Phi proportions in the work involve larger sections. These are determined by a significant change in musical texture (number of voices, or rhythmic activity), timbre (instruments or combinations thereof). In the opening 100 measures of the work the following proportions occur. The number of measures are used here since the meter remains consistent throughout: mm. 10-26 (.384); mm. 14-38 (.368); mm. 26-67 (.388); mm. 53-87 (.609); mm. 58-74 (.783).

Further, larger sections exhibit GS proportions based on elapsed time. Example 4 shows measure numbers and elapsed time for: each section of the work (a^{1-6}), elapsed time to the ends of sections from the beginning (b^{1-6}), and proportions comparing individual sections to each other and the entire work. GS sections occurred between: (a^2/a^4) .386, (a^3/a^4) .376, (a^1/a^5) .237, (a^4/a^6) .230, (a^{2+3}/a^1) .390, (a^{2+3}/a^4) .763, (a^{5+6}/a^1) .355, ($a^{2,\ 6}$ /work) .088, .051, (a^{1-3}/b^6) .612. This last proportion is perhaps the most significant since it demonstrates that the entire work exhibits Phi (a/b = a+b/a = 1.634).

Example 4: *Retracements* Elapsed Times

Section	Measures	Section total a^{1-6}	Elapsed time at end of section b^{1-6}	Proportion a^1/a^n	Proportion a^{2+3}/a^n	Proportion $a^n/464.326$	Proportion $b^n/464.326$
1	1-100	200"	200"			.431	.431
2	101-125	39.625"	245.721"	**.386 (a^2/a^4)**	**.390 (a^{2+3}/a^1)**	**.088**	.529
3	126-152	38.510"	284.231"	**.376 (a^3/a^4)**	**.763 (a^{2+3}/a^4)**	.083	**.612**
4	153-205	102.514"	390.041"			.221	.840
5	206-225	47.334"	440.755"	**.237 (a^1/a^5)**	**.355 (a^{5+6}/a^1)**	.102	.949
6	226-234	23.571"	464.326"	**.230 (a^4/a^6)**		**.051**	1

Notes:

1 indeterminate factors include acoustics, playing technique, part density, etc.

2 The Fib. Retracement percentage of 78.6% is commonly used, but is not directly generated by powers of Phi (.618). It is within 3% of $2(1/\phi^2)$ = .764. See Ex. 2.

References:

1 *Fibonacci Retracement Levels*

https://www.investopedia.com/terms/f/fibonacciretracement.asp#:~:text=Fibonacci%20retracement%20levels%20are%20horizontal,are%20based%20on%20Fibonacci%20numbers.&text=The%20Fibonacci%20retracement%20levels%20are,%2C%2050%25%20is%20also%20used. (accessed, October 11, 2021)

2 Charles Madden: Fib and Phi in Music, Salt Lake City, UT: High Art Press, 2005.

3 *Support (Support Level)*

https://www.investopedia.com/terms/s/support.asp (accessed, October 11, 2021)

4 *Gartley Patterns*

https://www.investopedia.com/terms/g/gartley.asp (accessed, October 11, 2021)

5 78.6% Fibonacci Retracement, Fundamental Analysis. https://www.dayprotraders.com/78-6-fibonacci-retracement (accessed October 19, 2021)