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Implicit Register: Re-evaluating Pitch Height Perception in Central Javanese Gamelan Music

Introduction

Starting with Roger Shepard's (1964) sequences of computer-generated tones that appear to endlessly rise or fall, it has been convincingly demonstrated that perception of pitch height is malleable. In other words, the circularity of pitch – the fact that we hear the same note 'repeated' at the octave – can in some situations override our sense of actual vertical pitch relationships. While most convincing in artificial settings like those designed by Shepard, auditory illusions based on pitch circularity do appear in some forms of traditional music. Braus (1995) argues that pitch circularity as a compositional device has periodically fallen in and out of fashion in the West, having first appeared in 16th-century English keyboard music. More recently, Szczepanski (2015, 1) examines a genre of Buddhist ritual music in northern China that "makes use of staggered octave shifts" for "an octave-cycling effect." In a broader sense, the subjectivity of pitch height has important implications for the perception of register – whether a musical passage is heard as being higher or lower in overall height.

Despite other aspects of the music being explored in great detail, register in the context of Central Javanese gamelan remains an unresolved issue. Octave cycling or displacement certainly plays a role, but falls short as an explanation for a number of commonplace musical events. I argue that perception of register in the composite sound of the gamelan is both more complex but also more logically consistent than current theory suggests.

Implicit register

The idea that the *balungan*, the part played by one-octave instruments like saron, is a reduced form of an abstract multi-octave melody is not new. Some forms of early notation from the turn of the 20th century demonstrate an awareness of this (see Ishida 2010; Perlman 1991). The cipher notation commonly used today, called *notasi kepatihan*, adds dots above or below numbers to indicate tones outside of the central octave.¹ The conceptual range of the multi-octave *balungan* is as follows:

Slendro

$$\begin{array}{ccccccc} \underline{2} & \underline{3} & \underline{5} & \underline{6} & \underline{1} & \underline{2} & \underline{3} & \underline{5} & \underline{6} & \dot{1} & \dot{2} & \dot{3} & \dot{5} \\ \text{low} & & & & \text{middle} & & & & & \text{high} & & & \end{array}$$

Pelog

$$\begin{array}{ccccccccccc} \underline{1} & \underline{2} & \underline{3} & \underline{4} & \underline{5} & \underline{6} & \underline{7} & \underline{1} & \underline{2} & \underline{3} & \underline{4} & \underline{5} & \underline{6} & \underline{7} & \dot{1} & \dot{2} & \dot{3} & \dot{4} \\ \text{low} & & & & & & & \text{middle} & & & & & & & \text{high} & & & & \end{array}$$

It was first suggested by Sumarsam (1974) that the multi-octave *balungan* sometimes diverges from what is felt to be the ‘true’ melody of a composition. These divergences account for instances where the so-called elaborating instruments orient their patterns toward a goal tone (*sèlèh*) that differs from that indicated by the *balungan*. Sumarsam’s ‘inner melody’ was later generalized by Perlman (2004) as one of several ‘implicit melody concepts.’ Several, because they are based on conceptualization of musical structure from the individual musician’s point of view and are therefore somewhat subjective. It should be noted that while the implicit melody may be felt to diverge from the *balungan*, it is still conceptualized as existing within the same

¹ With minor differences, contemporary *notasi kepatihan* works on the same principle as the Galin-Paris-Cheve notation developed in 19th-century France.

two-and-a-half octave range.

These implicit melody concepts are useful in the sense that they help to explain some of the decisions musicians make in terms of selecting appropriate sequences of patterns. Where they are less useful is explaining how those decisions translate into meaningful sonic differences from the listener's perspective, particularly with regard to perception of register. I will call perception of the gamelan's composite sound as being low, middle, or high 'implicit register.' It is implicit because it entails reducing the composite sound – which at any given moment is likely to span four or five octaves – to the two-and-a-half octave range of the implicit melody. As Hastanto (1985, 20) elaborates, “although the gamelan covers a range of about six octaves, the Javanese think only of relative octave positions, and this in terms of individual instruments. Thus it is never necessary to distinguish more than three octaves.” In other words, whether a tone played by a particular instrument is considered low, middle, or high depends on where that tone is situated within that instrument's physical range; not on its actual frequency. Essentially only two instruments – rebab and gambang – have large enough physical ranges to fully realize the implicit melody.² To varying degrees, other instruments must displace certain notes up or down an octave to bring them within available range.

