Investigating ornamentation in Malay traditional, *Asli* Music.

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Abstract: - Singing voices are consist of frequency related to musical pitch. Singing Malay *asli* music requires the singer to perform ornamentation or known as *patah lagu* at every central notes (or any suitable longer notes) and end of a cadence. However, *patah lagu* is not indicated in *asli* music, *Seri Mersing*, thus every performer has different styles of improvising the *patah lagu*. *Patah lagu* carries identity to *asli* music and without it, the song will sound dreary and dull. This paper reveals *patah lagu* in singing *Seri Mersing*, a popular *asli* music in Malaysia. In this study, fundamental frequency (F0) of four singing voices (sustain vowels) were extracted using Matlab STRAIGHT to reveal *patah lagu* from pitch contour. The study found that there are an average of 79% use of *patah lagu* in the song and the pitch contours reveal dissimilarity in pattern and duration. The variation of pitch pattern in a sustain vowel significantly relates to the use of natural vibrato and ornamentation in singing. This research can be extended for music composition and singing synthesis application.

Key-words:- ornamentation, *patah lagu*, STRAIGHT, Malay *asli* music, pitch contour

1 Introduction

Singing a classical or a traditonal song is not an easy task without prior knowledge and proper understanding of the song. Many variables can be found in any musical composition such as tempo, dynamics, instrumentation, and ornamentation. But most of the time composers and performers did not expect musical notation to convey every detail in a work. Thus all performers are expected to add embellishments and alter the rhythms in appropriate places [5]. Notated ornaments indications may vary widely from country to country and from one composer to another. According to Elliot [5], the relationship of text and music, pitch, instruments and ornamentation in the seventeenth century were practiced differently in different geographical areas. Although the indication and practice of ornamentation may have been done differently, its presence however, is very important in Malay *asli* music.

Asli music is a famous syncretic Malay traditional music in Malaysia, developed during the post-Portuguese period (in 16th century). It is based on diatonic scale, which combines elements from local traditional Malay and foreign musical instruments and influenced by Islamic songs and tunes from quranic reading [7]. The word *asli* in musical perspective refers to a form of traditional music with its own singing and drumming styles [9]. There are many a*sli* music produced differently in many regions in Malaysia and they represent unique sense of aesthetics and culture. The uniqueness of these genres is in the composition style, to creatively reflect the specific ethnic groups of multiracial Malaysian society. It is normally played in slow tempo, 60 BPM, and the singing is often accompanied by violin, accordion, *rabana* and *gong*, and some with flute, oud, guitar and harmonium [7],[9]. Some examples of songs composed in *asli* music are such as *Bunga Tanjung, Tudung Periok, Mas Merah* and *Seri Mersing*. Most of the songs lyrics are originated from *Pantun* (i.e. poems) which is written in Malay. *Pantun* is considered as the Malays' most unique cultural heritage.

Singing of *asli* music involves traditional melodic ornamentation or *patah lagu. Patah lagu* (also known as *lenggok, bunga melodi, penyedap lagu* in Malay) is a form of ornamentation and widely used in most of *asli* music. The presence of *patah lagu* in *asli* music is very important; without it, a song will sound dreary and dull [9]. However, there is almost absence of documentation on the ornamentation part in performing these ensembles.

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This is because *asli* music were created based on play and memorize by native musician according to feel and taste [9]. The music was then rewritten by later musician but focusing only on the melody. Thus today, variation in rendition by different performers on a same song can be observed, especially in performing and improvising the *patah lagu*. With these limitation, student learning a*sli* music now and in the next generation, is left with no alternative but to find practical instruction and guidance from a Malay *asli* connoisseurs to pursue his personal singing development. This is especially crucial as the number of connoisseurs has dropped to almost none.

Based on the above mentioned problem, this paper is intended to reveal *patah lagu* performed by four singers in singing a popular *asli* music, *Seri Mersing* by using pitch extraction technique, STRAIGHT [6]. This study is essential to investigate pitch contour of *patah lagu* in the song which reflects the frequency changes performed by different singers, for the same composition and lyrics. This study is also important to document the pitch changes of *patah lagu* for singing synthesis.

