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EXPRESSIVE TIMING VIA METRIC HYBRIDS

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ABSTRACT

Timelines with unequal subdivision counts can have similar onset distributions. Two such timelines form an *analogous* pair. Their resemblance makes it possible for one of the timelines to stand as an expressive transformation of the other. A distance score and an onset displacement vector summarize the pair's expressive properties. Examples are provided in two contexts: compositional and analytical. In the former, gradual transformations result from tracing a path within a network of timelines. In the latter, metric ambiguity results from an analogous groove in Tinariwen's "Mano Dayak."

1. TIMELINES & ANALOGUES

Timelines are cyclic rhythms that can be classified by their number of onsets k and their total subdivision count n. One way to obtain a similarity score for a pair of timelines is to overlay the two onset distributions and sum the Euclidean distances between corresponding points (equation 1 in Toussaint 2010). For instance, setting the cycle length to 1.0 gives a summed difference of .250 for the two timelines in Figure 1.

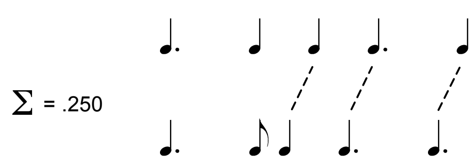

Figure 1: Similarity (distance) score for two timelines with $k = 5$ and $n = 12$ over a cycle of duration 1.0.

The above rhythms share the same n. We can also overlay unequal n's. Jeff Pressing (1983) calls these *transformational analogues*, and notes that certain timelines with unequal values of n can partition the cycle very similarly. He cites the Clave Son as an example: the onset distribution of the 12/8 version (22323; $n = 12$) resembles closely that of the 4/4 version (33424; $n = 16$). It seems logical to compare timelines of 12 and 16 because these are common musical meters. Further comparisons between "binary" and "ternary" timelines are explored in Gómez *et al.* (2007). This paper extends the comparisons to include other values of n. Doing so allows for expressive transformations and rhythmic illusions in various musical contexts.

2. EXPRESSIVE VARIATION

Timeline A ($n = 13$) in Figure 2 may be viewed as a slightly distorted version of timeline B ($n = 8$). Playing A over the metric context of B (4/4) will simulate a microrhythmic variation of timeline B. This distortion features a distance score of .096 and a profile of deviations with respect to A: ↓←←←←. A subjective appraisal of this distortion might be: "Moderate distortion, consistently anticipated."

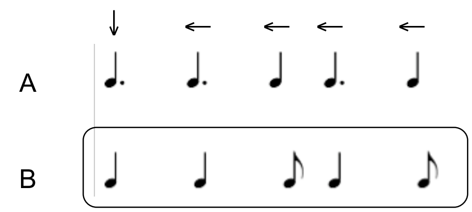

Figure 2: Timeline A ($n = 13$) masquerading as an expressive distortion of timeline B ($n = 8$). Their similarity score is .096. Arrows denote the direction of deviation only, even though their magnitudes are not always equal (some are barely perceptible).

Shifting the point of alignment—that is, transposing A and B by the same amount—gives rise to different displacement vectors. Figure 3 gives two transpositions (t_1 and t_2), both with better distance scores than t_0.

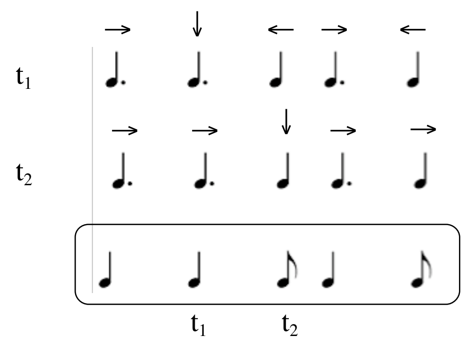

Figure 3: Two transpositions of Fig. 2, featuring rearranged displacement vectors and improved similarity: .058 (t_1) and .067 (t_2) instead of .096 (t_0).

3. ANALOGOUS PATHS

The distance half-matrix gives pairwise similarity values for a collection of timelines (Colannino *et al.* 2009). A sample matrix appears in Figure 4, where $k = 4$ and note values are confined to either 2 or 3 subdivision units. Note that this yields three different values of n. Suppose that we wish to find a good analogue to 3233 ($n = 11$). The lowest value (.091, or 1/11) is given by 2333 and 3323; we discard these because they are "inexpressive": all they do is transfer a single onset by one notch while retaining the underlying lattice of 11. The next lowest values (.100 and .111) belong to 3223 ($n = 10$, ↓→→←) and 2232 ($n = 9$, ↓←←→), which feature mirror-image displacement vectors.

