Study of Preference for Stereo Recording Techniques of a Pelog-based of Gamelan Gender, Bonang, and Peking Ensemble

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Abstract: The layout of gamelan ensemble produce stereo imaging, instrument separation, and sound clarity. Until now, for music production purposes, gamelan ensemble recording uses spot-based microphone technique, which produces more individual sound, while the stereo microphone technique is able to produce the characteristics of gamelan ensemble, either in instrument separation, sound clarity, or stereo imaging. No previous study has investigated on preference for stereo recording techniques of a pelog-based of gamelan gender, bonang, and peking ensemble. Techniques that applied in this research were XY stereo recording technique, NOS, ORTF, and AB. This research uses qualitative method, using statistical calculation. There were four stages, collecting data, which consists of assign the player, analyze the characteristics of the ensemble, choose the song to be recorded, decide the layouts of the ensemble and the microphones, and create the questionnaire. The second stage was recording process. The third stage was sample test and interview. These findings is clearly indicate that NOS stereo recording technique is the most prefered stereo recording techniques of a pelog-based gamelan gender, bonang, and peking ensemble.

1 INTRODUCTION

Gamelan is a traditional musical instrument in the form of ensemble from Java Island, Indonesia. The instruments are made of metal, wood, or bamboo, that creates sound by hitting it. It is also classified as an idiophone musical instrument (Tjahyanto et al, 2011).

Gamelan has its own characteristics. Each instrument of gamelan was created with frequency range and with different roles (Suyatno et al, 2013). The characteristics influence the layout of gamelan ensemble. The layout of gamelan ensemble produces wide stereo imaging (Suyatno et al, 2013). The impression of wide stereo image was created by stereo microphone techniques.

Until now, for music production purposes, gamelan ensemble recording uses spot-based microphone technique. No previous study has investigated on preference for stereo recording techniques of a pelog-based of gamelan gender, bonang, and peking ensemble.

The stereo microphone technique is able to produce the characteristics of gamelan ensemble, either in instrument separation, sound clarity, or stereo imaging. For example, Spaced-Pair (AB) stereo microphone technique is able to produce a clear stereo image, which makes listener able to differentiate the position of each sound source, and determine the boundaries of a room (Bates, 2016). But when compared with spot-based microphone technique, the spot-based microphone technique produces more individual sound.

Other than that, gamelan is also still less well-known in general, even by Indonesian people themselves. Iswara (2010) stated that the insufficiency of gamelan preservation is caused by the lack of government's participation, foreign culture, and gamelan which is still rarely known by Indonesian society, and the lack of interest towards the gamelan itself (Iswara 2017).

The aim of this research is to analyse four stereo recording techniques of a pelog-based of gamelan gender, bonang, and peking ensemble.

2 METHODOLOGY

There are four stereo recording techniques used on this research:
- XY 90°;
- NOS 90°;

- ORTF 110°;
- Spaced Pair (AB).

2.1 Data Collection

2.1.1 Instrument Players

There are three players and three instruments on this research:
- Gender: Roban Eko Putranto;
- Bonang: Rusli;
- Peking: Anastasia Emmanoela Putri.

2.1.2 Ensemble Characteristics Analysis

2.1.3 Song Selection

The song chosen for this study was Gundul-Gundul Pacul, written by R. C. Hardjosubroto. Music score courtesy of Rusli.

2.1.4 Ensemble Layout Planning

There are five ensemble layouts used throughout the recording process. One layout uses the standard ensemble layout (as 1), and the other four layouts are adjusted to the characteristics of each stereo recording techniques (as 2).

2.1.5 Microphone Layout Planning

For the research, the microphone that was used is a pair of Neumann KM184 as a stereo microphone and also stand mics. There are 24 microphone layouts that were used on the recording process (three of each ensemble layout and stereo recording technique). Three microphones were placed to the midpoint of all the ensemble layout with a distance of:
- Two point five meter (2,5 m) as A;
- Three meters (3 m) as B;
- Three point five meter (3,5 m) as C.

So, there were six names for each stereo recording techniques, namely 1A, 1B, 1C, and 2A, 2B, 2C.

