Acoustics perception aspect of Sundanese Celempong's ensemble recording

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Abstract. Celempong is a Sundanese traditional instrument from West Java, Indonesia made from bamboo internode. This instrument has three bamboo strings which cut out from the body of celempong itself. Celempong is played by hitting the bamboo strings using bamboo stick and hitting the open section at the end of bamboo by hand. The aim of this study is to determine the important acoustic aspects in celempong ensemble recording technique using semantic categorization. Recordings were made using several stereo recording techniques: XY, ORTF, NOS, Mid-Side (MS), Spaced-pair (AB), Decca Tree, STAAG, and the combination of AB and XY. Nine experts in traditional Sundanese music listened to the recordings using headphone and requested to give the open response regarding the quality of the recordings. Semantic categorization method was implemented to analyze the data using four categories: timbre, spatial, defects, and musical aspects. The study shows that timbre is the most important aspect of recording technique for celempong ensemble. Furthermore, spatial aspects also become the important aspect in evaluating the quality of the recording.

1. Introduction

Music recording is a unique and complex process. This process involves the art and science aspects [1]. Music recording is specific because one must embrace two domains that appear contrast, ranging from the sound source of musical instruments, music, and its complexity, the room used its acoustics characteristics as well, and also recording technology. The objective side of music recording includes acoustic aspects of music instruments such as sound dispersion, sound envelope. Then the acoustic aspect parameters of the room used for recording such as reverberation time, ITDG, C80, treble and bass ratio, etc. Also related aspects of microphones such as directivity pattern, frequency response, Stereo Recording Angle (SRA), etc. The art (subjective) side includes music that will be recorded itself from the meaning of the music, the arrangements, the inter-linkage of instruments, and to understand important criteria in a kind of music.

Celempong Sunda, is one of 20 bamboo musical instruments from West Java. In the last eight years, celempong with other Sundanese musical instruments, Karinding, experiencing a revival movement. Various music festivals, performances, music collaborations involving celempong so as to bring up new forms of musical creativities. On the other hand, recorded music has important role for the development of traditional music itself [2]. The recording technique that used affects the sound quality of a music and even opens new possibilities in producing a new sound experience.

In the concept of natural recording [3] one important aspect that determines the quality of the
recording is the selection of stereophonic sound recording techniques. There are several stereo recording techniques such as XY, ORTF, NOS, Mid-side (MS), Decca Tree. Each of the technique has different characteristic the implementation must be suitable context for the aim of music recording.

The quality of recorded sound can be evaluated using the categorization from audio attributes. The determination of the categorization is important to determine the important aspects in from sound recording. Moylan conducted a study to develop a system for sound evaluation based on people’s perception and determined four attributes aspect that used to evaluate the sound recording: time, pitch, dynamic, sound quality, and spatial properties [4]. Another study also has categorized the sound attributes into four categories: space, defect, timbre, and sound quality [5].

Although the categorization of has been determined, the information about how important those aspect to evaluate the sound recording has not been evaluated. The aim of this study is to determine the important aspect of sound attribute in celempung's music recording based on artist's preference.

2. Methodology

2.1. Celempung Music Materials and Recording
There were 24 sample recorded celempungs used for subjective testing. The music sample was a musical composition which was contain of three celempungs which is played live in a performance hall that becomes artist preference.

Recording techniques used in recording live celempung ensemble is a technique XY, ORTF, NOS, Mid-side (MS), Decca Tree, STAAG, and a combination of XY and AB. Recording is performed using a 48 kHz and 24 bit sampling rate. The variation of aspects used in these techniques include angular variants between microphones, microphone height, and distance of the microphone to the sound source.

Two other techniques used are techniques that are a combination of pure stereo recording techniques. STAAG is a recording technique that uses two opposite ORTF [6]. One pair captures the sound from the sound source while the other one is facing away from the sound source to capture the ambience of the room. One more technique used is a combination of XY and AB with variable level changes on AB technique 0, -5, and -10 dB at mixing.

