实验报告讨论

Weize Sun

实验三的提交方法

- 由于大家提交的实验一和实验二，有不少的"提交的时候的格式问题"，这里对实验三重新

3、 **The result and Analysis**

- **Part 1: Basic 1 (40 points)**

You should submit your codes that can generate the figures in 3). The codes should be runnable!

1) Plot the Periodogram with different window (rectangular and hamming), and compare the results, describ

- **Part 2: Basic 2 (40 points)**

You should submit your codes that can generate the figures in 1). The codes should be

- **Part 3: Advance (40 points)**

1) You are required to submit your code, and your code should directly give all the tables or figures in 1.2).

1.1) Plot your system flow chart. You can provi

50nd, 100nd run and the power spectrum. your figures here only, analysis can be given

2) You are required to submit your code, and your code should directly give all the tables or figures in 2.2).

1.1) Plot your algorithm flow chart. You can provide necessary explanations.

1.2) Give your MSE and success rate results, a
(Hint: use table or figure, and you should choc
see '100% success' and '100% fail')

3) plot the figures/tables in 2) using y
again, and show the comparison
Correlogram function and the default I

1.2) Give your MSE and success rate results, and analysis, under different SNR, and compare the results with 1). (Hint: use table or figure, and you should choose an SNR range that can at least see '100% success' and '100% fail')

实验三的提交方法

📄 2022300013-卫宏林-实验报告3.docx
📄 2022300013-卫宏林-实验报告3.pdf
📁 2022300013-卫宏林-实验报告3.rar
📄 advance1.2.m
📄 advance2.2.m
📄 basic1.m
📄 basic2.m
📄 MyCorrelogram.m
📄 MyPeriodogram.m

同时对doc文件生成一个pdf

然后压缩文件，压缩后的文件命名为"2022300013-卫宏林-实验报告3.rar"

