Cyclical Structures in Central Javanese Skeletal Melodies.
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Cyclical patterning of rhythm is a prominent feature in many musical traditions. To name a few: in early European music, isorhythmic motets; in later European music, ground basses, *bassi ostinati*, and themes and variations; in vernacular European music, rounds, catches, and strophic songs; in American-derived music, chord progressions and changes in jazz and blues; in sub-Saharan idioms and their diasporic extensions, percussive timelines and claves; in Middle Eastern and South Asian music, *awzān*, *īqā'āt*, *uşūl*s, and *tāla*s.

The present report considers cyclical patterning in the longest, most complex pieces of traditional music for instrumental ensembles in Central Java, namely, *gendhing*s. In particular, this report focuses on the initial, longest sections of *gendhing*s, termed *mérong*s.

Whereas the general analytical approach outlined here is, in principle, applicable to any of the genres just mentioned, its specific application is directly relevant to Central Javanese practice. In this regard, the approach outlined here differs from European-derived analyses of time intervals and melodic form.

Rather than abstract concepts of meter or hypermeter, the point of departure is continually recurring cycles of immediately audible concrete time-intervals and analytical results are interpreted in terms of behavioral psychology. Instead of describing melodic form in terms of discrete segments conveyed by, for instance, the letters A, B, C, etc., the present report identifies both overlap and gaps between segments and connects them directly to particular beats and time spans within rhythmic cycles. Also unusual is the present study's analysis of aggregated works rather than individual pieces.

Gong Cycles

For Central Javanese *gendhing*s, Barry Drummond's growing online database[1] notates cyclical patterning clearly and consistently for hundreds of works. In Drummond's notations, each section's cyclical pattern comprises gong tones that are aligned with the pitch classes of the principal, 'skeletal' melody played by a gamelan ensemble's keyed metallophones, the *saron*s.

Figure 1 specifies the pattern of the most frequent cycle among the *mérong*s. In this pattern, which occurs in 135 *mérong*s, a large gong is struck every 64 beats. In the Indonesian language, *bahasa Indonesia*, the time between these tones is termed a *gongan*.

(Because the term 'beat' refers to both a particular time and a particular unit of time, one should note that the following account toggles between, for example, 64 units of time in a gongan and the 65 times a *gongan* comprises.)

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1 Accessible at https://www.gamelanbvg.com/gendhing/index.php.

Smaller gongs, called *kenong*s in Indonesian, divide this 64-beat duration into four 16-beat spans, each of which is called a *nongan*.

As well, even smaller gongs, *kethuk*s, produce an 8-beat cycle that crosscuts the 16-beat cycle. This 8-beat cycle is out-of-phase with the cycles of the larger gongs, occurring as it does at the 5th and 13th beats of each instance of the 16-beat cycle.

Graphically, one could model these three cycles within the cycle as a whole, by means of a one-dimensional circular display, as in **<u>Figure 2</u>**.

Alternatively, one could project each of the cycles onto a helix.

As well, one could model the 64-beat cycle as a sine curve with modulus 2π, as in **<u>Figure 3</u>**.

Relative to this curve, the 16-beat cycle could be modeled as a sine curve with a modulus of 1/2 π, and the out-of-phase 8-beat cycle as a cosine curve with a modulus of 1/4 π.

Together, the 16-beat *nongan* cycle and the out-of-phase, 8-beat, *kethuk* cycle constitute an intermittent cycle of 4 beats. This intermittent 4-beat cycle is interrupted only at the mid-point of the 16-beat cycle, i.e., at the 9th beat of each *nongan* cycle. Nonetheless, indigenous Central Javanese theory identifies each of the intermittent cycle's beats, namely, the 5th, 9th, 13th, 17th, etc., as the final beat of a 4-beat measure or *gatra*.

What now follows mainly concerns ways in which the onsets of the *mérong*s' skeletal melodies tend to be related to the rhythmic cycles produced by the various gongs.

Since talk of 'tendencies' can degenerate into vague claims, I propose three general working hypotheses concerning such tendencies:

1) *<u>Anything</u> can happen in a piece of music.*
2) *Within a group of pieces that constitute a <u>genre</u>, certain things tend to occur more often than others.*

I reserve the third working hypothesis for later. In the meantime, one can note several things that tend to occur in the 135 *mérong*s.

Among the 135 *mérong*s, each in *pélog* tuning, onsets of the skeletal melody coincide with 80% of the cycles' beats. In **<u>Figure 4</u>** the horizontal line at the value '108,' which equals 80% of 135, identifies the number of *mérong*s in which one would expect a skeletal-melody onset to occur at each beat on average, all things being otherwise equal.

In Figure 4, the larger squares indicate that in all 135 *mérong*s a skeletal-melody onset coincides with the tones of the largest gong, i.e., on the 1st and 65th beats.