It would be simple to account for perception of implicit register if every instrument traced the same melodic path in parallel, performing brief octave displacements as needed. This however does not characterize the polyphonic texture of the music, nor would such a reductive system of melodic organization be desirable from an aesthetic standpoint. Firstly, it would not be acceptable for elaborating instruments to displace individual notes in the middle of a phrase. Such leaping is only employed on the one-octave balungan instruments. Instead, the entire

² The gambang in fact has a much larger range, but because it is played in parallel octaves, the effective range is similar to that of the rebab. The suling flute has a large range as well, but in practice its lowest notes are rarely used.

phrase will be displaced, or some other pattern or technique will be substituted in.³ Secondly, the elaborating instruments must create smooth transitions between phrases. If a phrase is displaced or substituted, it can affect how the phrases preceding or following it are rendered. Thirdly, phrases can be ambiguous in the way they imply register. This is especially true for instruments that play two-part patterns, like the *gendèr*. For example, the *gendèr* will use different patterns for implying motion to $\dot{1}$ versus 1:⁴

If to $\dot{1}$	If to 1
RH: $\dot{2}\dot{3}\dot{2}$. $\dot{2}\dot{3}\dot{2}\dot{1}$ 656 $\dot{2}$. $\dot{1}\dot{2}\dot{1}$	RH: 565. 5653 6563 656 $\dot{1}$
LH: .. $\dot{6}\dot{1}$ 2523 212. 321.	LH: .. $\dot{6}\dot{1}$ 212 $\dot{6}$. $\dot{5}\dot{3}\dot{5}$ $\dot{6}\dot{2}\dot{3}\dot{1}$

– but then use the same pattern for motion to either $\dot{3}$ or 3:

If to $\dot{3}$ or 3
RH: $\dot{2}\dot{3}\dot{2}$. $\dot{2}\dot{3}\dot{2}\dot{6}$ $\dot{2}\dot{1}\dot{2}$. $\dot{2}\dot{3}\dot{2}\dot{1}$
LH: ..23 535. ..65 3523

Furthermore, the *gendèr* may choose a higher or lower *sèlèh* tone for the same implied motion because of modal considerations:⁵

If to 2 in <i>pathet manyura</i> context	If to 2 in <i>pathet nem</i> context
RH: $\dot{1}\dot{2}\dot{1}$. $\dot{1}\dot{2}\dot{1}\dot{3}$ $\dot{1}\dot{2}\dot{1}\dot{3}$ $\dot{1}\dot{2}\dot{1}\dot{6}$	RH: 3536 3532 1213 1232
LH: ..12 312 $\dot{6}$. $\dot{1}\dot{6}\dot{1}$ 2312	LH: . $\dot{3}$. $\dot{6}$ $\dot{1}\dot{6}\dot{1}\dot{5}$ $\dot{3}\dot{2}\dot{3}$. $\dot{5}\dot{3}\dot{2}$.

³ See discussion in Sutton (1991, 55) about the *bonang*'s approach to register.

⁴ The *gender* patterns or *céngkok* notated here are intentionally very simple for ease of presentation. In practice, the *gendèr* player would spontaneously vary their *céngkok* through syncopation, passing tones, etc.

⁵ See Mcdermott and Sumarsam's "Central Javanese Music: The Patet of Laras Slendro and the Gender Barung" (1975).