The study discusses and introduce *patah lagu* in Malay singing focusing in Malaysian traditional, *asli* music. Section 2 is a brief discussion on vibrato, and *patah lagu* in Malay singing particularly in *asli* music and some reviews on previous methods used in pitch extraction will be discussed in Section 3. The method used in this research will be discussed in Section 4. Analysis of vibrato and *patah lagu* observed in the rendition of *Seri Mersing* by four singers will be discussed in section 5. Section 6 is a brief conclusion.

2 Vibrato, Ornamentation and *Patah Lagu*

Vibrato and ornamentation are two different terms used in singing. *Patah lagu* is another term used to describe ornamentation in Malay *asli* music singing.

Vibrato is a fundamental attribute of artistically effective singing voice, that present as a natural part in every healthy singing [8],[14]. Technically, vibrato is a pulsation of pitch with the accompaniment of synchronous pulsations of loudness and tone (timbre), to certain extent and rate as to give a pleasing flexibility, tenderness, and richness to the tone [16]. Elliot [5] distinguished the importance between a note that is affected by an intensity fluctuation caused by slight change in air pressure which results in narrow vibrato, and a note whose actual pitch is altered by a specific ornament. The intensity of a vibrato is usually small, does not alter the pitch of a note to a discernible degree [5]. It is observable about one-third of the time, seldom present at the beginning of a tone or in transitions [16]. The rate of the vibrato cycles averages about 6.5 pulsations per second, with the periodic oscillation of voice fundamental frequency (F0) at a rate of 5-8 *Hz*, the average rate

Ornamentation in music is a decoration used to embellish a song, performed as fast notes around a central note or any longer notes. It works by modifying an individual pitch into a pattern or variation of pitch in the note. The amount of ornamentation in a musical composition can vary from quite extensive to rather little or even none. In western music, ornamentation has been introduced in the seventeenth century. Standard ornaments based on western music are such as trills, appogiatura, acciacatura, glissando, mordent, and turn. These ornamentations are normally indicated by composer with standard symbols in music notation, but sometimes different ornaments can refer to an ornament from a specific area or period. Elliot [5] presents the historical information about vocal performance practice in different countries, vibrato and ornamentation from the early baroque through the twentieth century. Cultural, political issues as well as folk heritage may also contribute to the distinctive musical flavor between countries including Malaysian and Indian music.

The presence of ornamentation is not only important to western music but to all Indian music. Hindustani and Carnatic music in India are considered as two distinct musical areas with differences in nomenclature, style and grammar. There are heavier emphasis of singing ornamentation in Hisdustani than in Carnatic music [3]. Gamak, Taan, and Meend are some of the ornaments used in Indian music. These ornaments may have different names but some may still refer to the same ornamentation type as in the western. For example, Meend refers to a glide in western music. Andolan is another Indian ornament, perform in a gentle oscillation around a note, touching the periphery of an adjacent note as well as shrutis in between for Indian classical Raga. Radhakrishnan and Scherer [13] studied “Taan” gestures in Hisdustani classical singing and revealed that unlike vibrato, the assymmetric frequency modulation in ornamentation of “Taan” seems to be controlled voluntarily, and there are variation in the rate of pitch change.

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Patah lagu in Malay *asli* music is a unique type of ornamentation, that is turns, mellismetic rendering, embellishing the longer notes with new ideas and accent at the end of a phrase or cadence [9]. All *asli* music should be sung with *patah lagu*, even though the details of the *patah lagu* is not properly written or described in the score. This is especially challenging to new singers to perform and sing correctly, to ensure that the piece works both vocally and dramatically. Musicians normally listens to previous performance piece and depend on rote learning and playing from memory, although there is a lot of musicians today who use western notation when teaching and performing [9]. Thus this will cause various singing styles depending on mood, feel or taste of a singer to express the song even by some veteran singers. However, the originality of the *patah lagu* should be preserved to maintain its tradition and identity when performing *asli* music especially for the younger generations.

