**Task list of experimental report 2**

**Submit this report before 23:59:59, 18/05**

**Basic 1 (30 points)** :

Given a stochastic signal , where =50Hz, =200Hz, 𝑁(𝑡) is zero mean White Gaussian Noise with variance =0.1. Generate this signal with a sampling rate kHz for 3 seconds. Plot the signal and estimate the autocorrelation and Cross-Correlation . ( Hint : see practice 1, 2 of lesson 7 – experiment)

* **Requirement**：

1. Plot the signal
2. Estimate the autocorrelation and Cross-Correlation and give necessary analysis.
3. Provide your code (in your submitted rar), and it must be runnable (no error, warning accepted).

**Basic 2 (30 points)**:

Construct a sinusoidal signal with a sampling rate for T seconds, where 𝑁(𝑡) is zero mean White Gaussian Noise with variance . The parameters , T, and can be any appropriate values (you can decide their values).

* Use the autocorrelation to estimate your signal frequency and verify that the estimation result is the value as you defined. ( Hint : 𝑋(𝑡)=𝑋(𝑡+𝑇)=, and you are suggested to show ‘how close the estimated value is to the real ’ by any appropriate index(指标))
* Set =0.1, 0.5, 1, 5 (different noise power, you can try more), and plot the figure of Autocorrelation and analyze the results.
* **Requirement**：

1. Use the autocorrelation to estimate your signal frequency and verify that the estimation result is the value as you defined (Explain it with flowchart of your program)
2. Set =0.1, 0.5, 1, 5 (different noise power, you can try more), and plot the figure of Autocorrelation and analyze the results. (output the figures, and give analysis).
3. Provide your code (in your submitted rar), and it must be runnable (no error, warning accepted).

**Advance (40 points)**: include PartA and PartB

**PartA:** Under the default 4 microphones settings with (SNR=60, Is\_add\_special\_noise=1) {microphone locations: (0,0)m, (25,5)m, (50,0)m and (75,5)m; source located at (1,1)m}, correctly add the signals from the 4 microphones with correct lags, explain your program with flowchart, output the figures, output the clean speech, and give analysis.

Hint:

* You can calculate the cross-correlation between microphones 1&2, 1&3 and 1&4, and move the signal received from microphones 2,3,4 by delay some samples or adding some zeros; and then you can add them up to get a good clean speech.
* Therefore, you should change the ‘main.m’ file to achieve this task.
* **Requirement :**

1. Correctly add the signals from the 4 microphones with correct lags. (Explain your program with flowchart and necessary equations/texts)
2. Output the resulting figures with explanation, and give analysis.
3. Provide your code and the resulted clean speech (in your submitted rar), and it must be runnable (no error, warning accepted).

**PartB:** Under the default 2 microphones settings with (Is\_add\_special\_noise=0) {microphone locations: (0,0)m and (50,10)m; source located at (1,1)m}, calculate the probability of success of ‘correct lag detection’ under at least 7 cases: SNR = -20,-10,0,10,20,30,40, and

* The definition of ‘correct lag detection’ is:
  + If error in the figure below is 0, it is ‘correct’
  + Otherwise, it is ‘wrong’

**Requirement :**

1. You should write a ‘for’ loop, randomly test 100 independent times (write down your flowchart in your experimental report).
2. Then list all the results of ‘correct lag detection’ under different SNR in one table, and show your analysis.
3. Is there other criterion suitable to judge the time domain beamforming method instead of ‘correct lag detection’? Give your discussion and results.
4. Provide your code, and it must be runnable (no error, warning accepted).

**Extra (+10 points)** :

You are given 16 microphones, with id = 0:1:15. These microphones are located at (0,0+0.17\*id)m. The source is now located at (0,10)m, and:

* Parameter settings: SNR=20, Is\_add\_special\_noise=1.
* Note that the lags between microphones 1&2, 2&3, 3&4, …, (id-1)&id, …, 14&15, are the same.
* **Requirement:**

1. Correctly add the signals from the 16 microphones with correct lags, explain your program with flowchart.
2. Output the figures, and give analysis.
3. Provide your code and the resulted clean speech (in your submitted rar), and it must be runnable (no error, warning accepted).