然后直接发送此rar文件即可

实验三的提交方法

advance1.2

advance2.2

basic1

basic2

2022300013-卫宏林-实验报告3.docx

2022300013-卫宏林-实验报告3.pdf

2022300013-卫宏林-实验报告3.rar

> basic1

名称

basic1.m

MyCorrelogram.m

MyPeriodogram.m
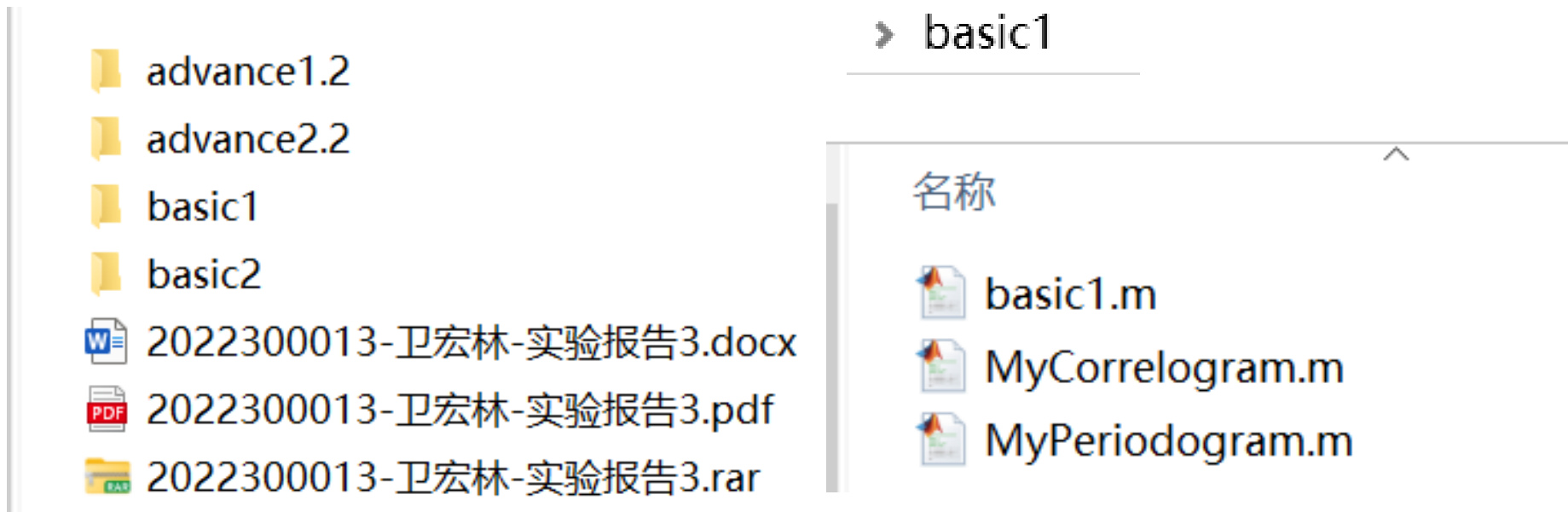
另一种方法是，每个部分单独用文件夹隔离开

然后压缩文件，压缩后的文件同样命名为
"2022300013-卫宏林-实验报告3.rar"

然后直接发送此rar文件即可

实验二的问题

- 有部分同学缺了程序，回头会单独通知，请补交程序（不补交report）

实验二的问题

- 有部分同学缺了程序，回头会单独通知，请补交程序（不补交report）

- 因为实验报告二的模板里面，没有说的很清楚要大家交的程序，要运行出来的图片和实验报告二中的什么部分要一致，所以，这里只是要求大家交实验程序，程序的作用是拿来做"参考"

- 但在实验报告三里面，程序会严格参与评分：如果程序无法允许出正确的结果会降低分数

• 有部分同学交了程序，例如


```
Advance1.m  ×  +

1 –     clc
2 –     clear all
3 –     close all
4 –     load noise.mat  |     % load the special noise if needed (there is no need)
5       % for the special noise, the odd lines are the opposite of the even lines
```
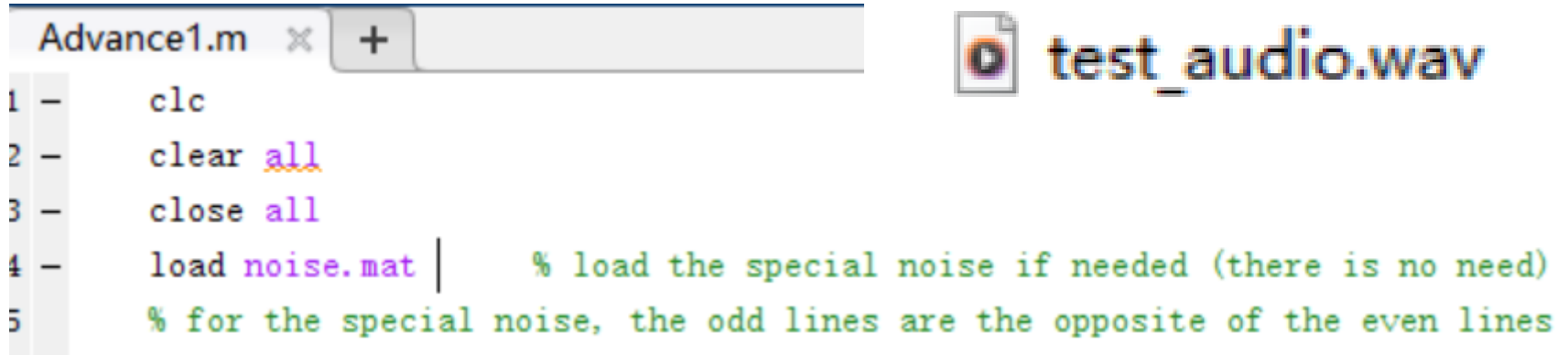
• 然后，没有附上noise.mat
• 虽然noise.mat是实验要求里面提供的文件，但，在"交程序"这个事情上，首要要求"说明清楚或直接配置好运行环境"，在我们的实验情况下，就是需要把"noise.mat"打包进自己的.rar文件里面。这样才能确保"能运行"