2.1.6 Questionnaire Making

The questionnaire sheet was divided into several section. The sections consist of application section, 'statement of being a respondent' section, explanation and interview section, as well as the interview questions (can be found in appendix B essay). The questionnaire was divided into three stages:
- First stage, is to find out the respondents' preferences for microphone distance towards gamelan ensemble for all ensemble layouts (first and second);

Respondents had to choose one out of the three given audio samples of first layout and one of the three audio samples of second layout, therefore respondents had to choose eight out of 24 given audio samples.
- Second stage, is to find out the respondents' preferences for gamelan ensemble layouts for all stereo recording techniques;

Respondents had to choose one of two audio samples from the previous selected audio samples, therefore respondents had to choose four of eight audio samples
- Third stage, is to find out the respondents' preferences for stereo recording techniques of gamelan gender, bonang, and peking ensemble.

Respondents had to choose one of four audio samples from the previous selected audio samples.

2.2 Recording Process

2.2.1 Recording Process

Devices being used on the recording process:
- Universal Audio Digital Apollo 8 audio interface, by using first and forth channel, and the amplitude of 40 dB;
- Mac Pro Server, mid 2010, 2.8 GHz Quad-Core Intel Xeon processor, 8 Gb 1066 MHz DDR3 memory, OS Sierra version 10.12.3;
- Yamaha HS8 speaker;
- Logic Pro X version 10.4.1;
- Two pieces of microphone stands;
- One pieces of carpet with 159 cm length and 123 cm width.

Audio samples have been recorded and bounced with 48 kHz 24 bits sample rate. The audio that was produced from the microphone was directed to the left and panned as much as minus 64 degrees (-64°) and the audio that was produced from the microphone was directed to the right and panned as much as plus 63 degrees (+63°).

2.2.2 Preparation of Audio Samples

The devices being used on the recording process:
- MacBook Pro Retina, Retina, 13-inch, mid 2014, processor 2.6 GHz Intel Core i5, memory 8 Gb 1600 MHz DDR3, OS High Sierra version 10.13.5;
- Headphone Sennheiser HD 280 Pro 64 ohm;
- Logic Pro X version 10.4.1.

Format of the audio samples is wav, with 48 kHz 24 bits sample rate.

2.3 Samples Test

2.3.1 Questionnaire

The respondents were divided into two categories:
- Professional, gamelan instrumentalist and sound engineer with minimum five years experiences;
- Non-Professional, musician and non-musician with age range 16 until 30 years.

The quantitative data collection was done by letting respondents listen to the audio samples that have been recorded. After respondents listen to the audio samples, respondents were asked to fill the questionnaire. After that, respondents were interviewed to find out the reasons of their choices before.

The devices being used to listen on the recording results:
- Focusrite Scarlett 2i2 interface, amplitude on 12 o'clock;
- MacBook Pro Retina, Retina, 13-inch, mid 2014, processor 2.6 GHz Intel Core i5, memory 8 Gb 1600 MHz DDR3, OS High Sierra version 10.13.5;
- Speaker Sennheiser HD 280 Pro 64 ohm;
- QuickTime Player version 10.4 (928.13).

2.3.2 Interview

After filling in the questionnaire, the respondents were also going to be interviewed.

Qualitative data collection was done by preparing interview's questions, sound recording device, and stationery. Interview was done with semi structured format, with two questions. First question, "why did the respondents choose the option?". Second question, "what are the factors that influence the respondents choices?"

Devices being used on the recording process:
- Iphone 6S, 2015, iOS 11.4.1 handphone;
- Stationery.

2.4 Data Analysis

2.4.1 Questionnaire

The questionnaire results on the first stage questionnaire is compiled and analysed on Table 2.1

$$FORMULA: \frac{Total}{Total\ Respondents} \times 100\%$$

The questionnaire results on the second stage questionnaire is compiled and analyzed on Table 2.2

$$FORMULA: \frac{Total}{Total\ Respondents} \times 100\%$$

Table 2.1: Analysis table from first stage questionnaire.