I limit my analysis to three instruments: rebab, gendèr, and bonang. The rebab's treatment of register is roughly comparable to that of gambang, suling, and voice. The gendèr is representative of other instruments that play 2-part *céngkok* – formulaic patterns that fill-in the space between *sèlèh*. These include gendèr penerus (like gendèr but one octave higher), siter, and cèlèmpung. Lastly, the bonang has been described as a mediator between the balungan and elaborating instruments (Sumarsam 2002, 6-7). The following figure⁶ details the physical ranges of these instruments and how their tones are conceived of with regard to register.

pitch class	OCTAVE																								
	II			III				IV				V				VI			VII						
	3	5	6	1	2	3	5	6	1	2	3	5	6	1	2	3	5	6	1	2	3	5	6	1	2
BALUNGAN INSTRUMENTS																									
Slenthem			6̣	1	2	3	5	6	ī																
Demung								6̣	1	2	3	5	6	ī											
Saron												6̣	1	2	3	5	6	ī							
Peking																6̣	1	2	3	5	6	ī			
ELABORATING INSTRUMENTS																									
Gender barung			6̣	1̣	2̣	3̣	5̣	6̣	1	2	3	5	6	ī	2̣	3̣									
Bonang barung									1̣	2̣	3̣	5̣	6̣	1	2	3	5	6	ī	2̣					
Rebab				2̣	3̣	5̣	6̣	1	2	3	5	6	ī	2̣	3̣										

Melodic aporia and indeterminate register

There occur situations where the implicit melody will quickly shift an octave upward over a descending balungan phrase. This is most obvious during transitions to a *ngelik* – a section that starts in a high register – but can occur virtually anywhere in the middle of a section as well. Take for instance the popular composition Ladrang Wilujeng. If returning to the

⁶ This figure assumes the slendro tuning system. For pelog, the principle is essentially the same, just with seven tones per octave instead of five. Similar figures appear in Hastanto (2009) and Sumarsam (1974). Tone 1 in octave IV is approximately the same frequency as C4.

beginning of the first section (A), the implicit register will be low as the motion of the balungan indicates; if proceeding to the ngelik section (B), the implicit register will be treated as ascending toward gong.

Balungan: 2 7̣ 2 3 2 7̣ 5 ⑥

 Rebab (A): 2 3 7̣ 2 2 3 3 7̣27̣ 2 7̣ .62 7̣ 6

Rebab (B): 2 3 7̣ 2 3 56676 577 676 6

 Bonang (A): 272 . . 72 . 232 . . 32 . 27 . 557 . . 575 . 67 . 6

Bonang (B):⁷ 272 . . 72 . 232 . . 32 . 27668 . . 8 . . 8 . .

 Gendèr (A): 2̣7̣2̣6̣2̣3̣2̣7̣5 . 7 . 6 . 676565656756575676

.72 . 6567 . 3 . 7 . 23 . . . 327267 . 5356726

Gendèr (B): 2̣7̣2̣6̣2̣3̣2̣7̣5 . 7 . 6 . 67 . 6 . 75672̣3̣ . 2̣3̣ . 2̣7̣6

.72 . 6567 . 3 . 7 . 23 . 726323723 . 23 . 276

Perlman (2004, 215) has given the name ‘melodic aporia’ to situations like the above, where the balungan “displays paradoxical motion” relative to the implicit melody. It is always the case that the former moves downward, and the latter upward; the opposite never occurs. There are yet other situations where the balungan will *nggantung* (literally, hang) on a single tone while the implicit register shifts upward. Some examples of this can be found in Gendhing Raranjala. The first two lines of the *mérong*⁸ section start in the same manner:

. 2 1 . 2 1 6̣ 5̣ 5̣ 5̣ . 6̣ etc.

⁷ Slashed ciphers indicate playing in octaves.

⁸ The *mérong* is the opening section of a larger composition and typically starts low in register. Smaller compositions may have a functionally similar section called *ompak*.

