

Code and Report Practical

CS4302: Practical 2

It is worth 70% of the coursework

Please note that MMS is definitive for weighting and deadlines, which, occasionally have to be changed.

Summary

This practical consists of writing a Matlab program to solve signal processing and image processing tasks and writing a report to describe and discuss your methods and results.

Goals

The main goal of this practical is to gain experience in the processing of signals in the time and frequency domains. A secondary goal is to provide you with an environment for image and signal processing.

Requirements

You will prepare a report for this practical. Please refer to the requirements below. Please include figures in your report.

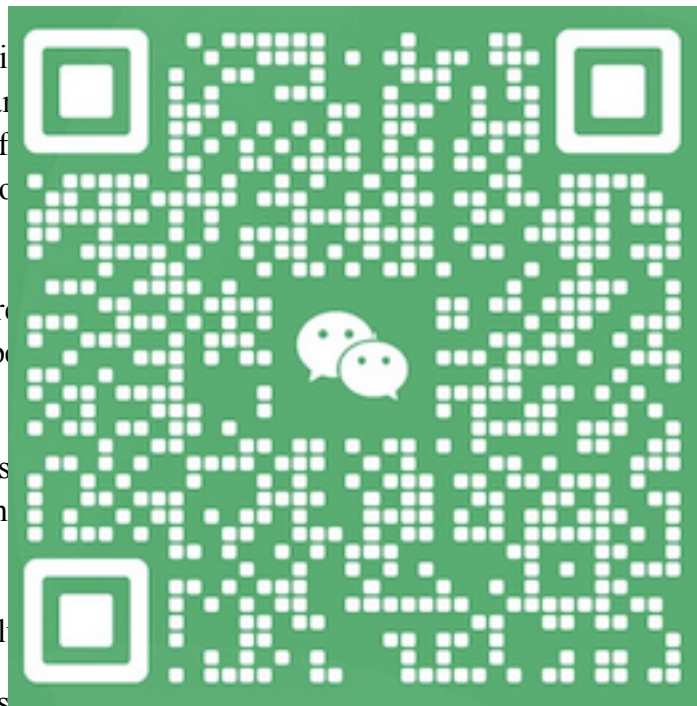
Note that some parts of the practical are more challenging than others. The practical is to get you to be familiar with the tasks.

Tasks

You will need to solve

Audio Signal Processing

1. I have provided you with three audio files with the same base signal of interest, each of which contains different background noise (audio_in_noise1.wav, audio_in_noise2.wav, audio_in_noise3.wav). For each of these files, what is the frequency of the noise? Show how you identified the noise frequency using a frequency plot and provide an explanation. Note that in one of the files there are two noise frequencies.
2. What do the audio files sound like with noise removed? Remove the noise from the audio files by using frequency filtering. Show your steps for frequency filtering including plots in the frequency and time domain and a description of your process. Save the filtered signal as noise_removed<noisefilename(1/2/3)>.wav for each



respective audio file, using the same numbering strategy as the original filenames. Listen to these audio files and describe the change in the audio file for each in the report.

Image Analysis:

Rainbow Shapes Inc. is working on creating software that can identify coloured blocks of different shapes. This software will not just count the total number of blocks and the quantity of each shape but will also offer a detailed breakdown of the colors for each type of block. You can access a collection of challenging images featuring colored blocks placed on a neutral-toned surface in the practical directory on studres – with filenames: “<difficulty-level>.jpg”, with very_easy, easy, medium, hard, very_hard and extreme difficulty levels [tip: start with the easy difficulty and work up. I would not recommend starting on a hard to extreme difficulty. Also note that it’s not expected that you will get the “correct” answer for harder difficulty levels].

The below tasks ask you to write a/some program(s) to count (a) the total number of blocks, (b) the number of blocks for each shape and (c) the number of blocks for each color. In all cases you must show results for each image and discuss these results.

3. Develop a program to segment the image into blocks. Detail your methodology and discuss results.
4. Expand the program to count the number of blocks for each color in the image. Justify your approach in terms of accuracy and analyze the results.
5. Further improve the program to count the number of blocks for each shape. Whether using a different approach, show the results for each image.
6. Perhaps extend the program to count the number of each shape with a corresponding colour, and document your approach as previously described.

