Workshop: Make Your Own MP3 with "Algorhythmic" Generation and *Aksak*–Euclidean Synthesis

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Abstract

The workshop presents rhythm cells and their interactions according to the Afro-Latin framework uncovered by the facilitator. After trying out rhythm segments through clapping, singing, drumming, or using free drum-machine software, participants record their preferences on a worksheet, and receive an MP3 based on their construction in one of several styles (Brazilian, Haitian, funk, Middle Eastern, etc.).

Introduction

Using the concepts of clave direction [1–3], Euclidean rhythms [4] and *aksak* rhythms [4, and the author's cultural heritage], workshop participants will be shown how to generate their own rhythms using rhythmic cells (to be available on handout, and which participants can clap, sing, or play on freeware drum machines during the workshop). The creative process will take place in one of three mathematical modes: standard clave direction, quasi-fractal clave direction, and cross-cultural synthesis. These modes are explained below.

Creative Directions

Creating Rhythmic Patterns in Standard Clave Direction. The participants are first introduced to a variety of rhythm cells (Figure 1) and their relationships to one another, and are encouraged to try out these patterns by using free or otherwise available software, or by clapping, vocalizing, or drumming (with the facilitator's help, if necessary).

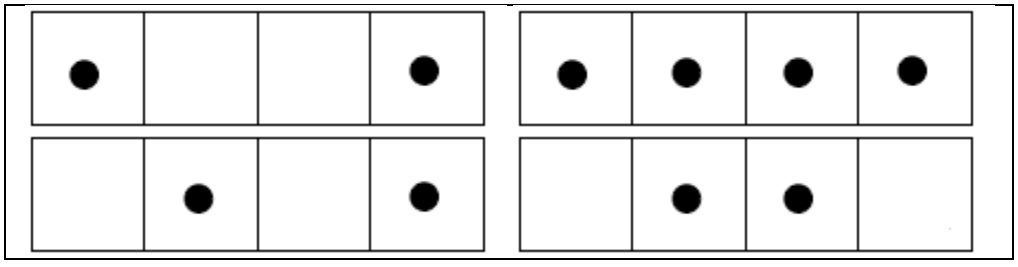

Figure 1: *Four examples of rhythm cells. Combining these cells left-to-right, top row first will result in a mildly "inside" (2-3) pattern, whereas bottom row first will result in a strongly "outside" (3-2) pattern.*

After familiarizing themselves with several rhythmic cells (the complete list of which, and their relationships to be available at the workshop), participants are introduced to the *balanço* [3] method (Figure 2) of combining such cells to make culturally functional Afro-Latin rhythms. The participants submit their designs (along with their specifications for what type of music they want their patterns to result in) to the facilitator. They may specify simple binary rhythms, or more involved descriptions using dynamics, note names, and so forth. (This level of detail is not required, but those who wish can make use of such options.) The participants also specify what style of Afro-Latin music (from a list of options) they would like their construction to be incorporated into.

Their designs are added by the facilitator to pre-made *Henry's Percussion Studio* arrangements of generic, or at least representative, background music inspired by the traditions of Brazil, Cuba, Haiti, Belize, and other clave cultures.

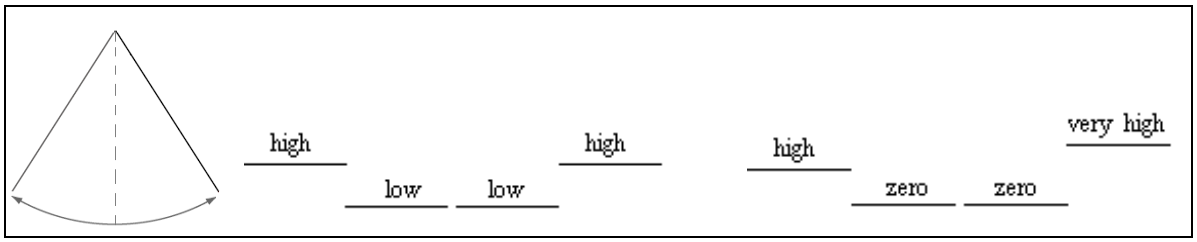

Figure 2: *An illustration of* balanço *in terms of rhythm cells: The trajectory of a swing ("*balanço,*" left), a highly quantized version of the trajectory (center), and the offbeatness degrees of cells that comprise 3-2* partido-alto *(right) [3].*

Creating Quasi-Fractal Clave Patterns. By applying the *balanço* concept at both the rhythm-cell level and the bar (musical measure) level, one can devise longer patterns that echo the flow of *balanço* at longer time intervals, effectively implementing the clave concept as a larger-scale musical structure.