Similarly done on the MS recording, which the microphone side level setting was 0 dB, -10 dB.

2.2. Test Setup and Subjects
Tests performed using AKG HD280 headphones Pro to remove the effect of the room from the experiment. Music was played using laptop via audio interface Steinberg UR22.

Results of the recording will be tested to the respondents. They were asked to make a numerical judgments of a rating scale from 24 samples of recordings with a sample duration of 90 seconds. The rating scale used is the 5-scale rating. The smallest numbers 1 to 5 successively represents bad, poor, fair, good, and excellent.

Subjective tests were conducted on nine respondents, divided into groups of experts and non-experts. The expert group consisted of six respondents, while the non-expert group consisted of three respondents. The group of experts has qualified experience in the field of Sundanese musical art more than 25 years while the non-expert group has less than 10 years’ experience.

2.3. Interview
After an assessment of 24 samples of celempung recording given by the respondent, then conducted the interview. The purpose of this interview is to obtain the subjective criteria of both groups in providing an assessment of the quality of sounds of celempung sounds.

Interviews were conducted on 3 respondents from expert groups and 3 respondents from non-expert groups. Interviews are conducted in a semi-structured manner, by asking what the criteria for
assessment of a sample record are and what the reason for giving an excellent or bad assessment of a sample of celempung recordings.

The interview was recorded using a handy recorder for subsequent transcription of the recording. Interview results were analyzed using Word Cloud technique. World cloud is a visual representation of the text data used to describe keywords. Visible visuals are presented by color and font size to describe a certain level of text data. Voyant was performed to analyze the text.

Word Cloud results will be filtered and grouped according to the four categories of space, defects, timbre, and quality (Table 1). This method is excellent useful in studying and classification of artists' attributes regarding sound quality of celempung's recording.

| Category             | Meaning                                                  | Attribute          |
|----------------------|----------------------------------------------------------|--------------------|
| Defects              | Relating to distortion, hiss, hum, etc.                  | Noise              |
|                      |                                                          | Distortion         |
|                      |                                                          | Background noise   |
|                      |                                                          | Hum                |
|                      |                                                          | Hiss               |
|                      |                                                          | Disruption         |
| Space                | Relating to the three-dimensional nature                  | Depth              |
|                      | of the sound sources and environments                    | Reverberation      |
|                      |                                                          | Width              |
|                      |                                                          | Distance           |
|                      |                                                          | Localization       |
|                      |                                                          | Spatial distributions |
|                      |                                                          | Spatialization     |
|                      |                                                          | Envelopment        |
|                      |                                                          | Immersion          |
| Timbre               | Relating to the tone color                               | Brightness         |
|                      |                                                          | Tone color         |
|                      |                                                          | Clarity            |
|                      |                                                          | Hardness           |
|                      |                                                          | Equalization       |
|                      |                                                          | Richness           |
| Quality/meanings     | Relating to the remaining properties                     | Homogeneity         |
|                      |                                                          | Stability           |
|                      |                                                          | Sharpness           |
|                      |                                                          | Realism            |
|                      |                                                          | Fidelity            |
|                      |                                                          | Dynamics            |

3. Result and Discussion

The most frequent words that used during the interview by the subjects, assumed as the most important words that define the aspect the quality of recording celempung. The result of word cloud analysis of expert respondents is shown in Figure 1. The most frequent word used by Subject A is “gema” which means reverberation. The other word frequently used by Subject A are: “gemanya” (the reverberation), “ting” (the sound of highest note of celempung), “jenger” (boxy vocals sound), “halimpu” (soft, balance in low and high frequency), “hempuung” (unbright), “nyaring” (loud), “jauh” (far), “intensitas” (intensity), “sop” (soft), “cempreng”, “tung”, “teungpeuk” (dull), “warna” (color), “soft”, “saweur” (harsh metal sound), and “murni” (pure). Subject B uses the word “warna” (color), “jelas” (clear) and “kemurnian” (purity) as the most frequent word. Subject C use the word “bersih” (clean) and “timbre” as the most frequent word.
From Subject A, it was found that some words such as “gema” (reverberation) and “jauh” (far) are the word representing the category of space. The subject explained that those two words must be considered because it will decrease the recording quality of the celempung. This result shows that the most important aspect in the evaluation of celempung’s music recording is related with the aspect of timbre.