The circles show that in all 135 *mérong*s, skeletal-melody onsets coincide also with the tones of the second largest gongs, i.e., on the 1st, 17th, 33rd, 49th, and 65th beats.

Further, upright rectangles show that, among the 135 *mérong*s, there tends to be a considerable decline in the number of *mérong*s that have skeletal-melody onsets that coincide with the 4 beats immediately after these second-largest gong tones.
As mentioned previously, these four beats comprise a single 4-beat measure between each *kenong* tone and the following *kethuk* tone of the out-of-phase 8-beat cycle. In Figure 4, smaller squares indicate the tones of this out-of-phase 8-beat cycle.

Among the 135 *mérong*s, the decline in skeletal-melody onsets is especially sharp at the 2nd beat, i.e., directly after the largest and second largest gong tones sound together. As well, such a decline is quite clear immediately after the other tones of the second largest gong, i.e., at the 18th, 34th, and 50th beats of the cycle.

The larger, upper rectangles in Figure 4 highlight a necessarily complementary tendency for an increasing number of skeletal-melody onsets to coincide with the remaining beats between the second-largest gongs' tones.

In terms of behavioral psychology, one can regard this pattern as similar to what happens during a fixed-interval schedule of reinforcement, where, in the present instance, the fixed intervals span 16 beats and 64 beats.

A common, homely illustration of fixed-interval reinforcement involves preparations for a deadline: e.g., submitting an essay, sitting for a test or exam, or performing at a lesson or recital. Characteristically, students' activity, i.e., as students, tends to decline soon after such events. Thereupon, their activity, as students, increases, especially as the next deadline approaches.

What, then, of the remaining 20% of the beats, i.e., the beats at which there are no skeletal-melody onsets?

The beats with which skeletal-melody onsets coincide result in immediate successions of onsets that form inter-onset intervals of various durations. In studies of music psychology, such inter-onset intervals are called by their acronym, 'IOIs.' In total, 85% of the IOIs span a single beat. The remaining IOIs span 2 to 5 beats.

Figure 5 illustrates such IOIs in the Indonesian cipher notation for the first 25 beats of the *mérong* section of *Gendhing Layar Genjong*. As Figure 5 shows, two of the gaps in this passage span two beats; one gap spans three beats, and another gap spans five.

As shown in **Figure 6**, all of the 4-beat inter-onset intervals in the 135 *mérong*s begin at a beat that coincides with the 16-beat cycle: the 1st, 17th, and 49th. In other words, each of these 4-beat, 1-gatra inter-onset intervals spans a tone that coincides with the 16-beat cycle and a tone that coincides with the out-of-phase 8-beat cycle. Relative to these cycles, the 4-beat inter-onset intervals can be considered 'commetric,' or, to neologize, 'con-cyclic.'

Like the 4-beat inter-onset intervals, each 3-beat inter-onset interval begins on an odd-numbered beat. As **Figure 7** shows, 3-beat inter-onset intervals most often begin at, or soon after, an odd-numbered beat that coincides with the 16-beat cycle. As well, triangles in Figure 7 show that in contrast to all the other inter-onset intervals, 3-beat inter-onset intervals quite often begin at one of the gaps in the 4-beat cycle that is implied by the 16- and 8-beat cycles. In any event, all the 3-beat inter-onset intervals result in counterparts to the dotted rhythms of European-derived notation and music theory.

Figure 8 shows that among the 135 *mérong*s, 5-beat inter-onset intervals begin only at odd-numbered beats. Most begin at the 1st, 17th, and 33rd beats (indicated by circles); that is, their beginnings coincide with the gong tones of the 16-beat cycle.

As well, the beginnings of all but one of the remaining 5-beat inter-onset intervals coincide with the first tone of the out-of-phase 8-beat cycle: specifically, beats 5, 21, and 37 (indicated by small squares).

All of these 5-beat inter-onset intervals result in a counterpart to dotted rhythm insofar as they begin con-cyclically and they conclude, to neologize again, non-cyclically.

Finally, the great majority of inter-onset intervals larger than a single beat span 2 beats (**Figure 9**). Unsurprisingly, 2-beat inter-onset intervals begin at beats that coincide disproportionately often with the 16- and 64-beat cycles, indicated by circles and larger squares.

Next most frequent are 2-beat inter-onset intervals whose beginnings coincide with the 8-beat cycle, indicated by small squares. Also frequent are syncopations of the 1st, 3rd, and 7th beats of the out-of-phase 8-beat cycle, indicated by downward-pointing triangles. Otherwise, 2-beat inter-onset intervals tend to coincide with odd-numbered beats and almost never syncopate a beat that is not part of the implied 4-beat cycle.

Now, for the third general working hypothesis:

3) Things that happen more often result in simpler structures.