Responden	XY						NOS						ORTF						AB					
01	Sampel 1			Sampel 2			Sampel 1			Sampel 2			Sampel 1			Sampel 2			Sampel 1			Sampel 2		
	1A	1B	1C	2A	2B	2C	1A	1B	1C	2A	2B	2C	1A	1B	1C	2A	2B	2C	1A	1B	1C	2A	2B	2C
02	Sampel 1			Sampel 2			Sampel 1			Sampel 2			Sampel 1			Sampel 2			Sampel 1			Sampel 2		
	1A	1B	1C	2A	2B	2C	1A	1B	1C	2A	2B	2C	1A	1B	1C	2A	2B	2C	1A	1B	1C	2A	2B	2C
03	Sampel 1			Sampel 2			Sampel 1			Sampel 2			Sampel 1			Sampel 2			Sampel 1			Sampel 2		
	1A	1B	1C	2A	2B	2C	1A	1B	1C	2A	2B	2C	1A	1B	1C	2A	2B	2C	1A	1B	1C	2A	2B	2C
04	Sampel 1			Sampel 2			Sampel 1			Sampel 2			Sampel 1			Sampel 2			Sampel 1			Sampel 2		
	1A	1B	1C	2A	2B	2C	1A	1B	1C	2A	2B	2C	1A	1B	1C	2A	2B	2C	1A	1B	1C	2A	2B	2C
05	Sampel 1			Sampel 2			Sampel 1			Sampel 2			Sampel 1			Sampel 2			Sampel 1			Sampel 2		
	1A	1B	1C	2A	2B	2C	1A	1B	1C	2A	2B	2C	1A	1B	1C	2A	2B	2C	1A	1B	1C	2A	2B	2C
Jumlah																								
Persentase																								

Table 2.2: Analysis table from second stage questionnaire.

Responden	XY		NOS		ORTF		AB		Keterangan
01	1	2	1	2	1	2	1	2	
02	1	2	1	2	1	2	1	2	
03	1	2	1	2	1	2	1	2	
04	1	2	1	2	1	2	1	2	
05	1	2	1	2	1	2	1	2	
Jumlah									
Persentase									

The questionnaire results on the third stage questionnaire is compiled and analyzed on Table 2.3

$$FORMULA: \frac{Total\ Like}{Total\ Respondents\ Like} \times 100\%$$

$$FORMULA: \frac{Total\ Dislike}{Total\ Respondents\ Dislike} \times 100\%$$

Table 2.3: Analysis table from third stage questionnaire.

Responden	XY		NOS		ORTF		AB	
01	Sampel Nomor …		Sampel Nomor …		Sampel Nomor …		Sampel Nomor …	
	TS	S	TS	S	TS	S	TS	S
02	Sampel Nomor …		Sampel Nomor …		Sampel Nomor …		Sampel Nomor …	
	TS	S	TS	S	TS	S	TS	S
03	Sampel Nomor …		Sampel Nomor …		Sampel Nomor …		Sampel Nomor …	
	TS	S	TS	S	TS	S	TS	S
04	Sampel Nomor …		Sampel Nomor …		Sampel Nomor …		Sampel Nomor …	
	TS	S	TS	S	TS	S	TS	S
05	Sampel Nomor …		Sampel Nomor …		Sampel Nomor …		Sampel Nomor …	
	TS	S	TS	S	TS	S	TS	S
Jumlah								
Persentase Tidak Suka								
Persentase Suka								

2.4.2 Interview

The interview results (qualitative data) have been processed with three stages:

▪ Evaluation Coding;

Evaluation coding is a systematic data collection process to increase the effectiveness of the research. This method focuses on patterned observation or respondents' answer from detail's quality. This method also allows the researcher to know which participator has given positive or negative response.

▪ Data Presentation;

Reduced data was grouped and took the action to be presented at data conclusion. This stage allows the researcher to take further actions if there were less information to understand the interview data analysis

▪ Data Conclusion.

On this stage, all data preparation should be done, so that data can be presented by bar chart.

3 ANALYSIS AND DISCUSSION

3.1 Preference Analysis of Stereo Recording Techniques based on Professional Preferences

3.1.1 First Stage

The first stage most liked stereo recording technique by professional category preference is XY 2A (50%), NOS 2C (50%), ORTF 1A (50%), and ORTF 2C (50%), followed by XY 1B (42.9%), XY 1C (42.9%), and AB 2C (42.9%).

At the same time, the first stage most disliked stereo recording technique by professional category preference is NOS 1A (35.7%), NOS 1C (35.7%), AB 1A (35.7%), and AB 1C (35.7%).