				n=	9	9	10	9	10	10	11	9	10	10	11	10	11	11
					2	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
					2	**2**	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**3**
					2	**3**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**3**
n=					**3**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**2**
9	**2**	**2**	**2**	**3**	0	111	100	222	111	211	111	333	167	267	121	367	212	303
9	**2**	**2**	**3**	**2**		0	144	111	156	100	101	222	211	156	**111**	256	202	192
10	**2**	**2**	**3**	**3**			0	256	100	200	100	367	200	300	155	400	245	336
9	**2**	**3**	**2**	**2**				0	156	100	192	111	211	156	202	144	111	101
10	**2**	**3**	**2**	**3**					0	100	91	267	100	200	145	300	145	236
10	**2**	**3**	**3**	**2**						0	136	211	200	100	191	200	191	136
11	**2**	**3**	**3**	**3**							0	303	191	236	~~91~~	336	182	273
9	**3**	**2**	**2**	**2**								0	167	111	212	100	121	111
10	**3**	**2**	**2**	**3**									0	100	**100**	200	100	191
10	**3**	**2**	**3**	**2**										0	145	100	145	91
11	**3**	**2**	**3**	**3**											0	245	~~91~~	182
10	**3**	**3**	**2**	**2**												0	155	100
11	**3**	**3**	**2**	**3**													0	91
11	**3**	**3**	**3**	**2**														0

Figure 4: Distance half-matrix for all timelines containing four onsets and note values of 2 or 3 (omitting 2222 and 3333). The best analogues to 3233 are 3223 and 2232.

Analogue timelines can fulfill a compositional role. Figure 5 sketches a gradual transformation. As the granularity of the lattice evolves from $n = 12$ to 18 to 13 to 16, the timeline onsets snap to their nearest neighbors to yield low distance values. (Had we skipped the two intermediary steps, a direct path from the top to the bottom timeline would have resulted in a score of .146.) This four-node network belongs to a 1024-member set that includes all timelines with $k = 5$ and note values equal to 1, 2, 3, or 4. Defining transition rules gives rise to different paths within the network. For instance, one might set a threshold of .100 for all transitions and prohibit back-stepping.

Figure 5: A gradual transformation from 23232 to 24433.

Paths such as the one in Figure 5 can be realized in two contexts, both consisting of a background/foreground texture. The meter of the starting pattern can be retained from beginning to end while the timeline itself moves from node to node. This conceals the meters that underlie the transformations, creating a feel of ongoing microrhythmic variation (cf. Fig. 2).

Another strategy consists of retaining the meter during each transition (like a pivot), then revealing the new timeline's own meter—a process that can lead to interesting rhythmic illusions.

As an example, consider a two-instrument performance of the path in Figure 5. Instrument T plays the timelines while instrument M provides metric support.

1. Both begin in 12/8, with T(23232) and M(3333). In 12/8, T is syncopated but discrete.

2. The second timeline (34443) is first heard against 12/8, yielding the displacement profile ↓↓←→↓. Then M switches from 12/8 to 9/4 (because $n = 18$). In 9/4, T is syncopated but discrete.

3. The third timeline (23332) is first heard against 9/4, yielding the displacement profile ↓←<u>←</u> <u>→</u>→. (Underlined arrows denote negligibly small deviations.) Then M switches from 9/4 to 13/8 (because $n = 13$). M's 13/8 can take different long-short configurations; we choose 23332 to keep it aligned with T, even though more syncopated pairings could work as well.

4. The last timeline (24433) is first heard against 13/8 (23332), yielding the displacement profile ↓←<u>←→</u>←. Then M switches from 13/8 to 8/4 (because $n = 16$). In 8/4, T is syncopated but discrete.

Audio demonstrations will be presented at ICMPC11.

4. TINARIWEN: "MANO DAYAK"

In addition to aiding pre-compositional design, analogue timelines can model existing music. The transcriptions in Figure 6 depict two possible hearings of a passage by the Tuareg band Tinariwen (2007). The scenario in quintuple meter gives four consecutive delays along the timeline. The last (underlined) arrow denotes a much smaller deviation—a stabilizing on-the-beat pickup into the next cycle.

On the other hand, a ternary hearing gives one delay followed by four anticipations. In the recorded track, the microrhythmic ambiguity disappears gradually as the timeline crystallizes into the ternary framework. An interesting feature of the ternary model is its binary third beat, raising the possibility—not explored here—of splitting n into two or more subsets.

Clock representations appear in Figure 7. The placement of onsets (slashes) is identical on both circles. Choice of meter determines whether a given onset is heard as a delay or an anticipation. A listener who is predisposed toward behind-the-beat performances might be drawn to the 5/4, while a listener with no such predilections may lock onto the alternate version—which turns out to be the "correct" one as the track unfolds.

Figure 6: Two hearings of the same groove in Tinariwen's "Mano Dayak" (1:20), each with its own repertoire of microrhythmic inflections.

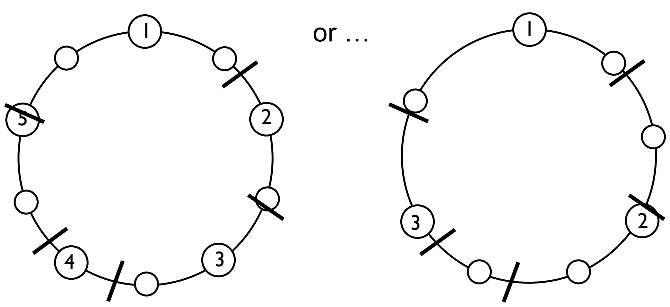

Figure 7: Clock views of Fig. 6, with 5/4 on the left and 9/8 (with a binary third beat) on the right. Slashes are onsets.

5. REFERENCES

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