Without taking refuge in vague notions of simplicity, one can begin by specifying with regard to the *mérong*s considered here, that each gong tone and each skeletal-melody onset is inherently prominent and adds complexity in the sense that a particular *mérong* thereby has more tones.

As their durations are the same, the great majority of inter-onset intervals, 85%, that span a single beat simplify the skeletal-melodies' immediately prominent onsets.

That particular gong tones and skeletal-melody onsets constitute time intervals that are the same in size by virtue of lasting 64 beats, 16 beats, or 8 beats further simplifies such complexity.

Whereas each gong tone and each skeletal-melody onset is perceptually prominent, those that initiate an inter-onset interval longer than a single beat are even more salient. Accordingly, beginnings of inter-onset intervals that coincide with one or more of the cycles that span 64, 16 or 8 beats, or—at least implicitly—4 beats enhances structural simplicity even further.

Connecting the ideas of structural simplicity and a fixed-interval schedule of reinforcement, one can propose the hypothesis that structural simplicity is a reinforcer; that is, structural simplicity increases the probability that the activity that immediately preceded the occurrence of the simplifying stimulus will recur in the future. In this case, the relevant activity would be performing, imagining, or listening to gong and skeletal-melody tones in a way that involves hearing pairs of tones as having inter-onset intervals of the same size.

Within this sea or bath of structural simplicity, the syncopated 2-beat inter-onset intervals are arguably counter-structural. Nonetheless, they tend overwhelmingly not to be random or capricious. Instead, they tend to highlight the out-of-phase 8-beat cycle by their lack of coincidence with it, so that they constitute an expressive counter-structural exception relative to the single cycle that is out-of-phase with the other, predominant cycles.

Finally, all these observations could be expressed in terms of Central Javanese notation and its attendant theory, i.e., in a 'top-down' manner that would accord decisive authority to indigenous concepts. Nevertheless, each is immediately accessible to perception and cognition if one attends to the skeletal-melody onsets relative to the gong-tone cycles. The gong-tone cycles are not only directly audible but also very prominent due to the contrasts of timbre and register they produce with the skeletal-melodies' *saron* tones.

In their own right, the skeletal melodies are quite prominent insofar as they are doubled, and even tripled, by simultaneous octaves among the *saron* instruments that produce them. If one compares their actual pitch-classes with the 64-beat gong-tone cycle, one regularity stands out: namely, that among all 135 *mérong*s, the first and last pitch classes of the 64-beat cycle are the same.

The first tone of a *mérong* is the last tone of the *buka* passage that introduces it. As well, the first pitch class of a *mérong* is the same as its last pitch class. Further, as a consequence of cyclical repetition, the identity of a *mérong*'s first pitch class and its last pitch class continues through all the repetitions of a *mérong*. As reported by Hardja Susilo via Mantle Hood, master musician Pak Cokro is reported to have said more than 50 years ago that when one creates an introductory *buka*, 'the majority of *buka*s are taken from the ending, the tail.'

The *buka*s are much shorter than the *mérong*s they introduce. In contrast to the *mérong* cycles' 64 beats, the *buka*s comprise as few as 13 and no more than 32. Whereas the last pitch class of a *buka* is always the same as the first and last of a *mérong* it introduces, the amount of repetition between the end of a *buka* and the end of its subsequent *mérong* can be much greater than a single pitch class, as illustrated in **Figure 10**. In fact, the number of beats at the end of a *buka* that are the same, in both pitch and rhythm, as those at the end of its *mérong* ranges from 1 to 22 beats, as shown in **Figure 11**.

Such precise identity of pitch and rhythm is directly connected to the *mérong*s' 64-beat cycle and enhances similarity between a *buka* introduction and its subsequent *mérong*. As such, it might lead one to regard each *buka* as what one would term, in quite another cultural setting, an introductory 'refrain' or 'rhyme.' How, then, are precise pitch-class and rhythm repetitions arranged throughout individual *mérong*s? And how long do they last?

Since no more than 7 pitch classes are distributed among 64 beats, several would necessarily appear more than once. Indeed, repetitions of a few successive tones that comprise the same pitch classes and the same onset rhythm would be quite probable. Accordingly, the next stage of the analysis focuses on the single longest successions of tones that comprise the same pitch classes in the same rhythm throughout each *mérong*.

Excluding *mérong*s in which there are two or more such longest successions, 118 *mérong*s (88%) contain a unique, longest succession of tones that comprise the same pitch classes in the same rhythm. **Figure 12** illustrates such a uniquely longest succession.

As it turns out, in each of these 118 *mérong*s, all the tones in such uniquely longest successions are repeated at a time interval that spans precisely 16 or 32 beats: a further indication of the importance of gong-tone cycling in the *mérong*s, in this instance the importance of the 16-beat *kenong* cycle.