The third line of the *mérong* also starts off similarly. However, by the fourth *gatra*,⁹ the implicit register must already have ascended to 5 in preparation for the second half of the line, which is all in a higher register. As far as the rebab is concerned, there are two options. The first (A) is to shift upward over the descending 2165 *gatra*. The second (B) is to complete the 2165 *gatra* as written and then shift upward over the subsequent rests. The *nggantung* pattern played by both *bonang* and *gendèr* is ambiguous; it could represent either 5 or 5.¹⁰

Balungan:	2 1 6 5
Rebab (A):	$\overline{\overline{612}} \quad \overline{\overline{45.5.}} \quad \overline{\overline{55.5.}} \quad \overline{\overline{55.5.}} \quad \overline{\overline{5.5.}} \quad \overline{\overline{55.5}}$
Rebab (B):	$\overline{\overline{6}} \quad \overline{\overline{1}} \quad \overline{\overline{2}} \quad \overline{\overline{1}} \quad \overline{\overline{6}} \quad \overline{\overline{565}} \quad 2 \quad \overline{\overline{4.5.}} \quad \overline{\overline{55.5}}$
Bonang:	212..12.6155 5 .. 5 .. 5 .. 5 .. 5 .. 5 ..
Gendèr:	3232353635363565..65..65..65..65 65356352.3235615.....55.....55..

Yet another example from *Gendhing Raranjala* is located toward the end of the *inggah* section where the following *balungan* passage occurs:

5 6 7 6 5 4 2 1 6 6 . . 6 4 6 5 etc.

⁹ *Gatra* refers to a four-beat grouping of the *balungan*. Most compositional forms can be defined in terms of the number of *gatra* per large *gong*, ranging from four to sixty-four.

¹⁰ When approaching *nggantung* passages, some *bonang* players differentiate between *nduduk gembyangan* – a rolling triplet pattern played in octaves, and *nduduk tunggal* – the same pattern, but with the upper octave omitted. The latter suggests a low implicit register. However, other players will not use *nduduk tunggal* at all, or only in certain contexts. For instance, one of my teachers in Java felt that *nduduk tunggal* is only for *gendhing bonang*, compositions performed without vocals or any of the soft-sounding instruments. For this reason, it is not a reliable indicator.

After descending to 1, does the balungan indeed suddenly leap up to 6 as the notation implies? Or is 6 in fact the conclusion of a descending line, and therefore low? The sheer downward momentum of the phrase would seem to suggest the latter. However, the implicit register of the subsequent 6465 gatra is unquestionable; it can only be high because afterward, the balungan descends stepwise to 1 on gong. Therefore an upward shift in implicit register must occur somewhere between 5421 and 6465.

Balungan:	5 4 2 1 6 6 . .
Rebab:	$\overline{5 \ 6} \ \overline{4 \ 542} \ \overline{5 \ 6} \ \overline{. \ 6} \ \overline{6 \ .6} \ \overline{6 \ 6} \ \overline{.6}$
Bonang:	545..45.212..12.♭..♭..♭..♭..♭..♭
Gendèr:	5.5635656i626i656.i6..i6..i6..i6 .12..615.6161231.6..66.....66..

Once again, the gendèr and bonang are ambiguous with regard to implicit register. It can be seen that the rebab descends as if heading toward 1, but then slides upward to 6 at the last moment. This type of slide – called *plèsèdan* – is commonly used when the end of a gatra is immediately followed by a *nggantung* passage on a different tone (Brinner 1993, 237). If the rebab did in fact descend to 6, it would then still have climb to 6 in preparation for the subsequent 6465 gatra, and then in an even shorter timeframe. Understanding the nature of rebab playing to be anticipatory (Sumarsam 1974, 258–9), the *plèsèdan* to 6 cannot be taken as definitive proof that the ‘correct’ reading of the balungan entails such an upward leap. Rather, it could be that the balungan as originally conceived does descend to 6, but is commonly notated otherwise to indicate that the rebab and other instruments need to slide up in that moment (Sutton 1991, 55).

Returning to the term melodic aporia; the implication is that such events are exceptional, and therefore not necessary to account for. In reality, these events are so commonplace and integral to the compositional language that they cannot be dismissed. I argue that they are not inherently paradoxical, just paradoxical within the confines of conventional theoretical and notational practices. As it currently stands, every moment of the balungan and implicit melody is understood to have one and only one register designation. A passage being realized in the high register precludes it from also being realized in the middle register, et cetera. But what if in addition to implicit register being low, middle, or high, it could also be a composite low-middle or middle-high? I believe this describes what occurs in the previous example from Gendhing Raranjala. The implicit melody is simultaneously heading to $\underset{\cdot}{6}$ and $\underset{\cdot}{6}$. We the listener hear the actual upward motion of the rebab while at the same time hear the implied downward motion of the balungan. A brief moment of ambiguity follows; then clarity as the feeling of $\underset{\cdot}{6}$ comes to dominate.

