

# AMATH 582: HOMEWORK 1

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ABSTRACT. **TODO: Actually edit this later** Your report should contain a brief, 100 word abstract describing what is contained in the document and what you did. **Don't forget 6 pages max.**

## 1. MISC NOTES WHILE ANALYZING THE DATA

**TODO: Remove later** I am currently trying to visualize the data more on my own with the packages provided by matplotlib and plotly. It is confusing to me a bit since we are really visualizing something that has 4 dimensions. There are signals or values which are occurring in a 3 dimensional space.

## 2. INTRODUCTION AND OVERVIEW

**TODO: Actually edit this later** Here you will give a brief introduction to the problem you solved. Including some discussion of relevant literature and background.

Make sure you use the correct citation commands (i.e., `\cite`) to keys from your bib file like this `[?]`. If you want to cite more than one reference simply use `[?, ?]`. You can grab latex citations from Google Scholar. Just keep in mind that they often need to be cleaned up.

## 3. THEORETICAL BACKGROUND

**TODO: Actually edit this later** You dedicate this section to the theoretical background of the methods and frameworks that you used in your homework. This is not meant to reproduce material from the lectures or references you used but rather to demonstrate your understanding of the mathematical foundations of the methods and algorithms. You can create equations like this

$$f(x) = \int_A \sin(\pi x) dx.$$

You do not need to label your equations unless they are referenced in the text. In that case simply use

$$(1) \quad -\frac{\partial^2 u}{\partial x^2} = \sin(\pi x).$$

Also look up the `align` or `aligned` environments if you want multi-line equations. You can then reference your equations in text using the `\eqref` command as such (1).

#### 4. ALGORITHM IMPLEMENTATION AND DEVELOPMENT

**TODO: Actually edit this later** Here you discuss the algorithms and software packages that you used. Not much to it. Just make sure you cite the packages properly and avoid including code. You are welcome to use  $\text{\LaTeX}$  packages that are specifically designed to show algorithms such as this, but it is not always worth the effort and real estate.

#### 5. COMPUTATIONAL RESULTS

**TODO: Actually edit this later** In our work to locate and track the suspected submarine in the puget sound, it was of utmost importance to be able to think through the dimensionality of this problem. We are tracking a signal from a location in 3 dimensional space, which inherently becomes a 4 dimensional problem. I had to come up with methods of thinking about what it meant to average something that is 3 dimensional across its fourth dimension (time). I had to visualize things in lower dimensions in my mind to make sense of the actions that we need to take. One thing that helped was taking slices of the average frequencies across time to confirm what we found by calculation. As seen in Figure 1 by looking at the slices corresponding to the location of the max frequency in our cube of frequencies.



FIGURE 1. **TODO: increase font size and give a detailed caption.**

This helped confirm that I had identified the correct dominant frequency at which to center the gaussian filter to help us eliminate the noise. Furthermore we visualized the path of the of the submarine in Figure 2

Moreover, I was able to generate several other important visualizations in gif form which are viewable on my Github. This is the animation of the 3 dimensional path and this is the animation of the path in just the  $x$ - $y$  plane ( $z = 0$ ).

You will most definitely need tables and figures. So here is an example.

row 1	column 1	column 2
row 2	column 1	column 2
row 3	column 1	column 2

TABLE 1. Don't forget to include a caption for your table. Say a few words about what is being shown.

Make sure your table is labeled and referenced withing the text using `\ref` as such Table 1. In fact, you can use `\ref` to cite anything else in the document such as sections (ex. Section 2). This will create hyperlinks in your pdf after compilation and automatically update the numbers and tags whenever you change anything.

Figures are very similar to tables. Here's an example:

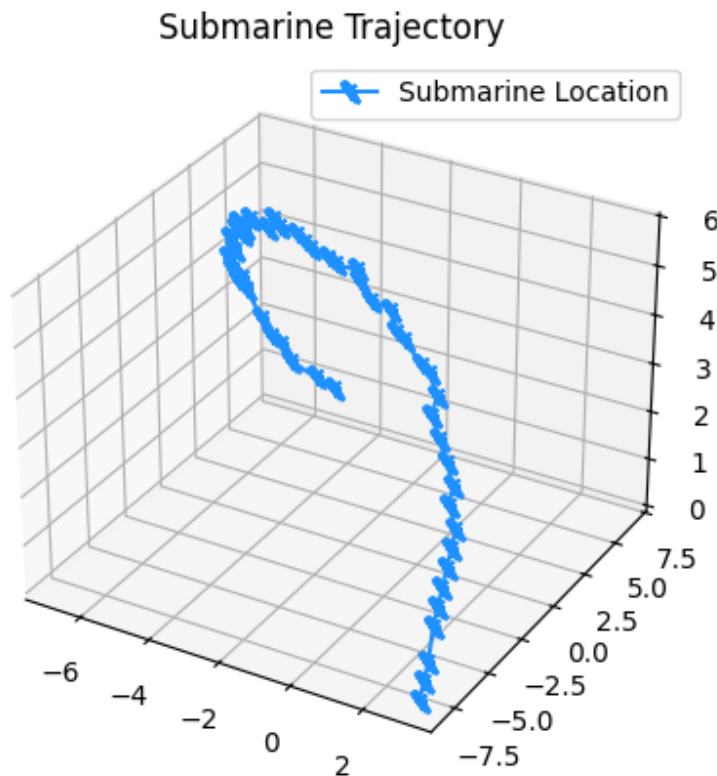


FIGURE 2. **TODO:** give a detailed caption.

You may also need to include multiple figures:

Once again, make sure all your figures are referenced like Figure ?? or Figure ?? in the text body of the report and discussed in detail. This is where you will make observations about your results and we will look at these very closely.

Also note, I am using PDF figures. These give you the best looking graphs but PNG works well too. I advise staying away from JPG as it always looks weird and low quality.] Both Python and MATLAB can output figures in PDF or PNG.

## 6. SUMMARY AND CONCLUSIONS

Wrap up your report with a brief summary of what you did and what you discovered. Finish with some conclusions and possibly future directions if any.

## ACKNOWLEDGEMENTS

The author is thankful to Jaxon Tuggle for useful discussions about the process to find the dominant frequency in task 1. Additionally Hailey Sparks was thoroughly helpful when comparing methods by which we identified the correct location of our gaussian filter for task 2. I would also like to thank Professor Eli Shlizerman for carefully instructing us in class and answering questions in Office Hours.