Since the tones, or tone, at the very end of the *buka* are, or is, repeated at the very end of the *mérong*, and since both conclude at a gong tone in the 64-beat cycle, one might reasonably expect that precise repetitions within the *mérong*s would tend to conclude at a *kenong* tone of the 16-beat cycle, as in Figure 12. Indeed, this happens in many of the *mérong*s— but not all: specifically, 50 of the 118 *mérong*s in which there is a uniquely longest precise repetition of pitch classes and their rhythm.

In 50 of the remaining 68 *mérong*s, such repetitions extend beyond a particular *kenong* tone; that is, they 'wrap around' the 16-beat cycle that is the main framework for their Central Javanese cipher notation, as shown in **Figure 13**. As well, repetitions not only wrap around *kenong* tones but can also result in overlap, as **Figure 14** shows.

Whether the unique longest repetition concludes at or after a *kenong* tone, it might span more than 16 beats. Indeed, the number of beats in the unique longest repetitions ranges from 3 to 32 beats, and in 31 of the 118 *mérong*s (26%) they span more than 16 beats. Of these, 16 of the 50 uniquely longest repetitions that conclude on a *kenong* tone span more than 16 beats, so that they have already wrapped around a *kenong* tone before they conclude at a subsequent *kenong* tone. As a consequence, one can regard repetitions within a framework of continual, 16-beat cycling rather than a framework of discrete, discontinuous, 16-beat segments within which repetitions begin and end.

In a superficial reading of cipher notation, the two successions that constitute a repeated pair of successions begin at times that are 16, 32, or 48 beats apart, as displayed in **Figure 15**. However, since a *mérong* is immediately repeated several times, successions that begin 48 beats apart are also heard as beginning 16 beats apart. In other words, wrap-around cycling is relevant not only to a 16-beat *kenong* cycle, but also to a 64-beat gong cycle.

Relative to the four 16-beat spans, pairs of repeated successions that are 16 beats apart might begin in four ways: during the 1st and 2nd 16-beat spans, or during the 2nd and 3rd, or 3rd and 4th, or 4th and 1st. Successions that are 32 beats apart might begin in only two ways: during the 1st and 3rd or 2nd and 4th 16-beat spans. Accordingly, one would expect two-thirds of the repeated pairs to begin 16 beats apart and one-third to begin 32 beats apart; that is, 67% and 33%, respectively. Instead, 90% begin 16 beats apart.

Of the 90% that begin 16 beats apart, one would expect 25% to begin during each of the 1st, 2nd, 3rd, and 4th 16-beat *nongan*s. Instead, 75% begin during the 1st and 4th *nongan*s: 33% during the 1st, and 42% during the 4th. That so many begin during the 1st leads one to consider how it compares with the 4th concerning its relationship with the *buka*. In this regard, the end of fully 80 of the 1st *nongan*s are precisely identical in their rhythms and pitch classes with the end of the preceding *buka*. In short, the first and/or fourth *nongan*s tend to be a 'hinge' around which skeletal-melody repetitions rotate along a complex temporal helix.

Conclusion

What next? The analysis just presented provides hypotheses to be tested or adapted for all the other 16 kinds of gong cycles. In this regard, the next most frequent *mérong* cycles comprise 1 *gongan* that consists of 4 *nongan*s of 32 beats each, and 2 *gongan*s each comprising 4 *nongan*s of 16 beats each. Preliminary analysis of the latter shows that both *gongan*s are similar to the *gongan*s just discussed, and the second *gongan* is more similar than the first.

Also to be considered are the sections that follow the *mérong*s in the pelog *gendhing*s as well as the *mérong*s and other sections of the *sléndro gendhing*s.

Finally, there are varied repetitions and shorter repetitions within the skeletal melodies as well as the so-called 'treatments' of the skeletal melodies by other instruments in the gamelan ensembles: whether these treatments be products of improvisation or what in jazz of the 1920s would be termed 'head arrangements.'

FIGURES

Figure 1. Beats at which gong tones are heard in the most frequent kind of *mérong*'s 64-beat cycle.

G: Gong (largest)
KN: *Kenong* (second largest)
KT: *Kethuk* (smallest)

	1	5	13	17	21	29	33	37	45	49	53	61	[65]
‖:	**G**												**:‖ [G]**
‖:	**KN**			**KN**			**KN**			**KN**			**:‖ [KN]**
‖:		**KT**	**KT**		**KT**	**KT**		**KT**	**KT**		**KT**	**KT**	**:‖**

Figure 2. Circular model of gong tones in the most frequent kind of *mérong*.
Large square: Gong (largest) Circles: *Kenong* (second largest) Small squares: *Kethu*k (smallest)

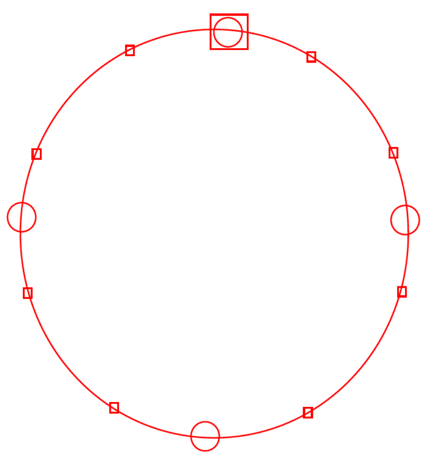

Figure 3. Sine curve model of gong tones in the most frequent kind of *mérong*.
Large square: gong (largest); circles: *kenong* (second largest); small squares: *kethuk* (smallest).
x-axis: time; y-axis: rotation (cf. Figure 2).