I claim that these moments of indeterminate register are not an oversight, but an intentional compositional device completely in keeping with the broader aesthetic of the music. Much in the same way that moments of modal ambiguity smooth over modulation between *pathet* (see McDermott & Sumarsam 1975), or moments of temporal ambiguity smooth over shifts in *irama*,¹¹ moments of indeterminate register smooth over large melodic leaps that would otherwise be jarring. If this is in fact the situation, it is unfortunate that the current notational system is incapable of conveying it. In addition to dots placed above or below ciphers to indicate upper and lower implicit registers, other symbols would need to be incorporated for indicating moments of indeterminate register.

¹¹ Commonly translated as 'density level,' *irama* describes how each beat of the balungan is rhythmically subdivided by elaborating instruments.

A chicken-and-egg problem

Is register a ‘built-in,’ unchanging aspect of a composed balungan that instructs the elaborating instruments? Or is it an impression that emerges from the elaborating instruments’ interpretation of the balungan? The likely answer is, both. It should be noted that composing a balungan is not a singular process. In some cases, it really does seem that the balungan was composed in full as a complete melody unto itself. In other cases, the balungan is composed around or in imitation of an existing vocal melody (Sumarsam 1995, 164). On a more subtle level, the balungan may be modified to better complement (or contrast with) the implicit melody as felt by players of elaborating instruments, or in response to conventions of tuning and mode. For example, the balungan of pieces originally composed in slendro often undergo changes when performed in pelog (Supanggah 2009, 51).

Some instances of ‘paradoxical’ balungan can be explained by the borrowing of characteristic phrases. Take for example the first section of Ladrang Lagu:

6̣.5̣6̣3̣ 6̣.5̣6̣3̣ 6̣.5̣6̣3̣ .2.1 .2.3 .2.1 3216̣ .5̣.3̣

Between the third and fourth gatra, there is a seemingly abrupt leap from 3̣ to 2. There are reasons to interpret low register repeating patterns like 6̣.5̣6̣3̣ as an imitation of older forms of gamelan (Sumarsam 1995, 216) which have a limited melodic range and no sense of register. Notating it as low indicates that the bonang player is to use their lower rack of kettle gongs, thereby creating a heavier and more archaic sound. This somewhat resembles bonang playing in gamelan sekaten,¹² a ritual music featuring extremely large, low-tuned instruments. In gamelan sekaten, the bonang melody is limited to the lower rack (that is, a range of one octave), while the

¹² Gamelan sekaten is performed within the royal courts of Surakarta and Jogjakarta to commemorate the birth of the prophet Muhammad. While it is not quite clear when gamelan sekaten was developed, it certainly predates what is understood to be modern-era musical practice.

upper rack is played by a second musician and serves a quite different role. It is also interesting to note that one of the compositions in the small gamelan sekaten repertoire goes by the same name – Lagu – although musically speaking, the two have little resemblance. Considering these points, it may be fair to treat the implied register of 6̣5̣6̣3̣ as essentially indeterminate, as the archaic musical forms it is referencing do not recognize differences in register.

Finally, I bring attention to Ketawang Gendhing Alas Padhang, which contains two identical sections save for momentary differences in register. The composition opens with the following balungan:

5̣2̣3̣. 6̣5̣3̣2̣ 5653 216̣5̣ 11.. 3216̣ 2321 6̣5̣2̣(3)

After a middle section, the same balungan is repeated but with the first two gatra treated as being middle register:

523. 6532 5653 216̣5̣ 11.. 3216̣ 2321 6̣5̣2̣(3)

