

# Signal detection for identification energy and behaviour of male dolphin bottle nose (*Tursiops aduncus*) using NTD Model

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**Abstract.** Noisy Time Domain (NTD) model and behaviour of male dolphin using the underwater camera, and also comparing between sound and time from the spectrum. Collecting data was taken at the Safari Park of Cisarua Bogor in Indonesia, in show pool. Data at the show with replications 1, 2, and 3 has a salinity of 29 ‰. Sound whistle 3 is 28.03 dB with the frequency interval of 14.64 kHz-16 kHz. The results showed that salinity in the show pool with replication 1, 2, and 3 has salinity value that is equal to 30 ‰. F-test at the show pool has heterogeneous value. Treat at the show pool has a value of  $P < 0.001$  and  $P < 0.001$ . Noisy Time Domain have differences with each other and have a lot of different sound patterns and detection of energy from power spectral density (PSD) signal.

## 1. Introduction

The application of science in the detection of acoustic signals generated in the present era which performs experimental control systems and methods is very limited or does not have the activity or result to test the sound results of echolocation derived from the object source the male dolphin bottle *Tursiops aduncus* [1-2]. Conditions in training on the Laboratory scale must produce data that has a high level of accuracy to see whether the object is taken for the treatment of feeding and without feeding using sonar system. This is very a challenge in the field of energy that takes the source of sound from marine mammals or marine animals. Bioacoustics is a science that answers the weakness of it, by doing voice detection using passive acoustic instruments commonly called hydrophones [3-6].

From the result of data obtained by using passive sonar with the object that is dolphin males, on vocalization that is click sound which produces energy with intensity range that is 171 dB with the reference that is 1 IPa at the peak to peak, with frequency interval 36-61 kHz [8]. Measuring the sound energy generated from the object of marine animals with the location or container in the captive pond is a very good thing. This is demonstrated by the support of the object of having a biosonar system in the body, capable of making a reliable experiment capable of providing location and energy information from biosonar reflections [9]. In this research object that is sea mammal animal using dolphin males as energy producer at vocalization treatment that is whistle sound with maximal intensity value (dB) that is 229 dB return 1 IPa and possesses the highest frequency that is <100 kHz that is when treatment at echolocation in a pond/captivity.

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The process of data retrieval/data recording is done that is when the object is observed and viewed at the bottom and the surface of the pool (on the surface of the pool is 4.5m kea rah array). This is done until the object passes the position of the recording platform using hydrophone, as well as to stop data recording every 5 minutes in the process of data retrieval. The noise value generated in this study is using a tool specification with 184 dB returning 1 lPa / V, 35 dB re 1lPa with intervals of 200 Hz-2.3 kHz. The resulting ambient sound is a long spectral [10-11].

## 2. Materials and Methods

### 2.1. Power Spectral Density (PSD)

PSD is useful to create similarities in the number of rows and columns in the matrix data in the m-file data in the result of the voting process. The value of spectral power density is a useful concept to show the band value at the optimum frequency of the existing signal transmission system. The useful energy power for the frequency spectrum which is a calculated density can be processed using the FFT method[12]. Power Spectral value can be obtained equation (1,2 and 3):

$$\lambda = \frac{v}{f} \quad (1)$$

$$\lambda = \frac{C}{f} \quad (2)$$

$$PSD = \frac{|X_n|^2}{f} \left( \frac{(Amplitudo)^2}{Hz} \right) \quad (3)$$

### 2.2. Recording Whistle

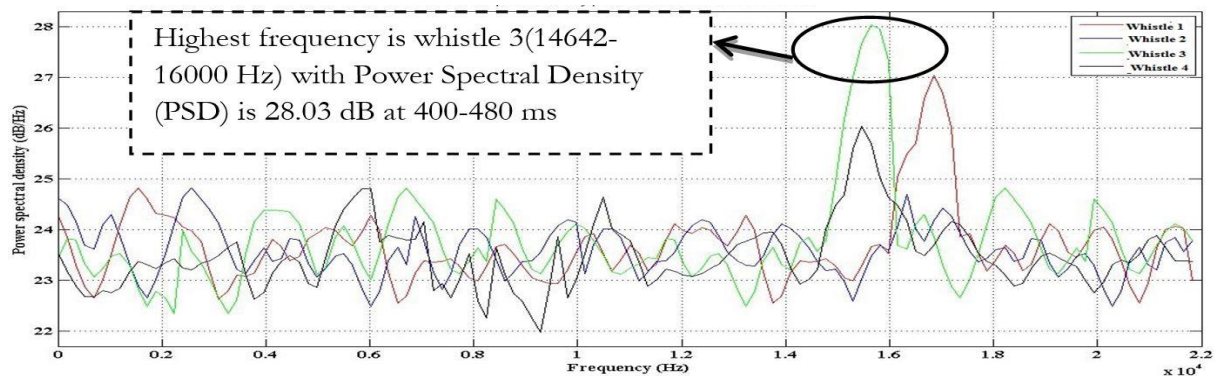
The results of the research on the energy derived from the sound of male dolphins obtained using passive acoustic method and taken underwater video data that is in July - August 2015, using GoPro Hero 3+ and hydrophone SQR 3, which has a range of hydrophone frequency is the maximum 22,000 Hz with a reference of -192 dB re 1  $\mu$ Pa. Energy derived from whistle sounds affirmed to a particular individual when a dolphin is around the camera/hydrophone, one-way proximity (<1.3 m) by simultaneously showing bubble emission and having a correlation with whistle sound results.