实验二的问题 – 最常见情况

- 大概统计，在实验二，80%的同学都交了附属文件。
- 如果只是缺图中两个文件的，我已经直接补充了

noise.mat

test_audio.wav
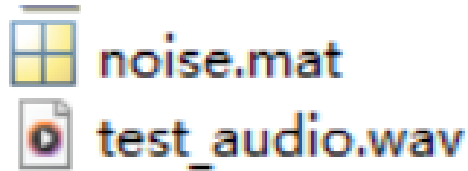
- 但如果有其他的，可以联系一致重新提交一次code
- 实验三里面，特别提醒：任何附属的.m和.mat等文件（如果有），一定要包含在内。举个例子：

basic1.m

MyCorrelogram.m

MyCorrelograms_add.m

MyPeriodogram.m
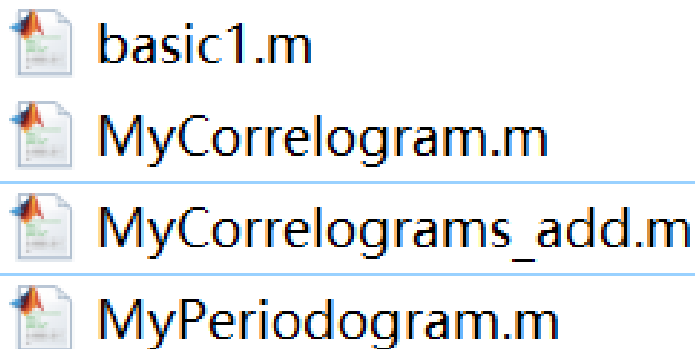
实验二的一些情况或问题总结

- 程序跑出来的结果
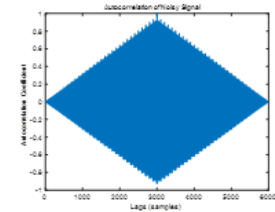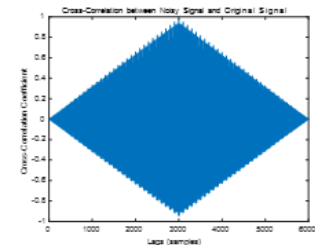
- Report 里面：
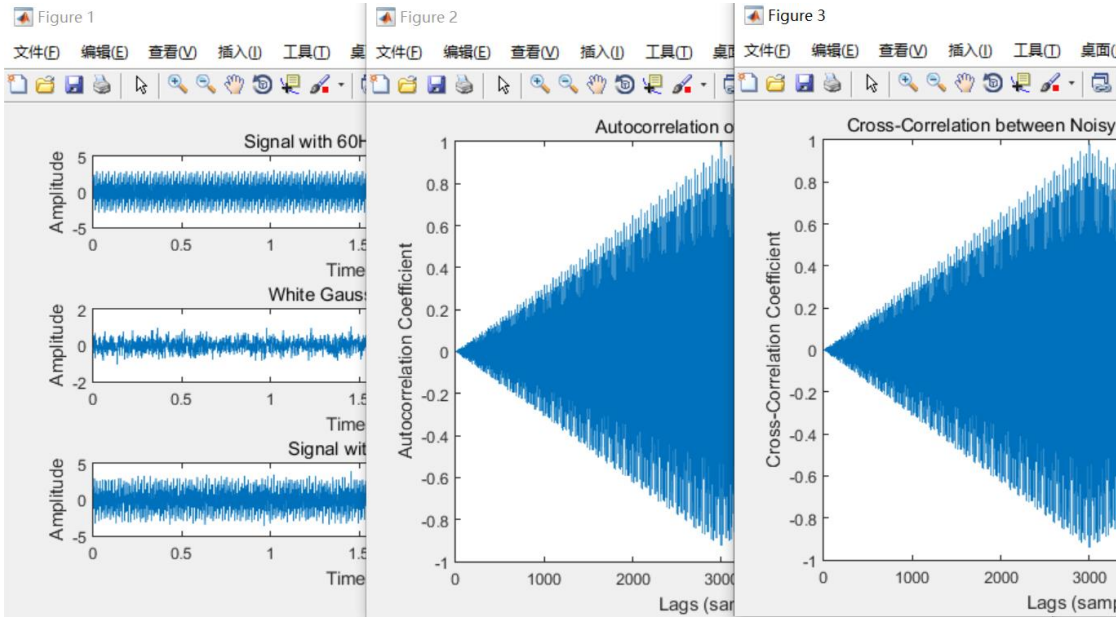
Good！

実验二的一些情况或问题总结

- 像这样列个表是最正确的
- 不过，在细节方面有可以改进的地方，例如这个 $\pi/2$ ，可以用公式编辑器或word里面的"插入公式"来写！

- **Part 2 - Basic 2: (40 points)**
a) Write your parameter setting here, using a table.