3 Previous research/methods

Some of the traditional methods used by musicians to identify pitch changes in music and singing voices particularly are based on pure tone pitches, manual annotation and measuring the pitch to a keyboard sound. This method however, is tedious and time consuming, especially on singing voices with rapid pitch changes, such in *patah lagu*. Schoen [14] however, has investigated pitch changes in singing using Seashore tonoscope, an instrument that visualizes the singing voice so an observer may tell whether an error is involved in the tone production. With technology advancement, current technique such as the automatic pitch detection/extraction for musical note detection and speech analysis is developed and researched.

Akagi [1] introduced and discussed the importance of fluctuations in pitch contours by analysing pitch fluctuations in singing voices and sustained vowels and how they influence the quality and naturalness of singing voices. The pitch were extracted using TEMPO in STRAIGHT, developed by Kawahara, et al. [6]. STRAIGHT which runs on Matlab, is a high-quality system for speech analysis, modification and synthesis based on source filter model which could accurately extract fluctuations in pitch contours [1].

Investigation on vibrato rate and singer's pitch change pattern has been done by Ferrente [4], Prame [10], [11], and Scherer [13]. Ferrante [4], reported that the vibrato rates in modern singing today has gone smaller than 5 Hz. The study was conducted using MATLAB scripts. Prame [10] found that vibrato rate typically increased at the end of each tone, and the mean rate across singers was 6.0 Hz. The study was measured using sonogram. Prame [11] had also examined pitch changes in singing voices using time spectrograms. Scherer [13] studied F0 rate of change for various speech and singing voices. However, the method was not discussed in the paper.

Arora, *et al*. [2] investigated vocal performance in Indian Classical Raga using PRAAT speech processing system. The researchers presented pitch contour shaping methods to improve the naturalness of the synthesized singing voice using a fixed parameter second order filter and an adaptive recursive filter to generate fundamental frequency contour. This research focused only on Indian Classical singing voice.

4 Method

Fig. 1 overviews the overall experiment process. This experimentation involves data acquisition from recording of singing voices, preprocessing of the singing voices data, pitch feature extraction, conversion of frequency to musical interval (semitone), musical notes conversions, and time (ms) to beat conversion. The results from this experiment were reviewed and confirmed by professional musicians.

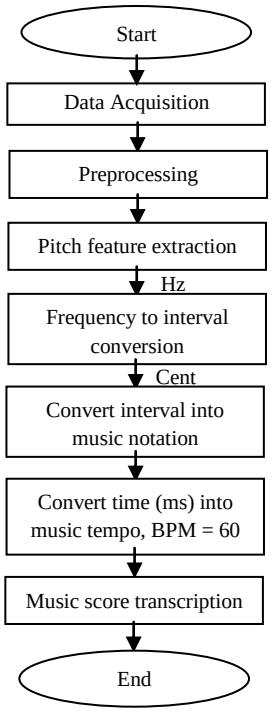

Fig. 1: Flow diagram of the experiment process.

4.1 Data Acquisiton

This experiment takes as input *patah lagu* from four singing voices. Recording of the singing voices was done in a studio, with a microphone distance of 20cm directly in front of the singer's mouth. The singing voices data was obtained from two amateur and two professional (connoisseurs) singers, both male and female age 84 and 48 years old, respectively. Amateur singers are singers age 20-25 years old, undergoing vocal training majoring in *asli* music with supervision from *asli* music connoisseurs. Each singer was asked to sing Malay *asli* music, *Seri Mersing* using same *pantun* with individual *patah lagu* improvising style. The singers were given a headphone to listen to the melody of *Seri Mersing* with a 60 BPM tempo. This is to ensure tempo and pitch consistency in singing by all four singers. The singing voices were recorded with 48-kHz sampling and 16-bit accuracy.