The sound produced from the male dolphin with a distance of more than 4.5 m from the recording equipment produces energy and whistle sound with a comparison of the energy obtained from the male dolphins at a distance of 1.5 m. In contrast to a group of dolphins in the dating, it will produce a whistle sound intensity value derived from the whistling individual sound energy that is leading to the center of the hydrophone (<1.5 m), this is estimation of the position conditions of a group of dolphins the male dolphin away ( $\geq 5$  m). In the previous study using sound and seeing the energy produced from male dolphins, only using the identification of sound bubbles removed from the object alone to identify the sound origin of each individual male dolphins [13-15]. In this study not only do that but do the recording and see the behavior of the dolphins are centered on the acquisition of energy generated in the park Safari, Cisarua Bogor in Indonesia. The sound recording of the object is using Raven Pro 1.5 software with a sampling frequency of 44.1 kHz (1-4 whistle sound). Analysis of data from the sound energy data is using F Test conducted in accordance with statistical methods with the software SPSS 14.0, and NTD model that is processed with Matlab R 2010.

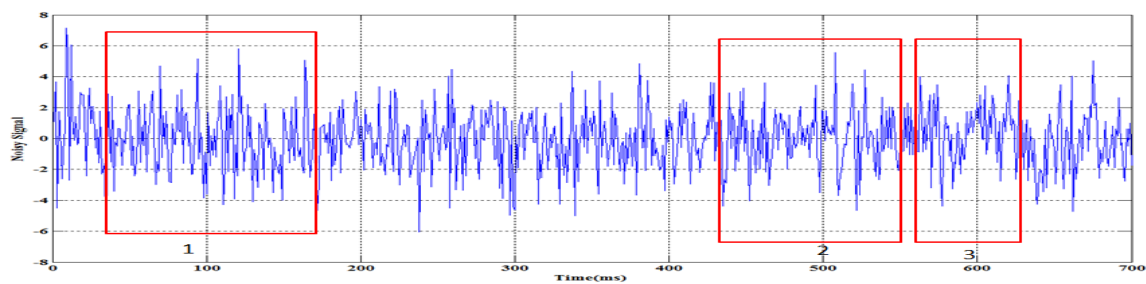
## 3. Results and discussion

The result of the PSD in the data result with M-file in the form of the matrix of the sound recording of the object has the energy of the spectrum frequency in the form of a density value which will be estimated by using FFT data processing. The Power Spectral Density (PSD) method is a useful method for seeing the amount of energy produced that is very widely used in the present era [16-17]. There are 4 whistle sounds that produce different energy from each other, with the highest PSD value being

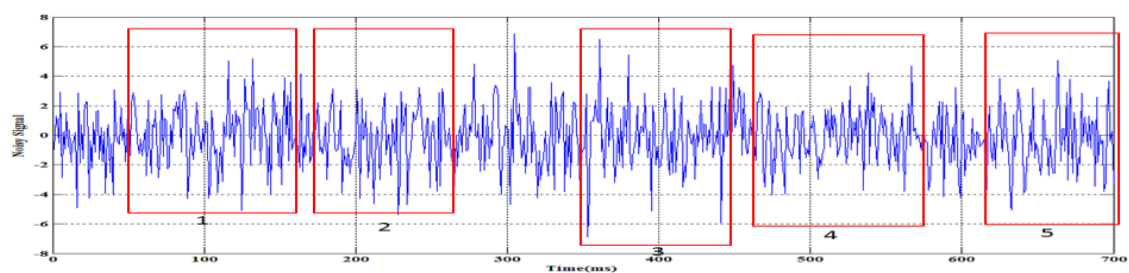
found with the highest 28.03 dB seen with the green line (figure 1). While the intensity value (dB) or calculated energy has a frequency interval of 14.64 kHz-16 kHz, while the intensity value (dB) of energy produced is at a frequency of 9300 Hz with a value of 21.97 dB PSD. In the voice data recorded on the sound of the whistle 3 produces a sound frequency with intervals of 14.64-16 kHz which is the highest sound compared with the intensity (dB) results at sounds 1.2, and 4 with the same frequency interval.



