2019 IEEE Signal Processing Cup Bonus Task : Data Collection Description

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1. Introduction

The report presents details of the data collection experiments, which are performed for the bonus task of 2019 IEEE Signal Processing Cup. In the experiments, the sound emitted by an UAV is recorded through one microphone attached to the UAV in an indoor environment as described in the syllabus. A detailed list of the experiment configuration is presented in Table 1. This report is organized as follows. The following section presents the specifications of the microphone and the recording equipment used in the experiments, and Section 3 describes the UAV. In Section 4, the recording condition is presented including the experiment environment and the floor plan of the recording space. The spectral property of the collected data and the constitution of the dataset are presented in Section 5.

Table 1. Summary of the experiment configuration.

Experiment Conditions		
Microphone		*Soundcard*
AUDIOTRAK ATM-520p (condenser microphone) / mono		Nexi NX-USOUND2 (5.1 channel sound)
Laptop		*Drone*
MacBook Pro (13-inch, 2017, Two Thunder bolt 3ports)		DJI Phantom4 GL300C
Room Size		*Sampling Condition*
Trapezoid Floor (top width : 11m / bottom width : 13.8m/ height : 13.2m) Room Height : 8.19m		Number of bits = 16 sampling rate =44100Hz

2. Microphone and Recording Equipment

   The microphone employed in the experiments is ATM-520p (condenser microphone) model of AUDIOTRAK and the sound card is NX-USOUND2 (5.1 channel sound) model of Nexi, which is attached to MacBook Pro (13-inch 2017, Two Thunderbolt 3ports) of Apple company. The microphone is attached to the bottom of the UAV stand using adhesive tape, while the microphone is connected to the sound card by wire. MATLAB 2018a installed in the computer is utilized to verify whether the waveform is saturated or not and whether the sound is audible.

3. UAV

  As a UAV, PANTHOM 4 GL300C from DJI is employed. The PANTHOM series are commonly available in South Korea. It is low in price and has a great flight ability against the wind for ordinary wind levels. Figure 1 displays the drone for the experiment and the overall experimental environment.

<div align="center">(a)   (b)</div>
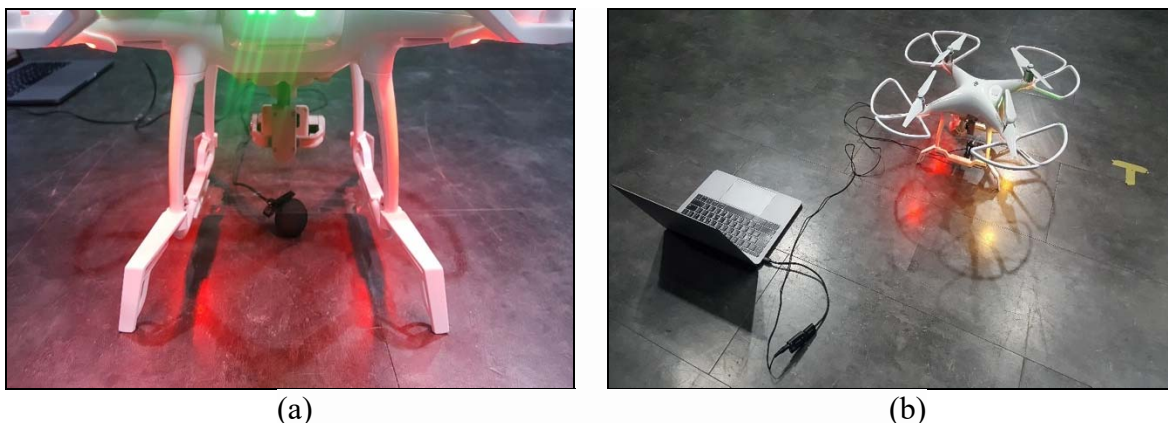
Figure 1. (a) A model PANTHOM 4 GL300C from DJI with mono microphone, (b) The laptop MacBook Pro is connected to the microphone with the sound card.

The drone can fly for 30 minutes, the steering range is 7 kilometers, and the drone speed is 72 kilometers/hour. It also has a 1-inch 20MP sensor, which has a range of 30 meters. Furthermore, It can avoid forward obstacles.

4. Recording Conditions

The number of reflectors is reduced as much as possible in the space where the recording is made. The room size is 14.166m x 14.5m x 8.4m. Figure 2 shows a photograph of the experimental configuration while Figure 3 shows the floor plan of the experimental site.
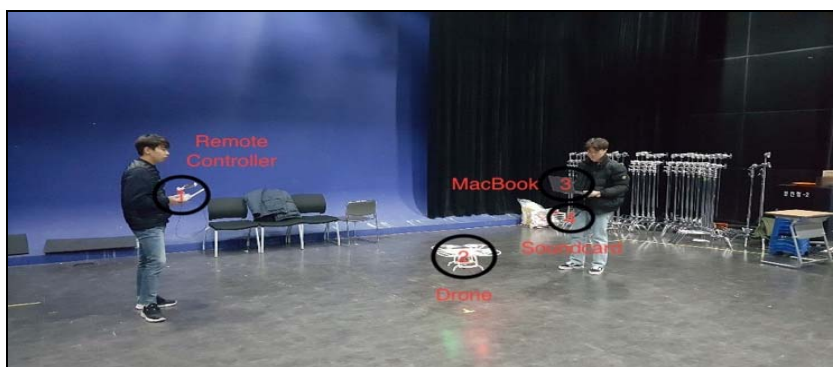