3.1.2 Second Stage

The second stage most liked stereo recording technique by professional category preference is NOS 2 (85.7%), followed by AB 1 (71.4%), and ORTF 2 (64.3%).

At the same time, the second stage most disliked stereo recording technique by professional category preference is XY 1 (50%) and XY 2 (50%).

3.1.3 Third Stage

The most liked stereo recording technique by professional category preference is NOS (71.42%), on Figure 3.1. There are several factors:

- The sound of the gamelan blends together;
- Enough reverb;
- Clear and balance stereo image;
- Clear separation instruments;
- Clear gamelan's sound;
- Balance loudness;
- Cleaner sound;
- Comfortable to hear;
- Optimal harmonic content;
- Balance of gamelan's sound;
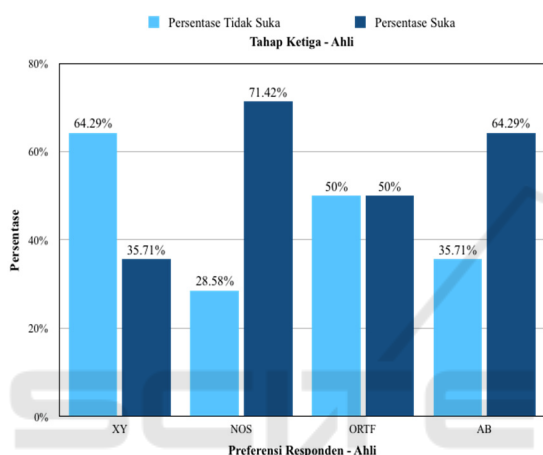- The performance;
- Tempo;
- Stable tone.

Figure 3.1: Diagram value on the third stage of professional respondent percentage.

The most disliked stereo recording technique by professional category preference is XY (64.29%), on Figure 3.1. There are several factors:

- Too much noise;
- Too much reverb;
- Narrow stereo image;
- The sound of gamelan does not blend together;
- The worst clarity sound;
- Less high frequency;
- The sound cracked;
- The sound was too smooth;
- Harmonics at certain frequencies was annoying;
- Less balance;
- The performances are not stable;
- The dynamics doesn't sound comfortable.

3.2 Preference Analysis of Stereo Recording Techniques based on Non-professional Preferences

3.2.1 First Stage

The first stage most liked stereo recording technique by non-professional category preference is NOS 2C (64.2%), followed by XY 1B (50%) and ORTF 2A (50%). At the same time, the first stage most disliked stereo recording technique by non-professional category preference is NOS 1B (35.7%) and NOS 1C (35.7%), followed by XY 2A (42.8%), ORTF 1B (42.8%), AB 1A (42.8%), AB 2B (42.9%), and AB 2C (42.9%).

3.2.2 Second Stage

The second stage most liked stereo recording technique by non-professional category preference is ORTF 2 (78.5%), followed by XY 1 (71.4%) and AB 1 (71.4%). At the same time, the second stage most disliked stereo recording technique by non-professional category preference is NOS 1 (57.1%).

3.2.3 Third Stage

The most liked stereo recording technique by non-professional category preference is NOS (71.42%), on Figure 3.2. There are several factors:

- Comprehensive reverb;
- Perfect melody and accompaniment separation;
- The sound of gamelan blends together;
- Clear melody and accompaniment;
- Clear transient;
- Balance range frequency;
- Sound of the reflection effect from hitting gamelan;
- Balance melody and accompaniment loudness.

The most disliked stereo recording technique by non-professional category preference is XY (64.29%) and ORTF (64.29%), on Figure 3.2. There are several factors:

- Too much noise;
- Less separation balance;
- The sound of gamelan does not blend together;
- Too wide stereo image;
- Less direct and reflected sound balance;
- Annoying resonance;
- Less melody sound;
- Too much high frequency;
- Too rough, sharp, and piercing sound;
- Too much noise.