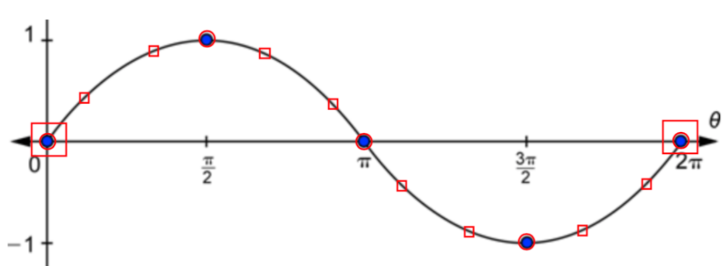

Figure 4. Number of *mérong*s in which skeletal-melody onsets coincide with specific beats of the 64-beat cycle.
x-axis: beats 1 to 65 in gong cycle; y-axis: number of *mérong*s (0 to 135).
Squares: gong tones; circles: *kenong* tones; triangles: *kethuk* tones.

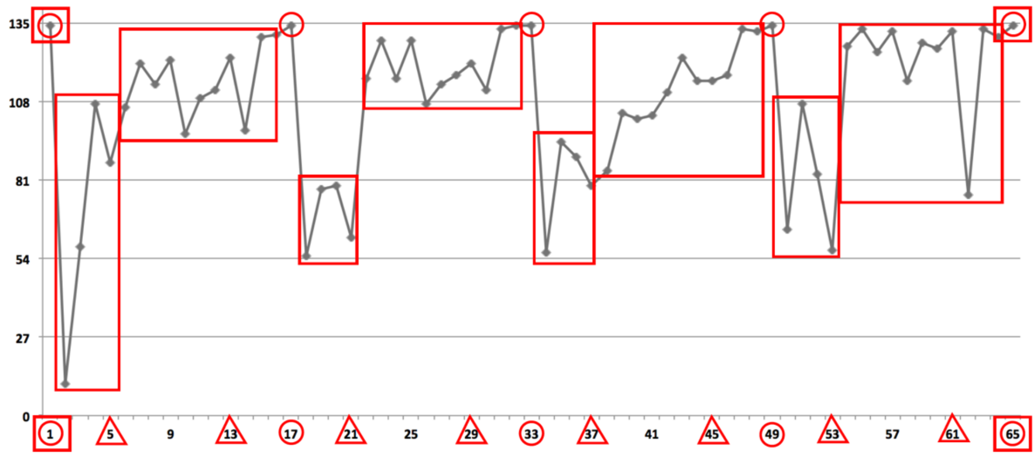

Figure 5. Initial 25 beats of the *mérong* of *Gendhing Layar Gènjong*.

Rectangles surround beats that do not coincide with the skeletal melody's onsets.
Arrows identify the inter-onset intervals that result from these gaps
(e.g., the 3-beat inter-onset interval between the onsets at beats 1 and 4).

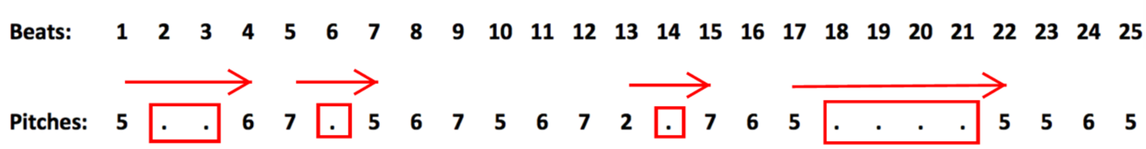

Figure 6. Number of *mérong*s (y-axis) in which a 4-beat inter-onset interval (IOI) begins at a particular beat (x-axis).
Circles and squares highlight 4-beat IOIs whose beginnings coincide with
the 16- and 64-beat cycles.