Deliverables

You will deliver through MMS the following elements, compressed in a zip with the same folder structure that you used to run them:

- A **pdf** with your answers to the tasks (include all figures in the report as well as a discussion of the method and results). This report has a maximum limit of 10 pages (with font size 12 of a standard font such as Arial or Times New Roman), including all the figures.

- Your Matlab Script.
- The audio files you created of the noise removed for each of the three audio files.
- Any additional files (code or otherwise) that you used to complete the assignment.
- The input files (audio and images).

The standard penalty for late submission applies (Scheme A 1 mark per 24 hour period, or part thereof): <http://info.cs.st-andrews.ac.uk/student-handbook/learning-teaching/assessment.html#lateness-penalties>

Over-length penalty applies: Scheme A (under-length not penalised): 1 mark for work that is 10% over-length, then a further 1 mark per additional 10% over. See <https://www.st-andrews.ac.uk/policy/academic-policies-assessment-examination-and-award-coursework-penalties/coursework-penalties.pdf>

For the avoidance of doubt – for this practical the length is defined as the total number of pages in the pdf (which must include all figures etc).

Please note that the Coursework Policy is available at <http://info.cs.st-andrews.ac.uk/student-handbook/learning-teaching/assessment.html#lateness-penalties>

The marking will cover the following areas: <http://info.cs.st-andrews.ac.uk/student-handbook/learning-teaching/feedback.html>

You should also be aware of the following practical:

- To get a mark in the 11-13 band is a submission which achieves a solution in a straightforward way and contains some evaluation, but is lacking in quality and detail, or is accompanied by a weaker report which does not evidence good understanding. Perhaps you have achieved only the first three tasks.
- To get mark in the 14-16 range should complete all parts of the specification, consist of clean and understandable code, and be accompanied by a good report which clearly describes the process and reasoning behind each step and contains a good discussion of the achieved results including graphs and evaluation measures. You are expected to try all tasks



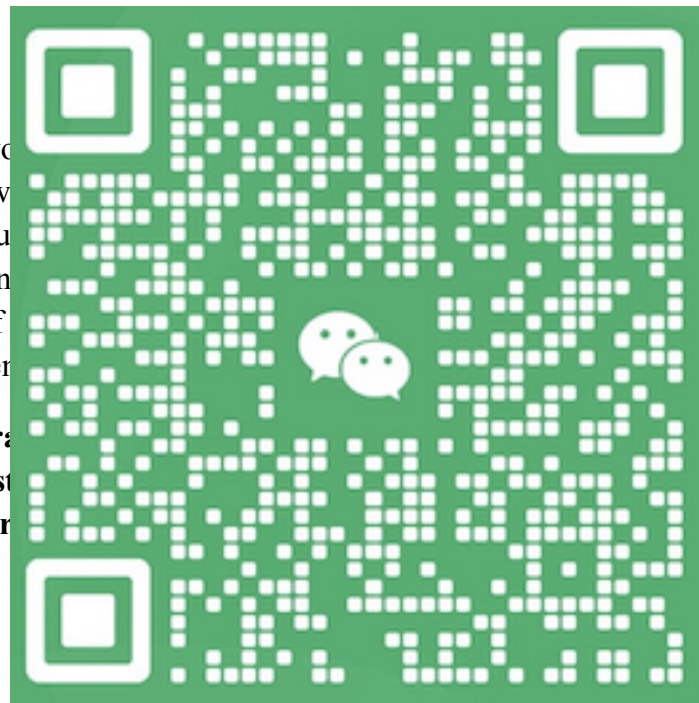
and have these written up, but perhaps tasks 5 and 6 are not fully complete and/or the methods used could have been improved.

- To achieve a grade of 17-18, this should have excellent justification and experimentation into the methods used with relevant citations linking with the literature. You must have completed tasks 1-5 and perhaps tried task 6 but there could be some improvement either in the report or the method (note that you are not expected to get perfect results for the image analysis task).
- To achieve a grade of 19-20, this should have exceptional methods and report with wonderful justification and experimentation into the methods used with relevant citations linking with the literature. You must have completed all tasks (note that you are not expected to get perfect results for the image analysis task).

General Advice

Try to relate what you have learned from the model lectures. Clarity in your answers is important for readability. Make sure you create figure captions that are larger than the font size of the text. Do not make the caption size small to compete with the text.

Throughout the project, explain what you did it that way (justification) along the way when you make a decision means.



model lectures. Present your code for the report) and you should not be smaller than the caption.

the work, why you outputs of the steps at the result