Parameter Table			
signal frequency	phase	sampling rate	sampling time
57 Hz	Π/2	2000Hz	1s

Table 1: The parameter for Basic 2

According to the Nyquist sampling frequency theory, the sampling rate should be greater than twice the highest frequency of the signal. But in the experiment, since the we want to calculate the autocorrelation function's period according to the distance between two local highest value, we set the sampling rate much higher than the twice the highest frequency of the signal. Otherwise, the consequent estimated frequency will be far away from the true frequency.

文件　开始　**OfficePLUS**　插入　绘

π 公式 ∨

在此处键入公式。

s)\pi

)π
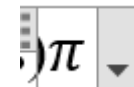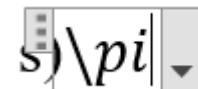
実验二的一些情况或问题总结

- 这种table也行，在这个report里面，没有那么在乎格式

- 但是，提醒：学校毕业论文的时候，里面的格式要求是非常严格的。

- 此外，从美观的角度看，一般建议一个report里面，图和表的格式只有一种。

True Frequency	Estimated Mean	Estimated Std Dev
57	58.475	2.9926

Table 2: The results of the signal frequency estimation of 100 independent runs

	signals received by the mics
X1, 2, 3, 4	signals received by mics 1, 2, 3, 4
Lag_**_estimate	negative, number of estimate lag samples
Real_lag	negative, number of real lag samples
x*_lag	the signal after aligning

Table 3: Some complicated variables' meaning in "Advance 1"

- 像这种表格也是可以的
- 但是，图片和表格一定要有标题
- 实验三的所有图片和表格一定要有标题

- **Part 2** - **Basic 2: (40 points)**
a) Write your parameter setting here, using a table.

Parameter	Value
Frequency (f)	100 Hz
Variance (σ^2)	[0.5, 1, 5]
Sampling Frequency	1000 Hz
Signal Duration	1 second
Number of Runs	3

nding DOAs for all lags from -

lag	DOA
-11	-86.141
-10	-65.098
-9	-54.719
-8	-46.521
-7	-39.414
-6	-32.971
-5	-26.969
-4	-21.273
-3	-15.79
-2	-10.452
-1	-5.204
0	0
1	5.204
2	10.452
3	15.79
4	21.273
5	26.969
6	32.971
7	39.414
8	46.521
9	54.719
10	65.098
11	86.141

of your program, the estimati

实验二的一些情况或问题总结

- 这里是一个超级经典的情况，在不少同学的report里面会看到。大家交过来的时候，可能公式是对的（无移位），但我这边打开的时候，可能会出现移位。在本次实验一二里面，我就直接给大家移回去了。

- 但是，在日常工作中，这是属于"需要避免"的情况。

- 如何避免？

<p style="text-align:center; color:red;">Pdf！</p>

anything with only equations)

If ____, and it is Stationary, then:

$$R_X(\tau) = E[X(t+\tau)X(t)] = E[X(t+T+\tau)X(t)] = R_X(\tau+T) \qquad (1)$$

Which means that if the stochastic process has a periodic component, the autocorrelation function also has a periodic component. From the equation, we can also see that the autocorrelation of the signal the signal <u>have</u> the same period. Consequently,

$X(t) = X(t+T)$

实验二的一些情况或问题总结

- 有同学在实验报告的一开始，把"requirement"文件的内容抄了一遍。
- 不会扣分，但不必要，实验三不要放了

教务处制

Description of format:
- Use Times New Roman, 12 pt, single column, single line spacing.
- When inserting figures and tables, title of the figures and tables must be included.
- Do not change '1、Purposes of the experiment' and '2、Design task and detail requirement'.