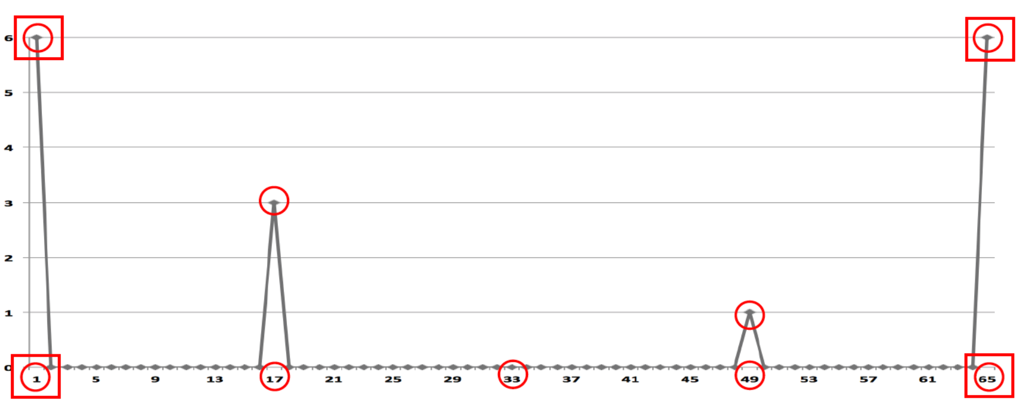

Figure 7. Number of *mérong*s (y-axis) in which a 3-beat inter-onset interval (IOI) begins at a particular beat (x-axis).
Circles and squares highlight 3-beat IOIs whose beginnings coincide with the 16- and 64-beat cycles.
Triangles highlight beats at the gaps in the 4-beat cycle that are 'implied' by the *kenong* and *kethuk* cycles.

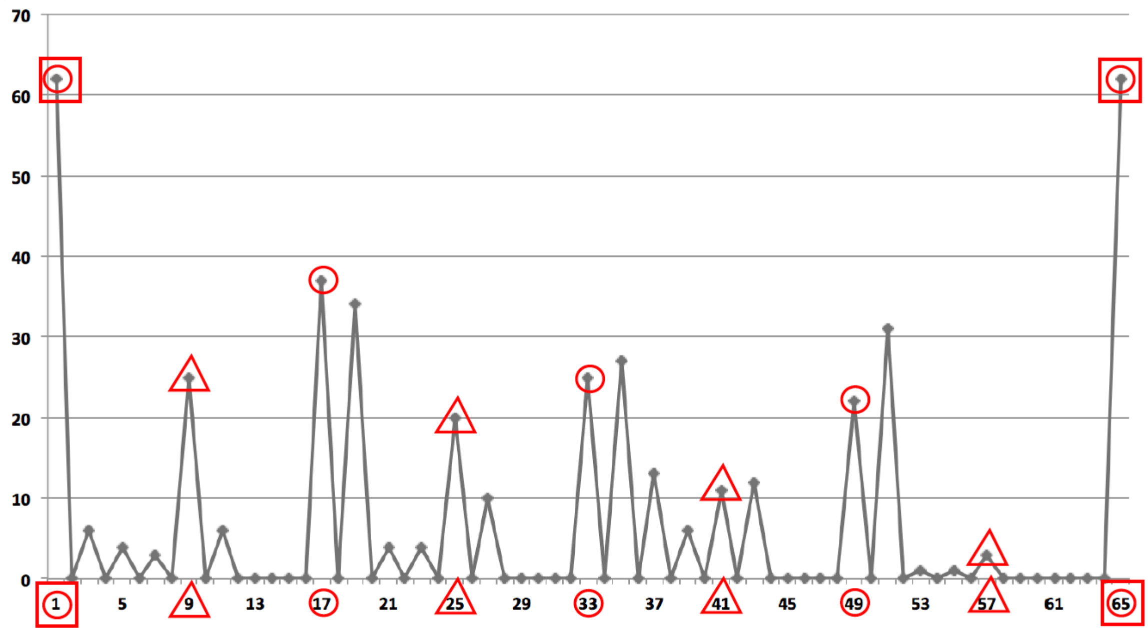

Figure 8. Number of *mérong*s (y-axis) in which a 5-beat inter-onset interval (IOI) begins at a particular beat (x-axis).
Large squares highlight 5-beat IOIs whose beginnings coincide with the 64-beat cycle.
Circles highlight 5-beat IOIs whose beginnings coincide with the 64- and 16-beat cycles.
Small squares highlight 5-beat IOIs whose beginnings coincide with the out-of-phase 8-beat cycle.