At one level above the regular clave, the first and fourth full *bars* can be selected or designed to have similar offbeatness functions (clave sense), just as the first and fourth rhythm cells do in ordinary clave. (They have the opposite function to the second and third cells.) Applying this principle again to a selection of four-bar phrases will exhibit the clave concept yet again at a higher time scale, and so on, should one wish to experiment, until the *balanço* form is as expansive as the sonata form. Examples are shown in Figures 3 and 4. Adding more levels while keeping the relationship of each of the parts to the new whole increases the combined mathematical and artistic challenge.

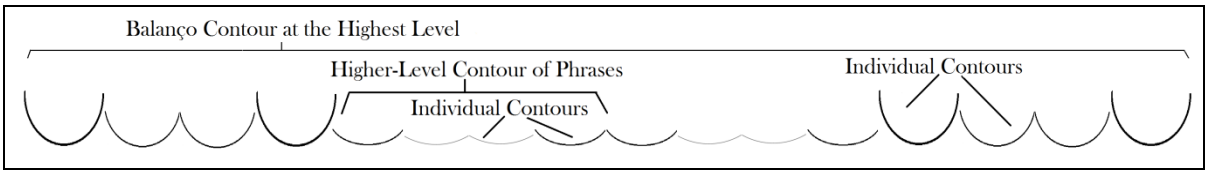

Figure 3: *The* balanço *idea (any individual swooping trajectory) repeated at two higher levels of temporal-organizational hierarchy, resulting in a quasi-fractal musical form in four movements.*

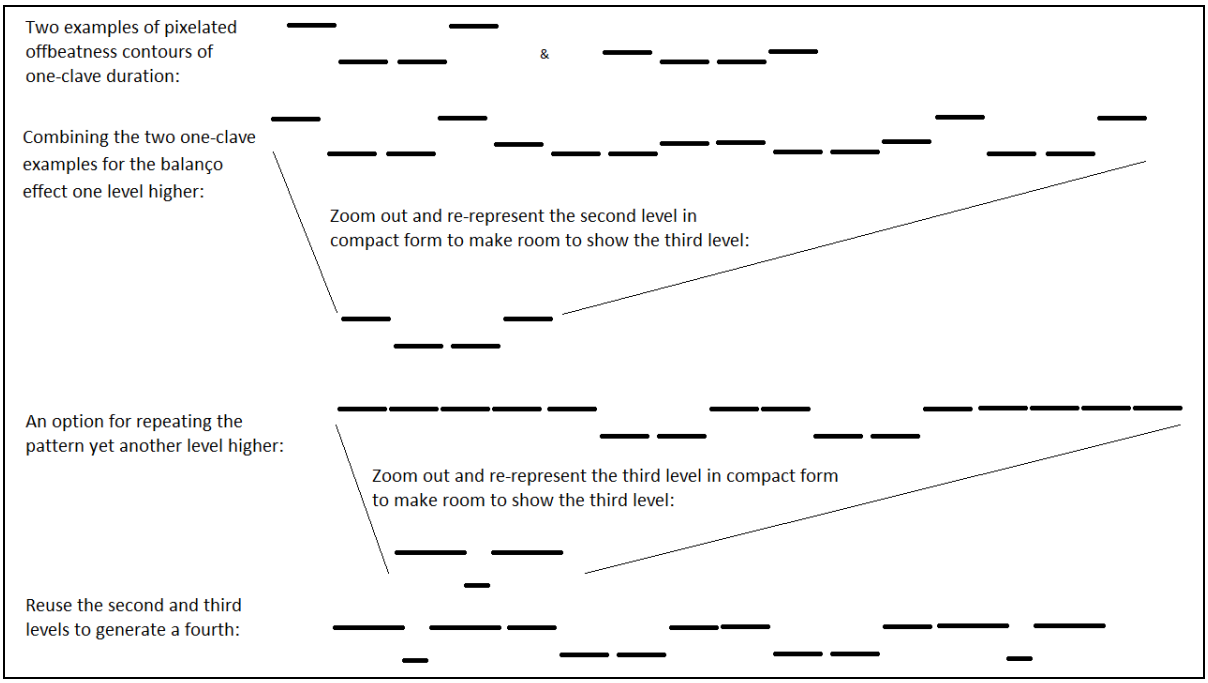

Figure 4: *Another graphical representation of the* balanço *structure at multiple temporal levels.*

In the opposite hierarchical direction, prominent 32nd notes and rests, tuplets or flams may be employed to advance this quasi-fractal repetition in the opposite direction of smaller time units, resulting in a type of "microclave" effect, similar to the use of 32nd rests in certain *gankogui* (bell) parts in *Ewe* music from Ghana [5].

Cross-Cultural Rhythm Synthesis. An interesting connection between Balkan (and other Eurasian) rhythms and the African and Afro-Latin clave form is that the latter can be generated by combining appropriate examples of the former.