1、 **Purposes of the experiment**
   1) Use Matlab to calculate the autocorrelation of some functions, and use the result to solve some typical problems.
   2) Analyze the results and give reasonable conclusions

2、 **Design task and detail requirement**
   Basic 1 (10 points):
   A random signa $X(t) = \sin(2\pi f_1 t) + 2\cos(2\pi f_2 t) + N(t)$, where f_1 =60Hz, f_2=150Hz, $N(t)$ is white Gaussian Noise with mean 0 and variance σ^2=0.1. Generate a signal sampled at 1 kHz for 3 seconds. Plot the signal, and the autocorrelation $R_X(\tau)$,

实验二的一些情况或问题总结

- 一些奇奇怪怪的小错误

$$R_{xx}(\tau\tau = \int [x(t) * x(t-\tau)]\, dt$$

- 所谓表格，是真的需要在word文档里面编辑个表，所以，任何时候，都不要截图！

a

Variance	Estimated_Frequency
0.5	1
1	1
5	1

实验二的一些情况或问题总结

• 关于matlab里面做截图
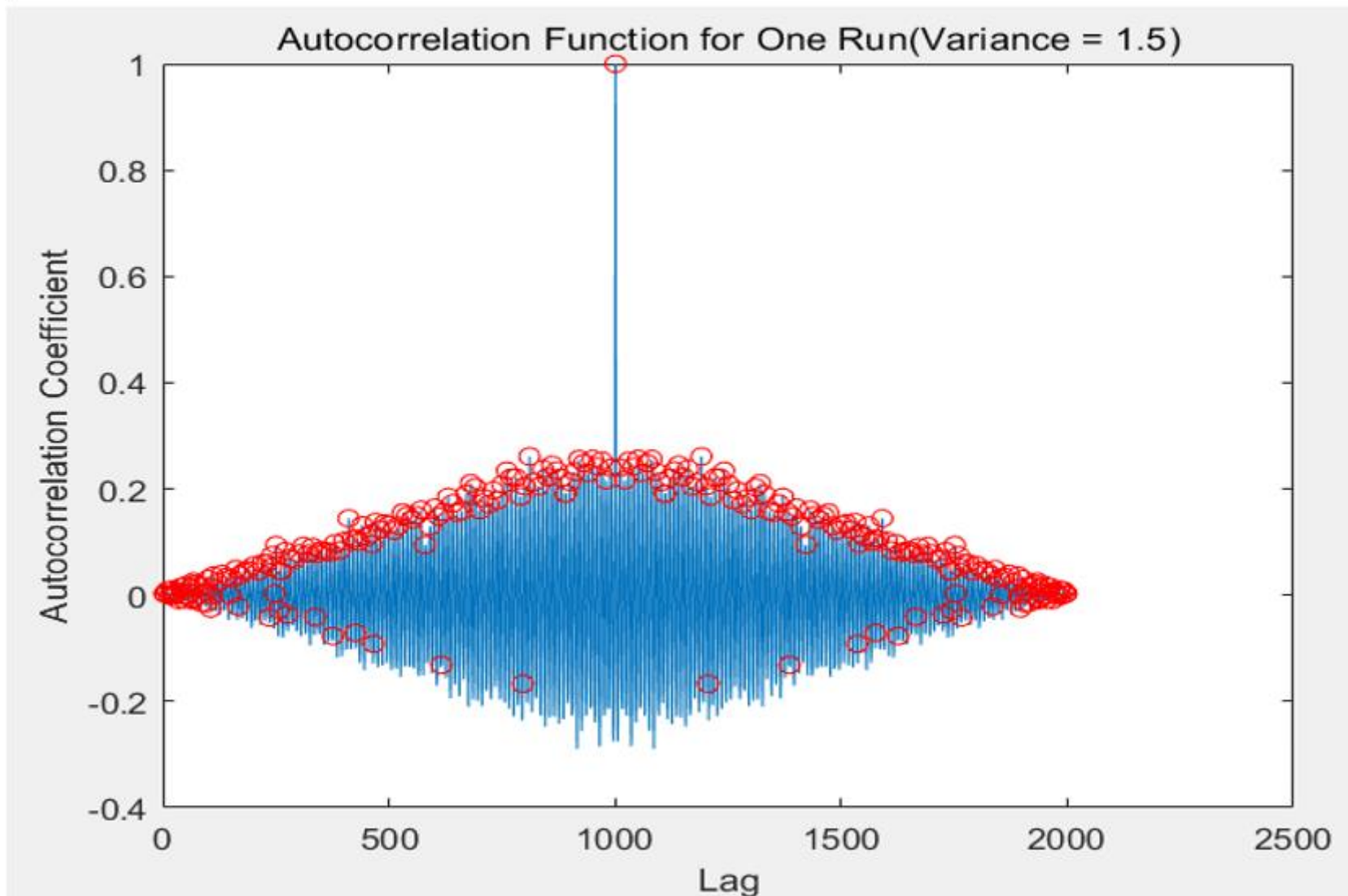
实验二的一些情况或问题总结

- 这里教大家一个更好的方法：matlab的图片里面有一个"copy figure"，用这个，会得到"矢量图"

这样截图的结果举例

Cross-Correlation between Noisy Signal and Original Signal

- 从内容来说，这个图好，因为它附加标记了max point
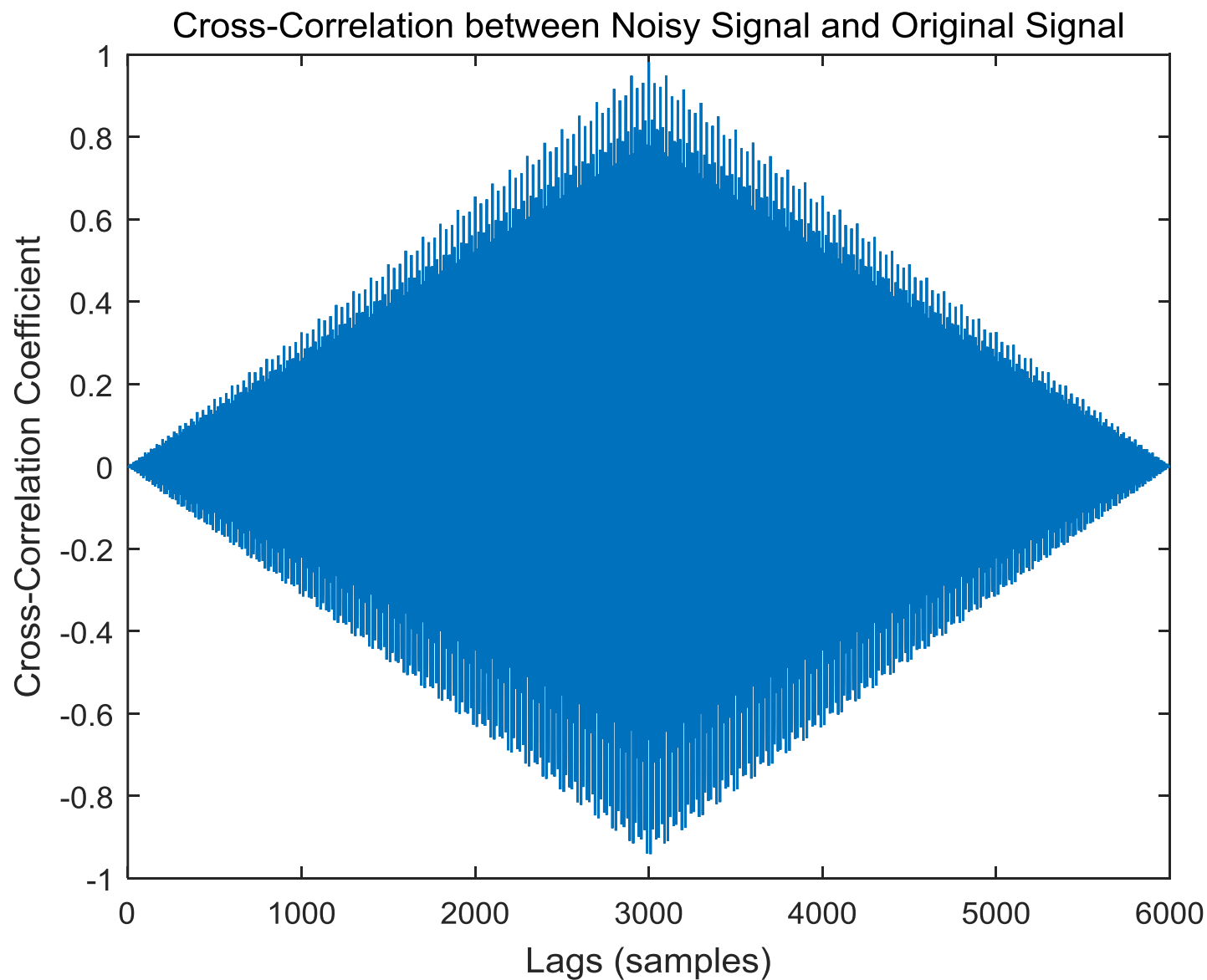
实验二的一些情况或问题总结