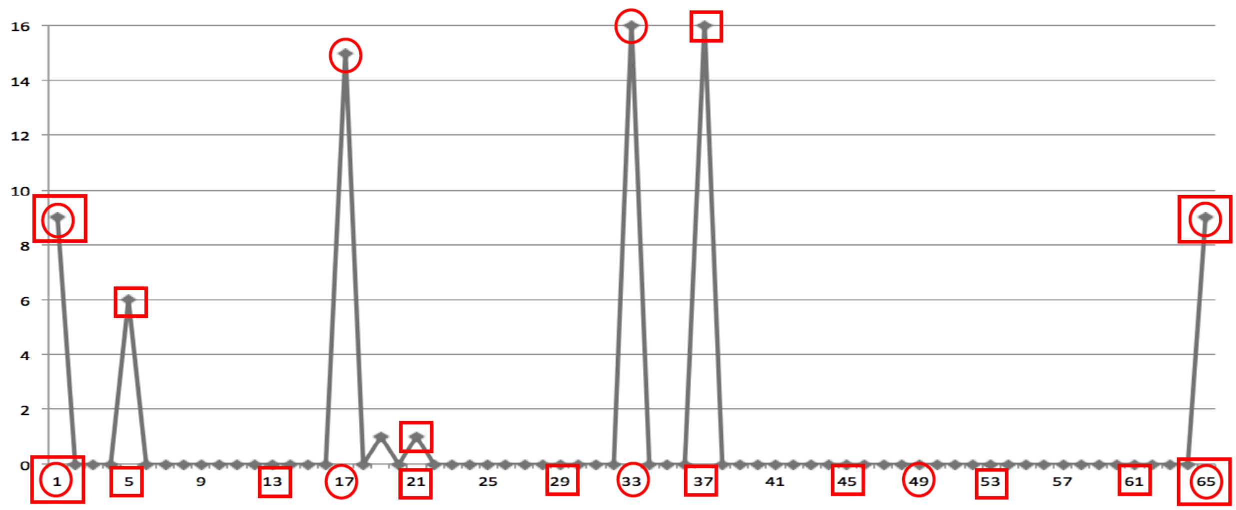

Figure 9. Number of *mérong*s (y-axis) in which a 2-beat inter-onset interval (IOI) begins at a particular beat (x-axis).
Circles and larger squares identify 2-beat IOIs whose beginnings coincide with the 16- and 64-beat cycles.
Smaller squares identify 2-beat IOIs whose beginnings coincide with the out-of-phase 8-beat cycle.
Triangles identify 2-beat IOIs that syncopate the 1st, 3rd, and 7th beats of the out-of-phase 8-beat cycle.

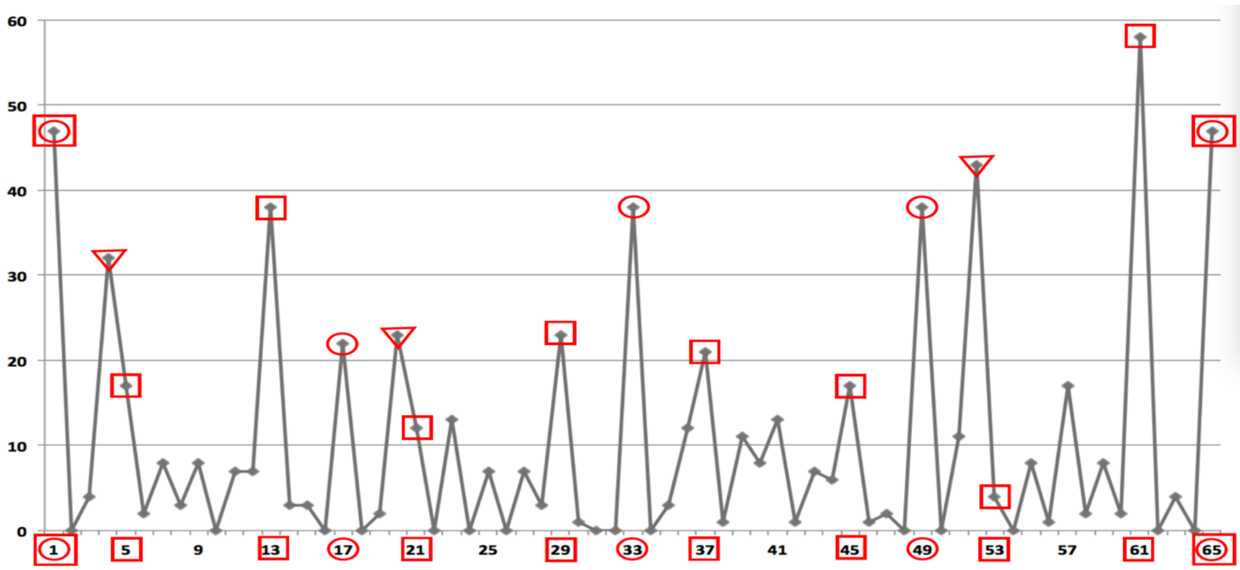

Figure 10. Final 12 beats of *buka* introduction identical in pitch and rhythm to the final 12 beats of the repeated *mérong* section.
In Central Javanese cipher notation, numerals designate onsets of pitch classes, and dots designate beats at which there is no onset.
As in previous Figures, circles indicate tones of the 16-beat *kenong* cycle and the square indicates a tone of the 64-beat gong cycle.