4.2 Preprocessing

For this experimentation, the noise from the recorded singing voices were removed and manually segmented then labelled using Audacity 1.3. Only the voice segment with *patah lagu* from the long notes were extracted, with a sustain vowel a, e, i, o, u. The unvoice part of the segmented sustain vowel were eliminated. A number of 74 sustain vowels from each singers were identified and segmented as shown in Fig. 2.

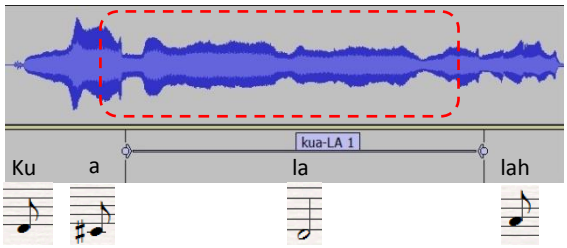

Fig. 2: Segmented and labelled sustain vowel 'La' for kua-LA 1 by a male amateur singer. The note 'D' for 'La' is in minim (2 beats).

4.3 Pitch feature extraction

Pitch extraction is important in this stage to examine how the feature values change over time, as well as how much of the total signal is taken up with periodic of voiced sound. Variation of pitch, if any, dictates the existence of *patah lagu*. Here, the pitch contour of the *patah lagu* were estimated using fundamental frequency (F0) extraction method, TEMPO in STRAIGHT [6]. F0 of a signal is the lowest frequency at which the signal repeats and is only relevant for periodic signals. The extracted F0 in log of frequency represent the pitch contour in Hz.

STRAIGHT is confirmed beforehand can extract fine fluctuations in the F0 contours accurately than other methods can [12]. It was reported that TEMPO in STRAIGHT is also one of the most useful methods for estimating pitch contours [6].

4.4 Frequency to interval conversion

The extracted pitch from STRAIGHT were then converted into musical interval into 12 semitones by 100 cent each. The conversion is done here to detect the connection between the frequencies of two notes, or the perceived pitches of the notes, at the beginning and at the end of the interval. The fundamental frequency (F0) in Hz is converted into cent scale according to Kako [18] using:

$$\text{Pitch (cents)} = 1200 \times \log_2 \frac{F0}{440 \times 2^{3/12-5}} \quad (1)$$

A semitone in the equal temperament is equivalent to 100 cent, and one octave is equivalent to 1200 cent. For vibrato, the extent ranges from 60 to 200 cents.

4.5 Convert interval into music notation

The pitch in cent in Section 3.4 is then notated into their corresponding musical notes based on equal temperament music scales, $A_4 = 440$. Musical scales are a specific pattern of pitch ratios of successive notes [19]. The purpose of this stage is to reveal the pitch difference between successive notes. The pitches that fall in between two notes will be assigned to the closest musical note.

4.6 Convert time (ms) into music tempo

The time in milisecond (ms) was converted to musical beat, with tempo/BPM 60 equal to 1 crochet. So a tempo of 60 BPM is playing 60 beats per minute. Therefore, 60 beats / 60 seconds = 1 beat per second, with 1 second equal to 1000 ms. Values 0 to 5 was given to indicate the duration for a note in the singing as shown in Table 1.

Table 1: Values and indication to the relative duration of a note

Value	Music note
0	Undefined (less than 0.0625s)
1	Hemidemisemiquaver (0.0625s)
2	Demisemiquaver (0.125s)
3	Semiquaver (0.25s)
4	Quaver (0.5s)
5	Crochet (1.0s)

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5 Analysis and finding

Observation was done by professional musician on *Seri Mersing* music score [18] to identify any indication for ornamentation, however there was none. This shows that singers play an important role in improvising *Seri Mersing* although the score contains a transcription of the way the piece is supposed to sound.

From the pitch extraction experimentation, about 55-60 *patah lagus* were observed to appear on almost all sustain crochet, minim and semibreve notes by each of the four singers (Table 2). It shows an average of 79% use of *patah lagu* in singing *Seri Mersing* on every central or long notes. Some of the *patah lagus* were accompanied with natural vibrato, and the power changes are synhronized with pitch. The pitch contour of the *patah lagu* appeared to be dissimilar in pitch and time/duration by different singer, as shown in Fig. 3 for sustained vowel or *patah lagu* : kua-**LA** (1).