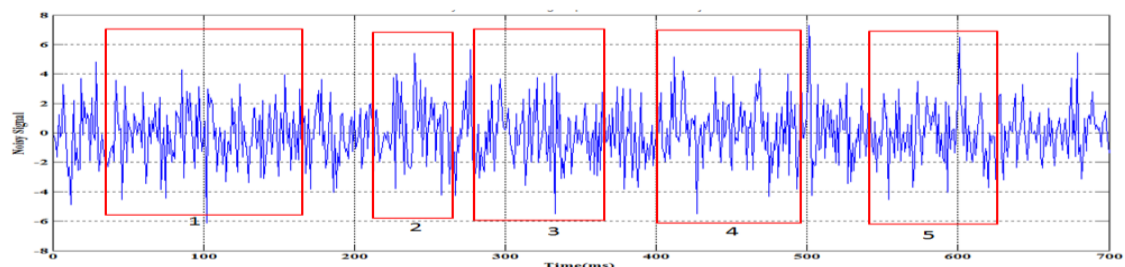
**Figure 1.** Whistle sound (PSD 1- 4).



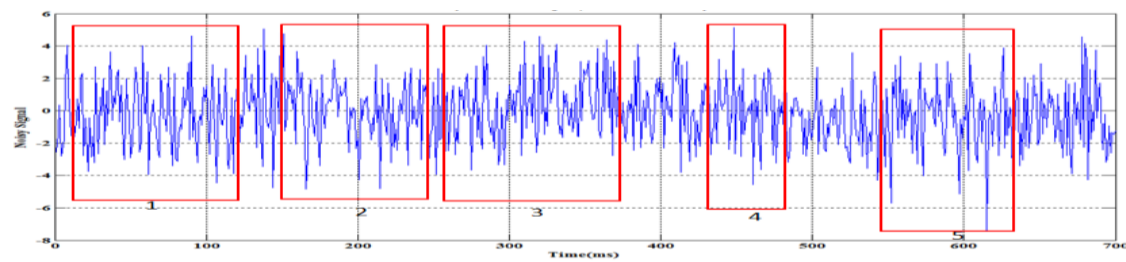
**Figure 2.** NTD whistle sound 1.



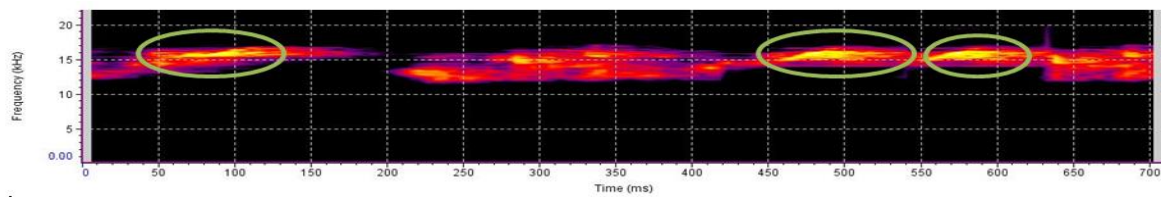
**Figure 3.** NTD whistle sound 2.



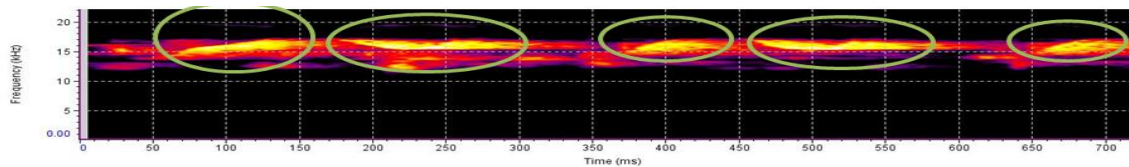
**Figure 4.** NTD whistle sound 3.



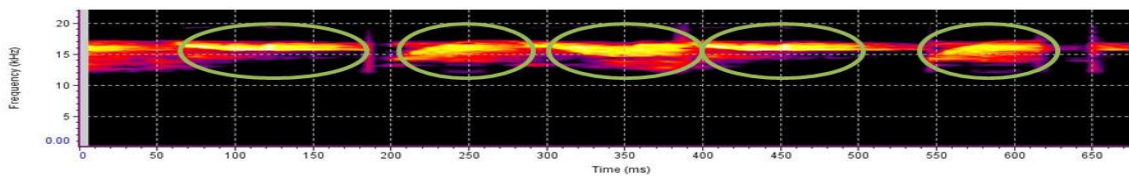
**Figure 5.** NTD whistle sound 4.