This second iteration is far more parsimonious with regard to melodic motion as it avoids the large leap from 2̣ to 5̣. In terms of the elaborating instruments, the two phrases are rendered the same on the gendèr, but differently on the rebab and bonang. Referencing transcriptions of rebab playing written during the British occupation of Java in 1811–1814, Brinner suggests that “the choice of register in pieces today may differ from past practice” (1993, 244). The opening section of Ketawang Gendhing Alas Padhang may in fact be a later addition, created by manipulating the register of an existing section. What may have originally been a two-section piece in the form –

A 523. 6532 5653 2165̣ 11.. 3216̣ 2321 652̣(3)

B 66.. 6656 356i̇ 6535 i̇i.. 3̇2i̇6 2̇3̇2i̇ 652̣(3)

Eventually became a three-section piece in the form –

A' 5̣2̣3̣. 6̣5̣3̣2̣ 5653 2165̣ 11.. 3216̣ 2321 652̣(3)

B 66.. 6656 356i̇ 6535 i̇i.. 3̇2i̇6 2̇3̇2i̇ 652̣(3)

A 523. 6532 5653 2165̣ 11.. 3216̣ 2321 652̣(3)

In the first, there cannot be said to be a proper ngelik section; while B does reach the upper register, it starts off in the same region as A. Contrasted against A' however, B functions as a ngelik because of the difference in implicit register between the beginnings of the two sections. The original A then becomes the second half of the new ngelik section. As to why musicians in the past felt that Ketawang Gendhing Alas Padhang needed clearly demarcated mérong and ngelik sections, I can only speculate. Perhaps it was just a desire for greater variety and complexity. There is evidence that other compositions originally lacking a ngelik section were later given one (see Martopangrawit's comment about Gendhing Gambirsawit, in Posnett 1990, 266), although not necessarily by the process described above.

Conclusion

In this paper, I argue that existing conceptions of melodic motion in Central Javanese gamelan are insufficient for explaining register, both as a perceptual phenomenon and as an important element of the compositional language. In particular, I discuss why it may be fruitful to allow for the possibility of indeterminate register, as well as offer ways of conceptualizing melodic motions in the balungan that appear incongruous or paradoxical through the lens of current theoretical and notational practices.

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Appendix

Full balungan notation of referenced compositions:

1. Ladrang Wilujeng, laras pelog pathet barang

<i>Ompak</i>	<i>Ngelik</i>
2723 2756	..6. 7576
33.. 6532	3567 6532
5653 2756	66.. 7576
2723 2756	7732 .756

2. Gendhing Raranjala, laras pelog pathet lima

Mérong

.21. 2165 55.6 11.. 11.2 3323 2121
 .21. 2165 55.6 11.. 11.2 3323 2121
 .21. 2165 55.6 11.2 3216 5424 5645
 55.. 5456 5424 .24. 4565 21.5 6121

Inggah

.241 .245 4645 .421
 .241 .245 4645 .421
 22.. 22.4 5676 5421
 66.. 6465 4245 4241

3. Ladrang Lagu, laras slendro pathet manyura

<i>Ompak</i>	<i>Ngelik (A)</i>	<i>Ngelik (B)</i>
6̣5̣6̣3̣ 6̣5̣6̣3̣	i̇i̇.. i̇i̇2̇i̇	6535 3231
6̣5̣6̣3̣ .2̣.1̣	3̇2̇6̇5̇ 356i̇	55.6 5323
.2̣.3̣ .2̣.1̣	3̇2̇6̇5̇ 3565	6535 3231
3216̣ .5̣.3̣	i̇2̇i̇6̇ 5323̣	3216̣ .5̣.3̣

4. Ketawang Gendhing Alas Padhang

<i>Mérong</i>	<i>Ngelik (A)</i>
5̣2̣3̣. 6̣5̣3̣2̣ 5653 216̣5̣	66.. 6656 356i̇ 6535
11.. 3216̣ 2321 6̣5̣2̣3̣	i̇i̇.. 3̇2̇i̇6̇ 2̇3̇2̇i̇ 6523̣
<i>Ngelik (B)</i>	
523. 6532 5653 2165	
11.. 3216̣ 2321 6̣5̣2̣3̣	