- 从内容来说，这个图好，因为它附加标记了max point

- 细节：可以看到，2000-2500这一截是多余的，建议看看这个
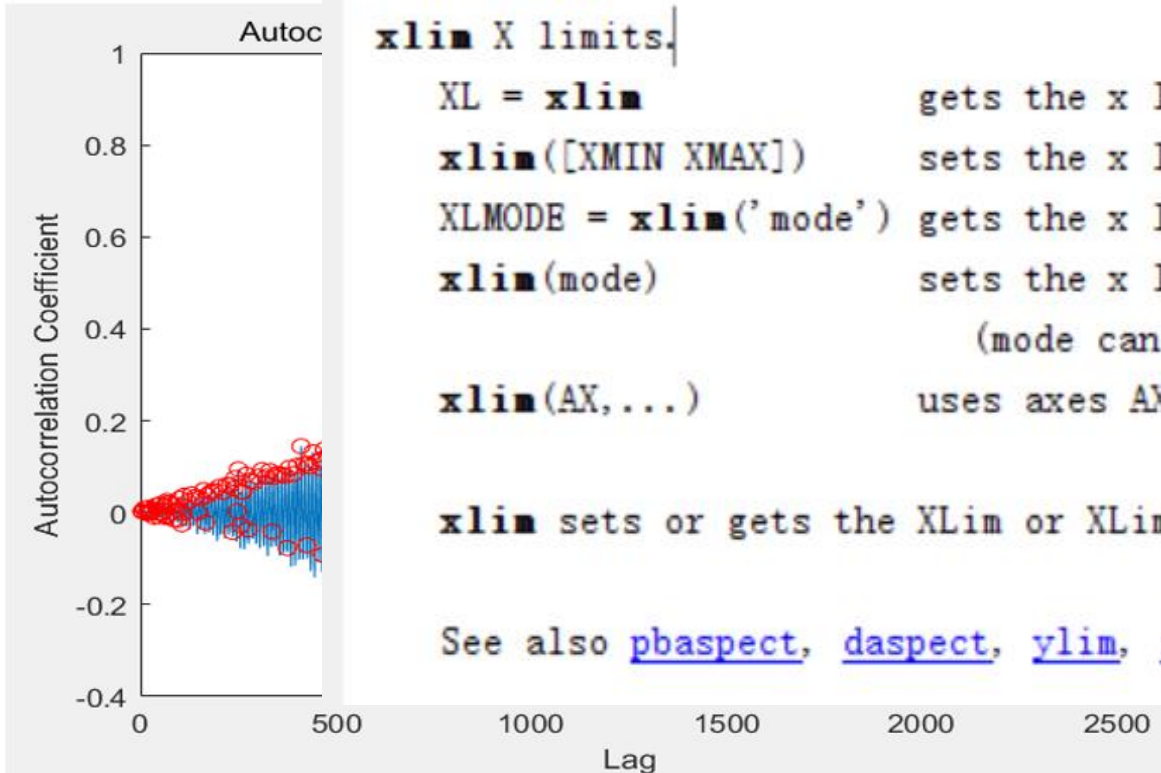
```
>> help xlim

xlim X limits.

    XL = xlim                    gets the x limits of the current axes.

    xlim([XMIN XMAX])            sets the x limits.

    XLMODE = xlim('mode')        gets the x limits mode.

    xlim(mode)                   sets the x limits mode.

                                    (mode can be 'auto' or 'manual')

    xlim(AX,...)                 uses axes AX instead of current axes.


    xlim sets or gets the XLim or XLimMode property of an axes.


    See also pbaspect, daspect, ylim, zlim.
```