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3.3 Preference Analysis of Stereo Recording Techniques Based on All Respondent Category Preferences
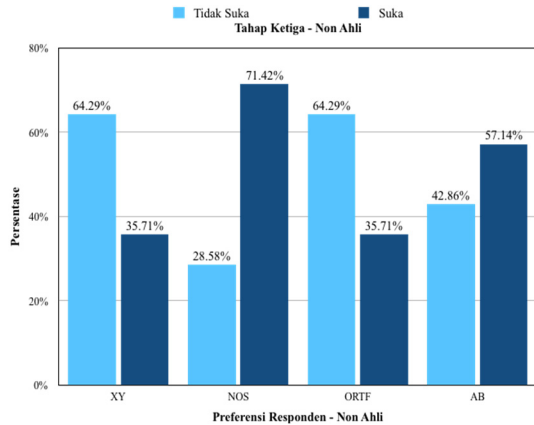

Figure 3.2: Diagram value on the third stage of non-professional respondent percentage.

3.3.1 First Stage

The first stage most liked stereo recording technique by all category preference is NOS 2C (57.1%). At the same time, the first stage most disliked stereo recording technique by all category preference is NOS 1C (35.7%) and ORTF 2A (35.7%), followed by ORTF 1A (39.2%), AB 1A (39.2%), AB 2C (42.9%), XY 1B (46.4%) and XY 2A (46.4%).

3.3.2 Second Stage

The second stage most liked stereo recording technique by all category preference is ORTF 2 (71.4%) and AB 1 (71.4%), followed by NOS 2 (64.2%). At the same time, the second stage most disliked stereo recording technique by all category preference is XY 1 (60.7%).

3.3.3 Third Stage

The most liked stereo recording technique by all category preference is NOS (71.42%), on Figure 3.3. There are several factors:
- The sound of gamelan blends together;
- Enough reverb;
- Clear gamelan's sound;
- Balance loudness;
- Cleaner sound;
- Noise were not disturbed by the gamelan's sound.

The most disliked stereo recording technique by all category preference is XY (64.29%), on Figure 3.3. There are several factors:
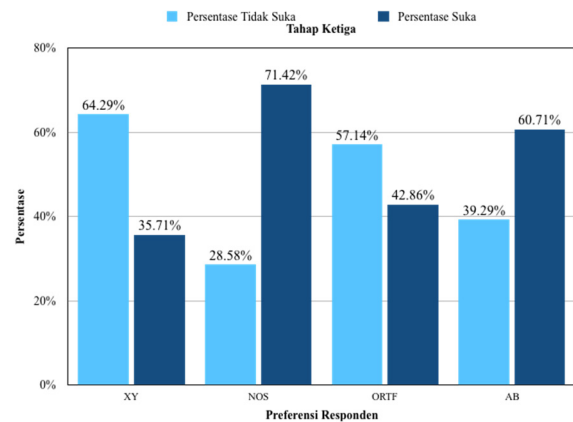

Figure 3.3: Diagram value on the third stage of all respondent percentage.

- Too much noise;
- Less clear sound;
- Less high frequency;
- Very less balance;
- The performance are not stable.

4 CONCLUSIONS

This research has shown that preference for stereo recording technique of a pelog-based of gamelan gender, bonang, and peking ensemble is NOS stereo recording technique. NOS stereo recording technique has high definition. However, it has long reverb time. A long reverb time is the characteristic of gamelan. There is no sound of gamelan instruments that is covering one another. Frequency ranges that are relatively balanced, there are no dominant or less frequency ranges. Gamelan performances are smooth and stable. In the majority of NOS samples, there is no high noise and sound of other disturbances that disturb the sound of the gamelan. This shows that the respondents likes the sound of the gamelan which replicated the room image factor, instrument separation, and the clarity of gamelan sound during the live performance.

There is a focus difference between the categories of professional gamelan respondents, professional sound engineer respondents and non-professional respondents. The professional gamelan respondents focus into the quality of the performance while the sound engineer and non-professional respondents categories tends to focus accordance with the research

topic, namely the analysis of stereo recording results. This is because gamelan's professional respondents plays the gamelan from five years to 40 years, different from sound engineer professional respondents who have at least sound experience for five years, and non-professional respondents who do not have any experience for gamelan musical instrument and are not sound engineers for at least five years. Vocabulary and responses from gamelan professional respondents are also based on perceptions, instead of sound engineer professional respondents who are based on technical matters.

The result of this research indicates that space, timbre, and quality factors are the aspects which the professional gamelan respondents focuses, while space, timbre, quality, and defects are the main focus of non-professional respondents.

Further research might explore room acoustics parameter measurements for gamelan's ensemble, because the room acoustics parameter measurements affects the gamelan's sound and the recording results.

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