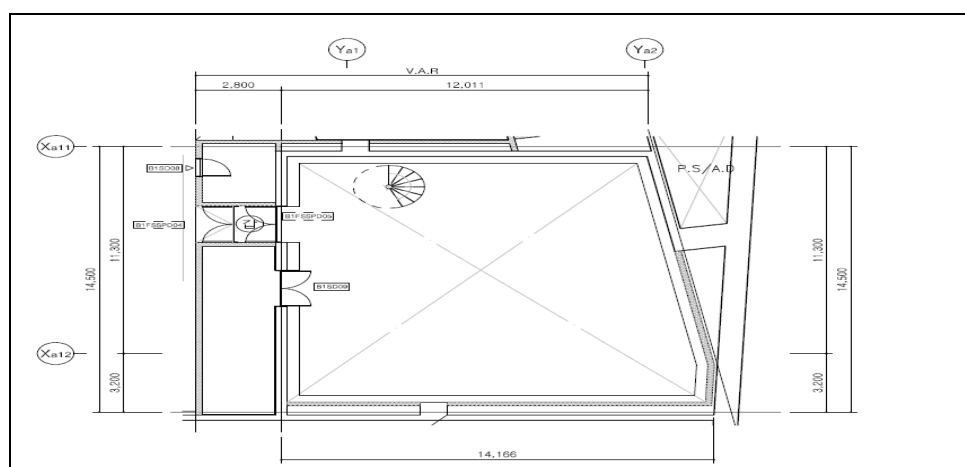Figure 2. (1) Remote controller, (2) Drone : DJI Phantom4, (3) Soundcard, (4) MacBook.

Figure 3. The floor plan of the experimental site.

5. Data set

Table 2. Configuration of the dataset.

Experimental Dataset	
Hovering	*Up-down Movement*
stationary_1 stationary_2	up_down_1
Clockwise	*Counterclockwise*
spinning_right_1	spinning_left_1
Free Flight	
free_flight_1 free_flight_2	

First, there are five flying states of the UAV: hovering, spinning (clockwise & counterclockwise), up & down, and free flight. In the hovering state, only the sound of motors and propellers is recorded. In the spinning state, height is kept constantly and rotation is only possible. Similarly, in the up & down state, only the height is changed while other conditions are fixed. In the free flight state, the motor and propeller noise are recorded when flying freely. A configuration of the dataset is summarized in Table 2.
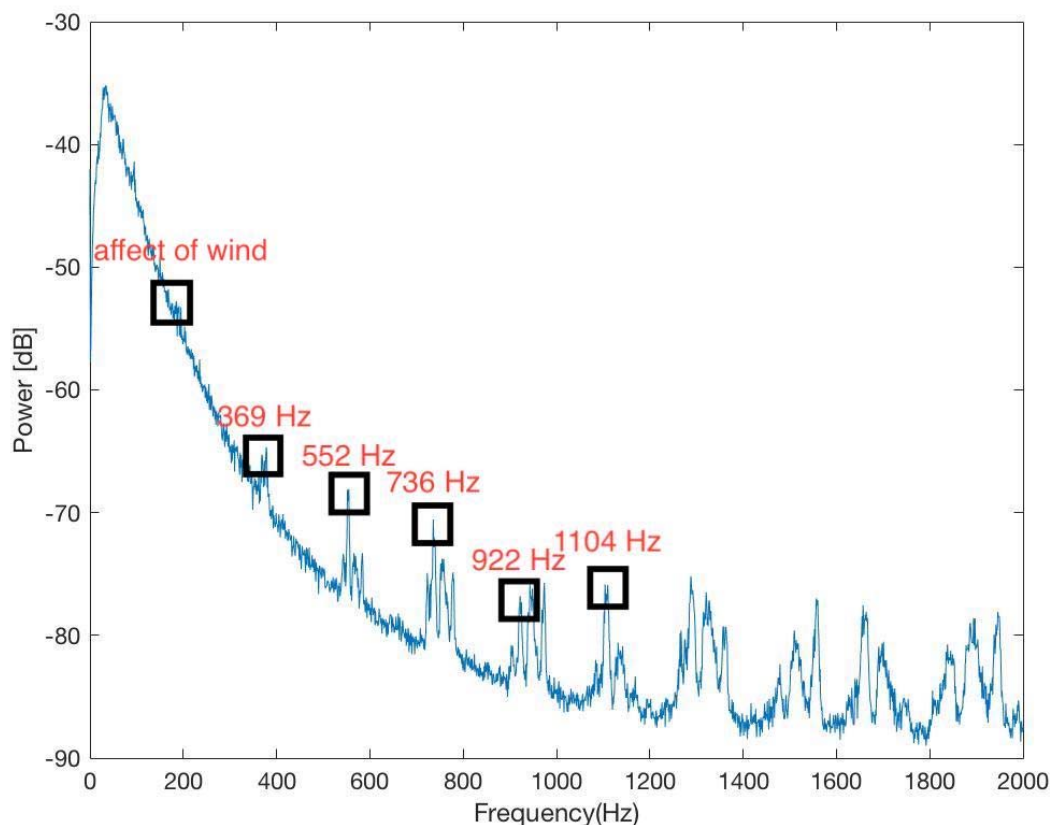

Figure 4. The power spectrum of the 'stationary_1.wav' file.

For example, Figure 4 shows the power spectrum of the stationary_1.wav file. According to this graph, the harmonic frequencies appear at an interval of 184 Hz, which indicates that the motor speed of the UAV is 184 turns/s. In the frequency band below 369Hz, the fundamental frequency component is not observed due to the wind noise.