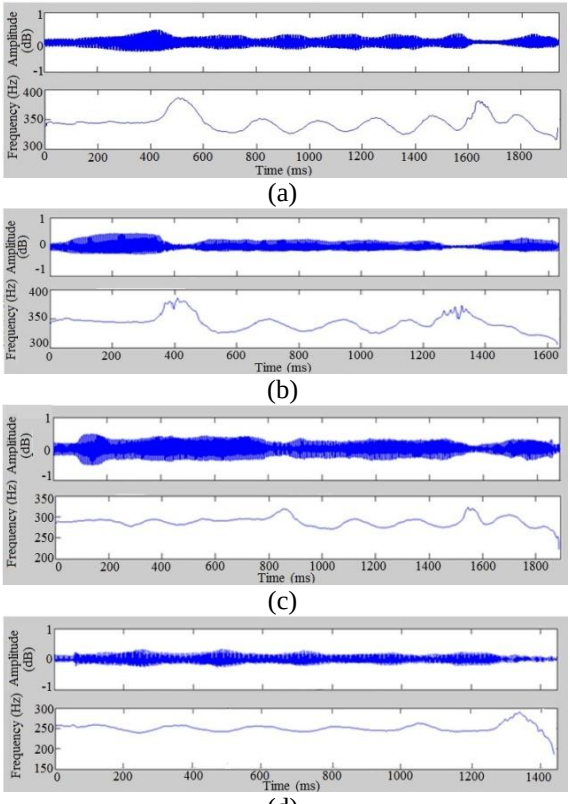
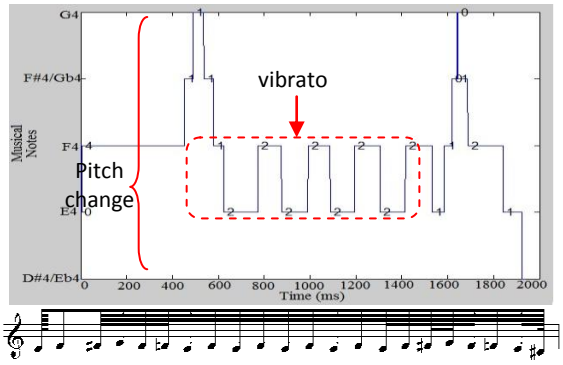


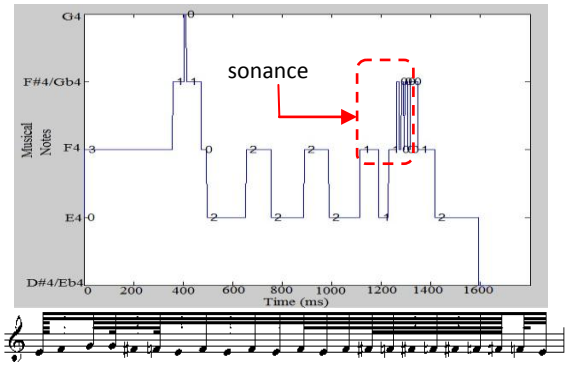
Fig. 3: Pitch contours of *patah lagu* in rendering "kua-**LA"** by four singers; (a) female amateur, (b) female professional (c) male amateur and (d) male professional.

Female singers appear to have higher pitch range, 300 to 400 hz, while the males ranges around 200 to 300 hz (refer Fig. 3). The pitch contour reveals large, ragged and irregular differences in the length of the successive sound waves. The pitch shows changes around 3 to 5 musical notes within a *patah lagu*. For example in Fig. 3(a), the voice glides up from note F4, F#4 to G4 and glides back down to E4. The variation of pitch significantly relates to the use of natural vibrato (100 cent) and ornamentation in singing. The roughness in frequency, however, contributes to sonance[1] as the quality of tone varies with the degree of roughness [16].