Another interesting finding that comes from the Subject A was he uses the terminology (heumpeung, halimpu, jenger, teungkeur, saweur, cempreng) that commonly used to explain the timbre characteristic of vocal quality in Sundanese Karawitan such as Cianjuran and Kiliningan.

The result of the expert subjects is also consistent with the non-expert subjects. Figure 2 shows the Word Cloud of the non-expert subjects. Subject D use the word “gema” (reverberation), “detail”, “jelas” (clear), “asli” (original), “jauh” (far), dan “mirip” (similar) mostly in his interview. Subject E mostly use the word “bright” and “bek” (refering to low frequency impression) in his interview and Subject F mostly use the word “jelas” (clear) and “keseimbangan” (balance).

Further analysis is conducted to determine the definition of good recording. The use of the word “kemurnian” (purity) and “kebersihan” (cleaness) by Subject B and Subject C indicates the preference of the sound recording to be as similar as the actual sound without any coloration. The word "bright” and “jelas” (clear) that used by Subject E and F respectively, also indicates the clarity of the instrument in the recording. The clarity aspect also consistent with the terminology “gema” (reverberation) used by Subject A and D. They do not like the reverberation in the recording because the reverberation makes the instrument sound unclear and different than the actual instrument.

Almost all subjects describe the criteria for evaluating the recording of celempung’s ensamble related to the tone color, brightness, and clarity. According to the Table 2.1, these attributes are included in the aspect of timbre. Even if there is an explanation of reverb and space, both of these are mentioned because both affect the timbre of the recording.

![Figure 1. Word Cloud Group of Expert](image1)

![Figure 2. Word Cloud Group of Non-Expert](image2)
4. Conclusions
This is the first study to identify the subjective criteria that used by artists to determine sound quality of Sundanese celempung's recording. This study has examined the factors which are thought to contribute to determine sound quality aspect of celempung sunda. The result of this study indicates that timbre is most important aspect in celempung’s music recording. Spatial aspects also become the important aspect in evaluating the quality of the recording, although the importance seems to be not as high as the timbre aspect. The result is consistent between the expert and non-expert subjects.
Further analysis shows that the respondents prefer the recordings that sound similarly to the actual instrument. Although the spatial aspects emerge in the description of the sound quality, the effect seems to be related with the timbre of the instruments. The respondents do not prefer the recording in reverberant space because the reverberation affects the clarity and coloration of the instrument.

5. References
[1] Rumsey F and McCormick T 2014 Sound and Recording (Hoboken: Focal Press)
[2] Suryadi S 2014 The recording industry and ‘regional’ culture in Indonesia: the case of Minangkabau (Netherlands: Leiden University)
[3] Romblom D, Guastavino C, and King R 2012 A comparison of recording, rendering, and reproduction techniques for multichannel spatial audio Audio Engineering Society Convention 133
[4] Moylan M 2007 Understanding and crafting the mix: the art of recording, ed 2 (Amsterdam, Boston: Elsevier/ Focal Press)
[5] Le Bagouss S, Paquier M and Colomes C 2014 Categorization of Sound Attributes for Audio Quality Assessment—A Lexical Study J. Audio Eng. Soc. vol. 62 no. 11 pp. 736–747
[6] Tagg J 2012 A Microphone Technique for Improved Stereo Image, Spatial Realism, and Mixing Flexibility: STAGG (Stereo Technique for Augmented Ambience Gradient) Audio Engineering Society Convention 133

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