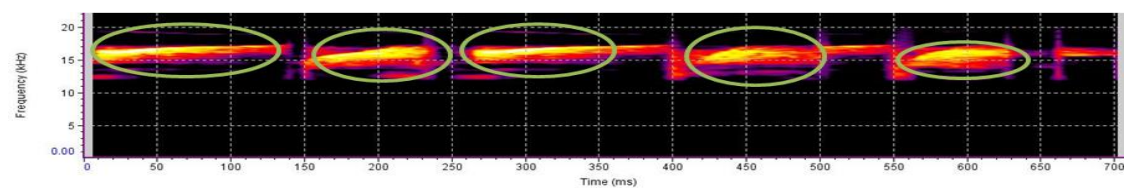
**Figure 6.** Whistle sound Spectrogram 1.



**Figure 7.** Whistle sound Spectrogram 2.



**Figure 8.** Whistle sound Spectrogram 3.



**Figure 9.** Whistle sound Spectrogram 4.

It can be seen that the whole results have 6 sound energy patterns generated at intervals of 71-141 ms, ms 1191-261, 3901-441 ms, 461-561 ms, and 6601-721 ms (figure 7). The results obtained from figure 8 obtained sound energy by the number of patterns ie 5 whistle sound patterns with intervals of 71-161 ms, 231-261 ms, 281-301 ms, 401-481 ms and 561-621 ms. In the sound energy output also produces 5 sound energy patterns whistle with intervals of 21-101 ms, 151-271 ms, 271-351 ms, 441-471 ms and 561-631 ms. The pattern has a sign with circled on the spectrogram result using a green circle, with a maximum of the original male dolphin sound results at 1, 2, 3, 4, which is 701 ms. The result of frequency value at sound energy has a range of 15.1-16.1 kHz.



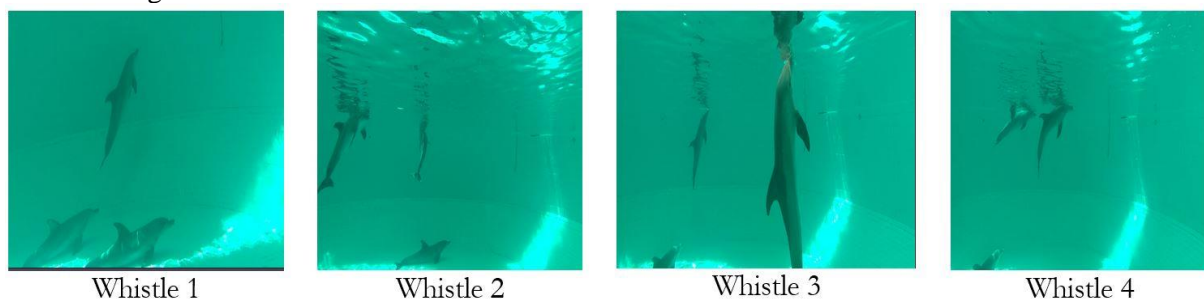
**Table 1.** F Test result

No	Time interval (ms)	Energy of whistle sound			
		1	2	3	4
1	101 with 201	*	-	-	-
2	201 with 301	-	-	*	-
3	301 with 401	*	*	-	-
4	401 with 501	-	-	*	*
5	501 with 601	-	-	*	-
6	601 with 701	*	*	-	*

-) Nothing significant effect

\*) Have significant effect

The test results using the statistical methods in F Test can be seen in table 1 on the sound energy of whistle 1 at the time interval of 101-201, 201-301 ms, 301-401 ms, 401-501, 501-601 ms, and 601-701 ms, which has a value of the test result is  $P > 0.001$ . Sound energy whistle at 101-201, 201-301 ms, 301-401 ms, 401-501, 501-601 ms, and 601-701 ms, which has a value of the test result is  $P > 0.001$ . with the result of the sound energy analysis 1-4 seen have a very significant effect on the value of the sound energy produced with the resulting time interval, while the behavior of the male dolphins during data recording tends to be above the surface of the pond. Results of photos of the dolphin behavior can be seen in figure 10.

**Figure 10.** Behaviour of male dolphin bottlenose.

#### 4. Conclusion

The results of the processing and identification of the whistle sound energy produced from the male dolphin nose bottle (*Tursiopaduncus*) carried out at the Safari Park, Bogor resulted in the PSD value, and the value of the NTD model which has a difference in the magnitude of the load (dB) other (1-4). The result of the obtained energy signal has a significant difference by using the statistical method (Test F) with the time interval of the sound energy of the whistle 1-4. This study can prove that the dolphins are used as objects have energy that is not the same as seeing the sound of the whistle 1-4.

#### 5. Acknowledgments

The study was financed by Safari Park, Cisarua Bogor, Indonesia, and we would like to thank to Politeknik Negeri Batam, for supporting all activities.

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