

# Analysis of Amanuban Feuk Bia Harmonic Series for Open Organ Pipe

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## Abstract

The study has been conducted analyze Amanuban feuk bia hrmonic series an experiment toward two open organ pipe. The method used is experimental. The result showed that there was compatibility between the series of Amanuban feuk bia harmonic with the theory of two open organ pipe harmonic series. The value of speed sound in the air was 310,8 m/s different from the value of theory which was 8,8%. The tone frequency was apparently up-side down with the harmonic series. It is suggested that the musical instrument (feuk bia harmonic) can be used to do an experiment on two point of open organ pipe.

**Keywords:** organ pipe, speed, sound audacity

## 1. Introduction

The study of physics-based STEM is expected to create culture integration. Beside that, it can create science literacy and technology in physics to support environment conservation including culture. The study of cultural-integrated physics as a realization of contextual learning can improve the learning outcome (1,2), improve the ability of problem solving (3), and create interesting learning atmosphere for students (4). Inquiry teaching and learning process through unification of physics and music on standing waves gives opportunity for students to be actively involved in the process (5) and create meaningfull teaching dan learning process.

The concept of standing wave on organ pipe exists as the basic concept that be utilized to comprehend the resonance in various musical instruments like guitar, violin (6) and flute (7). However, standing wave concept on organ pipe which taught for students is still only theory through math approach on ideal condition. Experiment on this topic is being denied since the equipments are expensive, such as generator function, oscilloscope and resonance tube.

Some researches had been conducted and recommended to be used like experiment on open organ pipe series using PVC pipe and benefitted visual software analyzer which freely available (8). Experiment on standing wave using fine wire (string) on guitar and violin by using macscopp software (6). Expperiment on doppler efect using video and audacity software with appropriate accuracy in measuring frequency (9). Those researches give inspiration on digging the local aspect of Amanuban tribe to design cheap experiment with high benefits on teaching physics and support cultural conservation.

Amanuban tribe is an original tribe in Timor Island in which most of its population are farmers. The geographic conndition which is mountain range exixts as hindrance for cow breeders in maintingg their cows. To be easier, breeders make use feuk bia or flute to call their cows (Figure 1) to herd them to their stbale when sunset. The instrument is made of wood and riddled. There are three holes in the upper end part near the mouth, in the middle and the other end side. Feuk is also can be set with violin and used as a musical instrument to welcomme guest. Feuk bia produces sounng from the oscillation of air column on open organ pipe. This musical instrument is not widely known by students and it is almost extinct. Therefore, efforts of mainting feuk bia can be done through analyzing harmonic series for experiment on two open organ pipe which is cheaper and easier to be accessed and provides extra benefits.

The relation of two open pipe, the length of air column,  $L$  and frequency,  $f_n$  (8) is determined by using the following equation:

$$f_n = \frac{n}{2} \left( \frac{v}{L + e} \right) \quad (1)$$

Where  $v$  = Speed of air sound,  $e$  = end correction and  $n= 1, 2, 3, \dots$

$$e = 2 \times 0.33 D \quad (2)$$

$D$  is pipe organ diameter.

V value is determined through an experimental way using equation fitting curve (1)  $Y = AX^B$  where,  $Y = f_n$ ;  $X = n/2L(L+e) = \text{wave length}$ .  $A = \text{wave speed}$ .

The relation between harmonic series-n and the frequency on two open organ pipe using the following equation :

$$f_n = f_1^n \quad (3)$$

Where,  $f_1$  = the basic note frequency.

Frequency analysis using audacity software is freely available.

## 2. Research Method

The method used in this research is experimental method.

The instruments used in this research were:

- a) Feuk bia
- b) Termometer
- c) Sliding compas
- d) Installed audacity software laptop

Research Procedure

- a) Measuring space temperature, and feuk bia diameter
- b) The person who blow feuk bia was position about 30 cm before the laptop position.
- c) Feuk bia was played and at the same time the sound was recorded.
- d) The instrument was played four times.
- e) The sound frequency was analyzed using audacity software.

## 3. Result

The measurement of sound in space temperature is about 20°C, feuk bia diameter = 0,91 cm. The result of wave length and frequency is revealed on Tabel 1. An example analysis on sound frequency using audacity for one time blowing is revealed on Figure 2. Based on Figure 3 graphic  $f_n$  vs  $n/2(L+e)$  the value  $v$  is revealed through experiment way which is 310,8 m/s. The standard value on 20°C space temperature is 340,93 m/s. Different standard value of  $v$  theory with  $v$  experiment is 8,8%. This differences is caused by vary of temperature in organ pipe (8) and different air volume in flute (7). the value of B gained =  $-0,99 \infty -1$ . The condition is the sound frequency is comparably up-side down with the length of wave according to the equation  $f = v/\lambda$ .

Based on Figure 4 graphic  $f_n$  vs  $n$  is concluded that the tone frequency to  $n$  is comparable with the series of tone on two open harmonic pipe organ appropriate with the equation (3).

## 4. Conclusion

The harmonics series on feuk bia is mutual accord with the harmonic series of two open organ pipe, where the experiment value of speed sound in the air is 310,8 m/s contrast with the value of theory 8,8%. The tone frequency is comparably up-side down with the length of wave and proportional with harmonic series. The differences of the speed sound with the value of theory is caused by variation of temperature on feuk bia. Based on the result of the study, it is suggested that feuk bia of Amanuban tribe can be used for experiment of two open organ pipe. Continuous study research can be done toward correction of temperature and diameter on open organ pipe.