Table 2: Summary of the segmented sustain vowels and number of patah lagu observed in the pitch contour by each singers.

Singer	Number of *patah lagu*	Total segmented sustain vowel	%
(a) Female amateur	57	74	77
(b) Female professional	58	74	78
(c) Male Amateur	60	74	81
(d) Male professional	60	74	81





[1] Sonance is tone quality which results from fluctuations in pitch, intensity, time, and timbre within a tone (Seashore, 1967).

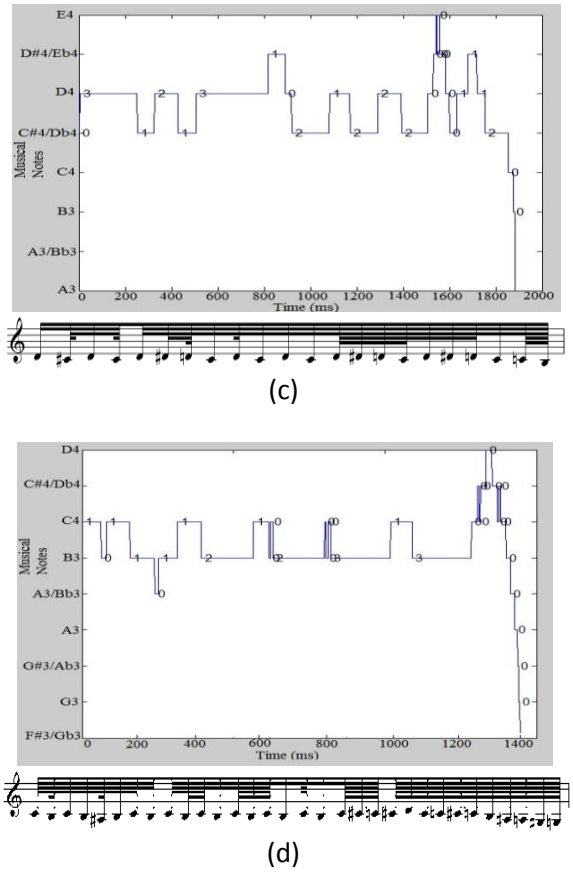


Fig. 4: Musical notes interval (semitones) of singing voices for *patah lagu* accompanied by musical score, for "kua-**LA** (1)" by four singers; (a) female amateur, (b) female professional (c) male amateur and (d) male professional. Refer Table 1 on note values.

As shown in Fig. 4, the song was rendered dissimilarly by all the singers. Although some *patah lagus* may have been performed in a same pattern, but the attack of gliding between notes were done at different time, and the *patah lagu* ended faster than the other. Professional singers are believed to have shorter rendition due to shorter breath compared to young amateurs singer who have longer and steadier breath control. The variation in singing rendition are employed rather unconsciously, to express taste and feeling of the singer. The tonal movement from note to note is obvious mostly by glides, in heavy and slow, so quickly and sometimes can hardly be perceptible to even most acute ear.

6 Conclusion

This paper reported the results of singing styles of four singers performing Malay *asli* music, *Seri Mersing*. *Asli* music must be performed with *patah lagu* as it carries its own unique style and identity to the music. Improvisation of *patah lagu* in *asli* music depends on the melody of the song, key signature and *pantun*. Most singers perform different styles of *patah lagu* though singing the same song and some western ornamentation such as gliss, trill, acciacatura, and mordent, is applied in performing *asli* music. The existence of *patah lagu* is proven through pitch extraction experimentation where results reveal variation of pitch changes in singing for a crochet, minim or semibreve notes. Today, Malay *asli* singers are few, thus any singer at present must first truly understand the traits of perfecting the technique of singing these songs by learning from the connoisseurs. For future work, the researchers will focus on rate of pitch changes and contours of *patah lagu* in more specific for development of singing synthesis system for teaching and learning *patah lagu* in singing *asli* music performances.

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