実験二的一些情况或问题总结

- 像这种，一般来说，最后列个表，画图也行。
- 截图不够正式

```
Accuracy at SNR -10 dB: 66.5%
Accuracy at SNR -9 dB: 76%
Accuracy at SNR -8 dB: 84.5%
Accuracy at SNR -7 dB: 91.5%
Accuracy at SNR -6 dB: 97%
Accuracy at SNR -5 dB: 98.5%
Accuracy at SNR -4 dB: 100%
Accuracy at SNR -3 dB: 100%
Accuracy at SNR -2 dB: 100%
Accuracy at SNR -1 dB: 100%
Accuracy at SNR 0 dB: 100%
```

accuracy under different SNR conditions(2 microphones)

实验二的一些情况或问题总结

- basic 和 advance部分，基本都能做对（大部分基本正确）。
- 细节这里就不一一说了。

- **Part 3 – Advance 1:**
  a) Explain your method (add the signals from the 4 microphones with correctly estimated lags) with necessary texts, equations, and/or flowchart.
  b) Show the figures under 3 SNR cases (SNR = 30,10,-10dB).
  c) Your analysis.
- **Part 4 – Advance 2:**
  a) Please list the corresponding DOAs for all lags from -11 to +11 in one table. (there are totally 23 numbers)
  b) Show the flow chart of your program, the estimation result (correct detection percentage or other indicators) of the DOA versus SNR(dB), and your analysis.
  c) Show the flow chart of your program, the estimation result (correct detection percentage or other indicators) of the DOA versus SNR(dB), and your analysis.

Extra

- **Part 5: Extra**

Is there any method to get better estimation? Please try it and give your result, **including flow chart of your program, explanation of your method, the estimation result (correct detection percentage or other indicators) of the DOA versus SNR(dB), and your analysis.**

Extra part (10 points):
You are given 8 microphones, with id = 0:1:7. These microphones are located at (0, 0+0.085*id)m. The source is now located at least 60 meters away. (It is far field source in engineering). The sampling rate of the signal is $N = 44100$. (use the sound signal given).

Now, assume that the signal comes from $[-\pi/2, +\pi/2]$ (randomly in every independent run), as describe above, the grid base method can only estimate 23 DOAs. If the real DOA is not in the 23 DOA grid, the error will be large! Is there any method to get better estimation? Please try it and give your result, **including flow chart of your program, explanation of your method, the estimation result (correct detection percentage or other indicators) of the DOA versus SNR(dB), and your analysis.**

- 做的人不多

Extra

- 值得注意的是，这里是已经限定了采样频率，因为是用的test_audio，所以，直接增加采样频率是不行的，需要用一些别的方法。例如

- 方法1：
  - 1&2之间，如果无法识别0.5个sample的差距，那么，1&3是否可以？
  - 在最极端的情况下，1&8号麦克风，能做到的最大的精确度是多少？

Extra

- 值得注意的是，这里是已经限定了采样频率，因为是用的 test_audio，所以，直接增加采样频率是不行的，需要用一些别的方法。例如
- 方法2：
  - 原始信号是给定的，但值得注意的是，对语音来说，44.1K的采样频率足够覆盖所有语音信号。此时，可以
  - 首先对信号做插值
  - 然后，对麦克风做接收（否则，麦克风是无法接收0.5这种非整数的信号的）
  - 但是需要注意的是，在麦克风做接收的时候，接收到的依然是44.1K的采样频率的信号
  - 然后，对每个麦克风接收到的信号做插值
  - 然后再插值后的信号里面去做匹配