Buka:										5	·	6	·	5	3	2
	·	1	1	·	5	6	1	2	1	3	1	2	·	1	6	5
Mérong:	·	6	2	1	·	·	·	·	3	2	1	2	·	1	6	5
	2	2	·	·	2	2	1	2	3	3	·	·	1	2	3	2
	·	·	·	·	2	2	1	2	3	3	·	·	1	2	3	2
	1	1	·	·	5	6	1	2	1	3	1	2	·	1	6	5

Figure 11. Number of tones identical in pitch and rhythm at end of *buka* and at end of mérong in 135 *gendhing*s.
x-axis: number of identical tones; y-axis: number of *mérong*s.

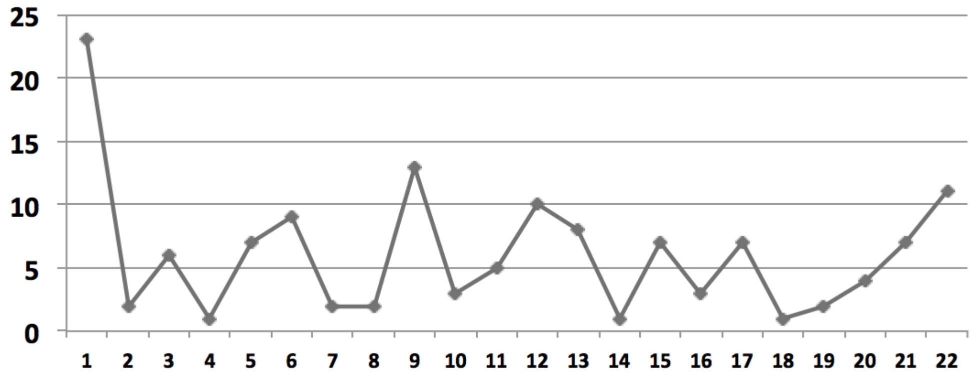

Figure 12. Longest succession of beats (specifically, 6 beats) repeated precisely within the *mérong* of *Gendhing Lipur Érang-Érang*.
As in previous Figures, circles indicate tones of the 16-beat *kenong* cycle and the square indicates a tone of the 64-beat gong cycle.
Note that the second iteration of the 6-beat succession 1 2 · 1 6 5 is precisely 16 beats after the first iteration.

·	6	5	·	5	6	1	2	1	3	1	2	·	1	6	5
1	1	·	·	1	1	2	1	3	2	1	2	·	1	6	5
·	·	5	·	5	5	·	6	1	2	1	6	5	3	1	2
6	6	·	·	6	5	3	2	1	1	3	2	·	1	6	5

Figure 13. Repeated successions that 'wrap around' *kenong* tones.
The repeated succession of 14 beats is highlighted in two colors to clarify the wrap-around structure.

·	6	5	·	5	6	1	2	3	1	2	·	5	3	2	1
·	2	1	6	5	6	1	2	3	1	2	·	5	3	2	1
·	2	3	5	·	·	·	·	5	5	6	·	4	5	6	5
·	3	3	2	5	3	2	1	5	6	1	2	·	1	6	5

Figure 14. Overlapping wrap-around successions.
The overlapping pair of 18-beat successions is highlighted in three colors to clarify how a wrap-around repetition can comprise an overlap of two successions.

·	·	5	6	1	1	2	1	3	2	1	2	·	1	6	5
2	2	·	·	2	3	2	1	3	2	1	2	·	1	6	5
2	2	·	·	2	3	2	1	·	1	1	1	2	3	2	1
3	3	·	·	3	5	3	2	3	3	1	2	·	1	6	5

Figure 15. Repetition pairs that begin at different time intervals.

a) 16 beats apart.

·	·	·	5	2	1	6	5	7	6	5	6	5	4	2	1
·	1	1	1	2	3	2	1	5	6	7	6	5	4	2	1
3	3	·	·	3	3	5	3	6	5	3	5	3	2	1	2
1	1	·	·	5	6	1	2	1	3	1	2	·	1	6	5

b) 32 beats apart, with 'wrap-around' extension.

·	3	5	2	·	3	5	2	5	6	5	3	2	7	6	7
·	3	·	2	·	7	6	5	·	·	5	6	7	2	3	2
3	5	·	·	5	5	·	·	5	5	6	5	3	5	6	7
·	3	·	2	·	7	6	5	7	6	5	6	3	5	3	2

c) '48' beats apart, i.e., 16 beats apart, with 'wrap-around' extension and overlapping.

·	·	3	2	5	3	2	1	·	3	1	2	3	5	2	3
·	·	3	2	5	3	2	1	·	3	1	2	3	5	6	5
·	·	·	·	5	5	·	6	7	6	5	6	5	3	2	3
1	2	3	·	5	3	2	1	·	3	1	2	3	5	2	3