Discrete Time Signals and Systems

Elec 342

Lab Experiment #4

Andre Hei Wang Law

4017 5600

Section MK-X

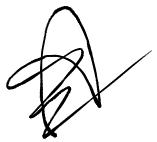
TA: Ahmed Salameh

TA Email: ahmed.salameh@mail.concordia.ca

Performed on March 13, 2023

Due on March 27, 2023

“I certify that this submission is my original work and meets the Faculty’s Expectations of

Originality.”

**1) Objectives**

For the fourth lab of the course Elec 342, students will first be introduced to user-defined functions through the usage of the MATLAB reserved keyword “function”. Then, students will practice on various variable access and modification method through the “persistent” and “global” reserved keywords as well as the call by reference and pass by value passing mechanisms. Finally, students will learn about the sampling theorem in order to investigate the effect of sampling rate on the Fourier transform of a signal.

**2) Theory - Definitions**

Function: In MATLAB, “function” is a reserved keyword that is used to define a function. This keyword is used at the beginning of the function definition to indicate that you are creating a function. The naming convention of the M-file is recommended to be the same as the function name.

Call by Reference: It is a parameter passing mechanism in which a reference to a memory location is passed to the function, and the function can modify the value at that memory location. Any changes made to the value in the function will also be reflected in the original variable outside the function.

Pass by Value: It is a parameter passing mechanism in which the value of the variable is passed to the function as a copy, and any changes made to the value in the function do not affect the original variable outside the function.

Persistent Variable: In MATLAB, it is a type of variable that retains its value between function calls. Once a persistent variable is defined and initialized within a function, its value will be preserved even after the function is exited, and the variable can be accessed and modified in subsequent calls to the same function.

Global Variable: It is a variable that can be accessed and modified from any part of a program. In MATLAB, the global variable can be defined by using the "global" keyword. This type of variable is usually used in situations where a variable needs to be shared across multiple functions or used in a central location in a program.

Sampling Theorem: This is a fundamental concept in digital signal processing also known as the Nyquist-Shannon sampling theorem. It states that in order to accurately reconstruct a continuous-time signal from its sampled values, the sampling rate must be at least twice the maximum frequency component of the signal. This means that the sampling frequency should be greater than or equal to twice the bandwidth of the signal.

**3) Tasks, Results and Discussion**

Task 1: User-defined function and function call

Ex 1 and ex 2 top

Results 1:

Discussion 1:

Task 2: Call by value

Ex 2 bottom

Results 2:

Discussion 2:

Task 3: Pass by reference

Ex 3 and ex 4

Results 3:

Discussion 3:

Task 4: Persistent Variable

Ex 5

Isempty function

Results 4:

Discussion 4:

Task 5: Global Variable

Ex 6

Results 5:

Discussion 5:

Task 6: Sampling Theorem

Results 6:

Discussion 6:

**4) Questions**

Question 1 a): Code

Question 1 a): Results

Question 1 b): Code

Question 1 b): Results

Question 2: Code

Question 2: Results

Question 3 a): Code

Question 3 a): Results

Question 3 b): Code

Question 3 b): Results

Question 3 c): Code

Question 3 c): Results

Question 3 d): Code

Question 3 d): Results

Question 3 e): Code

Question 3 e): Results

**5) Conclusions**

In conclusion, this lab is designed to provide students with a comprehensive understanding of user-defined functions in MATLAB, as well as variable access and modification methods using the reserved keywords "persistent" and "global", and the call by reference and pass by value passing mechanisms. Additionally, this lab will explore the sampling theorem and its application in digital signal processing, with a focus on understanding the impact of sampling rate on the Fourier transform of a signal. In the end, students will have a deeper understanding on signals by working with sampling rate, Fourier transform, polar plots, LTI system, distorted signals, etc.

**6) Appendix**

There will be no appendix for this experiment. All source code was placed accordingly in their section above.

**7) References**

ELEC 342 Lab 4: Functions in MATLAB and the Sampling Theorem.

<https://users.encs.concordia.ca/~realtime/elec342/manuals/lab4.pdf>