

EEE 438 Term Project

1 Objective

The aim of this project is to build a virtual, but complete digital communication system using MATLAB.

2 Description

The various functions that your code should have are described below.

main_file.m This is your code's master script which calls different functions to do certain tasks. This master script at first should take input from a text file called ***source_data.txt*** containing a long passage. This code also sequentially calls the following functions.

source_stat.m This function is called by the master script just after taking input from ***source_data.txt*** and it returns an exhaustive list of symbols present in the text and their corresponding probabilities to the master script.

source_code.m This function takes the returned symbols with their probabilities and method of source coding as input and produces a compressed bit string. The methods of source coding can be Huffman coding or Lempel-Ziv coding. In case of Lempel-Ziv coding symbols are binary encoded to convert them into bit string.

convolution_code.m This function takes the source coded bit sequence and generator sequences as inputs and produces a convolution coded bit sequence. The function must be general so that it can encode for any generator sequence.

modulation.m This function takes the convolution encoded bit sequence, bitrate and method of modulation as inputs and produces a time domain signal. The time domain signal should be the modulated signal of the bit sequence using the chosen method. The methods can be MASK, MPSK, MFSK and GMSK.

awgn_channel.m This function takes the line coded time domain signal and noise variance as inputs and produces received time domain signal by adding Gaussian noise.

demodulation.m This function decodes the received noisy modulated signal into a bit sequence. This function should optimally decode for all possible methods of modulation.

convolution_decode.m This function optimally decodes bit sequence using Viterbi algorithm. The function must have provisions for both full and low complexity decoding.

source_decode.m This function decodes the Viterbi decoded sequence into the original symbols and saves it in the text file *received_data.txt*.

3 Submission Guidelines & Requirements

The submission deadline is **July 25, 2018**. Each student must upload a single zip file containing pertinent codes (functions and master scripts described above) and a pdf report before the deadline. Submission window will be closed in due time and requests for late submission will not be considered. **File size must not exceed 5 MB**. The report should contain the following:

- A succinct theoretical description of the function blocks discussed above and how it is implemented in the MATLAB code.
- The effect of channel noise variance on the error rate (=number of wrong symbols/total number of symbols) of the digital communication system should be discussed. What is the maximum noise variance for which all the texts in *source_data.txt* and *received_data.txt* match? What is the minimum noise variance for which at least 40% of the symbols in the source and received text does not match?
- Does the presence of channel coding (convolution coding) have any effect on the error rate of the system? If channel coding is turned off for the same level of noise variance, what happens to the error rate?
- Does changing the generating sequence of the convolution code effect the error rate?
- Does the complexity of Viterbi decoding have any effect on the error rate of the system?
- Does the error rate change for same level of noise variance but different methods of modulation? What method leads to the lowest error rate and why?
- Does Huffman coding help to decrease the error rate? What happens to the error rate if Huffman coding is not used?
- Does Lempel-Ziev coding help to decrease the error rate? What happens to the error rate if Lempel-Ziev coding is not used?
- Does the dictionary length of Lempel-Ziev coding have any effect on error rate?

4 Notes

- Submitted report must have a top page containing the student's ID and name.

- This compulsory project carries minimum weight of 50% of final grade. Reports with quality figures and cogent presentation, and further investigation than the asked questions will be rewarded extra points to cover shortcomings in other grading criteria.
- Plagiarism is highly advised against and both parties will be penalized harshly if apprehended.
- Students are advised to avoid nested loops as much as possible and there will be extra points for optimized coding.
- You are welcome to discuss any problems you face with me over email or after the class.
- If your functions need more inputs than specified here, please feel free to do so.
- Do not worry if you do not understand how to to this assignment at this moment. You will be taught all these in EEE 437 theory class and EEE 438 sessional.