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Table 1. The result of frequency measurement based on harmonics series

Harmonic series to-n	L+e	m	f (Hz)					average $f_n$ (Hz)
			1	2	3	4	5	
1	0,303		1002	1015	1033	1017	1035	1020
2	0,152		1999	2032	2056	2040	2058	2037
3	0,101		2995	3057	3089	3061	3091	3059
4	0,076		3994	4054	4116	4074	4118	4071
5	0,061		4988	4896	4907	4905	4906	4920
6	0,051		5993	5870	5856	5909	5855	5897
7	0,043		6560	6531	6560	6529	6565	6549
8	0,038		7865	9084	9019	9096	9013	8815

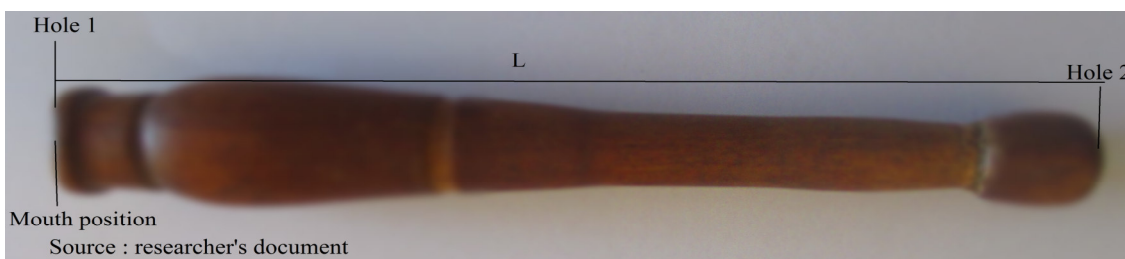


Figure 1. Feuk bia of Amanuban tribe consists of two holes on both ends. The left hole is the blowing hole.

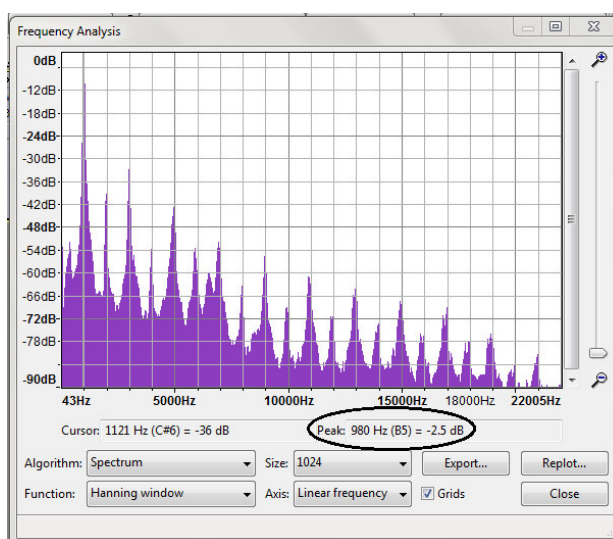


Figure 2. The example of frequency analysis of audacity result for one time blowing.

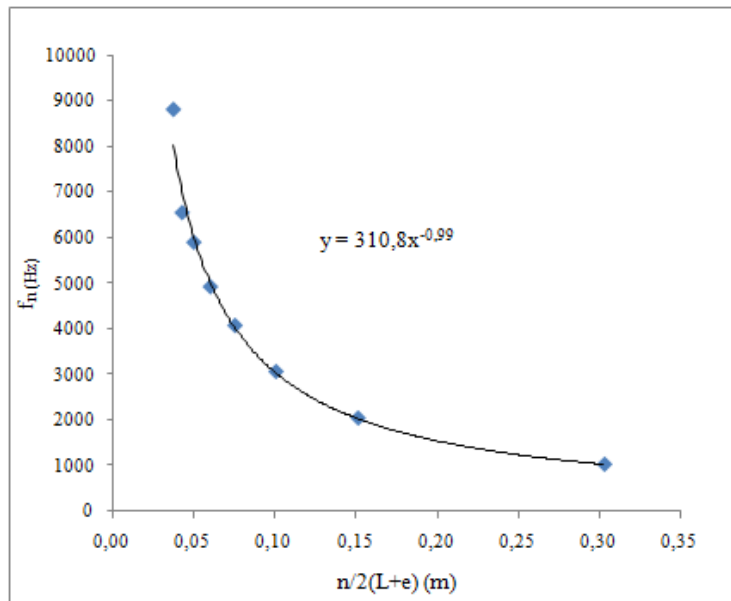


Figure 3 . Graphic  $f_n$  vs  $n/2(L+e)$

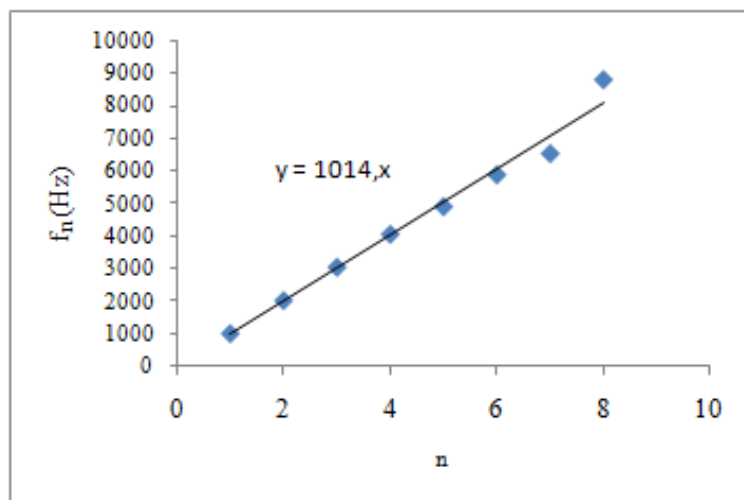


Figure 4. Graphic  $f_n$  vs  $n$