As shown by Toussaint in [4], the Euclidean algorithm generates a wealth of musical patterns in compound meters. These patterns are encountered throughout the folk and court musics of Asia, Europe, Africa and Latin America. Furthermore, a large subset of these Euclidean rhythms also conform the *aksak* principle, a Turkish word meaning "limping," "lopsided," or "interrupted," and which has entered English usage to signify a rhythm containing at least one binary and one ternary cell, and no cells of any other type. Such a description fits many Balkan and Middle Eastern metric frameworks (although the original Turkish rhythm contains binary and *unary* cells in common practice).

Patterns that are both Euclidean and *aksak* have the additional property that when combined in pairs (thus resulting in an even meter), they give rise to the alternatingly high and low prominence of offbeatness—the West African seed of Afro-Latin clave direction. Thus, by concatenating *aksak* Euclidean rhythms (also called additive compound metric outlines) two at a time, we can create novel or existing West African and Afro-Latin clave-type patterns.

Graphical representations of *aksak* Euclidean rhythms will be provided at the workshop. An example is given in Figures 5 and 6.

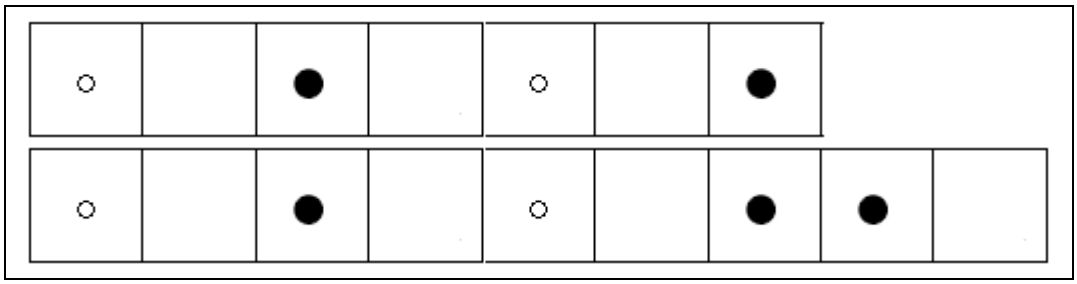

Figure 5: *Standard Balkan* $\frac{7}{8}$*, and Turkish* $\frac{9}{8}$ *rhythms (top and bottom, respectively), with open circles for the bass tones (vocalized* düm*) and filled circles for treble (vocalized* tek*). These are combined below to obtain the rhythmic outline of a characteristic West African bell pattern or Cuban montuno. (7 + 9 = 16*)

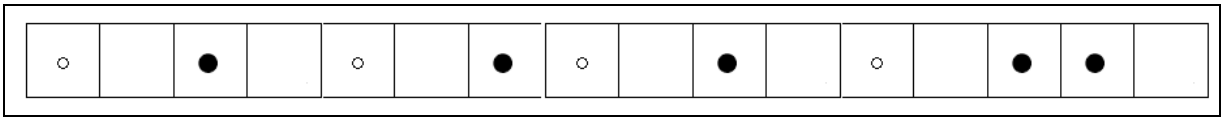

Figure 6: *Combining the patterns of two Balkan folk dances to generate the rhythmic outline of an African bell or clapping pattern [4, p. 9 & p. 10] or a Cuban montuno: Play the open and closed circles as two separate bells or two piano chords to hear this.*

Workshop Goals

There are two goals of this workshop. In terms of education, the goal is to give teachers a fun and engaging tool to use in introducing younger (K–12) students to rhythms of other cultures, and in broadening older students' conceptualizations of music around the world and its cultural diversity. In terms of recognizing bridges between mathematics and the arts, the goal is to demonstrate the interaction of mathematical concepts and rhythms in music from around the world, and especially the West African-derived rhythms of the Americas.

As an added benefit, participants get to create their own rhythm composition(s) and receive an MP3 file of the music, properly tagged to indicate the participant as artist and composer (along with "anon." for the traditional sources of these concepts, and the facilitator, and Bridges 2013 as the "album").

References

[1] M. Vurkaç, "A Cross-Cultural Grammar for Temporal Harmony in Afro-Latin Musics: Clave, *Partido-Alto* and Other Timelines," *Current Musicology* (2013), (in print, issue 94, "fall 2012").

[2] M. Vurkaç, "Clave-Direction Analysis: A New Arena for Educational and Creative Applications of Music Technology," *Journal of Music, Technology and Education*, Vol. 4, No. 1 (2011), pp. 27–46.

[3] M. Vurkaç, "*Balanço*: The Contour of Relative Offbeatness," *Proceedings of BRIDGES 2012: Mathematics, Music, Art, Architecture, Culture* (2012), pp. 329–336.

[4] G. T. Toussaint, "The Euclidean Algorithm Generates Traditional Musical Rhythms," *Proceedings of BRIDGES: Mathematical Connections in Art, Music and Science* (2005), pp. 47–56.

[5] J. Burns, "Ewe drumming from Ghana: the soup which is sweet draws the chairs in closer," (booklet, audio compact disc), *World and Traditional Music Section of the British Library Sound Archive*, Topic Records, London (2004) pp. 5, 13.