

FACULTY OF ENGINEERING, ALEXANDRIA UNIVERSITY ELECTRICAL ENGINEERING DEPARTMENT COMMUNICATION AND ELECTRONICS

MINI PROJECT I:

GENERAL SIGNAL GENERATOR

EEC 271 SIGNALS & SYSTEMS

SECTION:5

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General Signal Generator

Abstract

In the field of signal processing and analysis, the ability to generate customizable signals is crucial for various applications. This project presents a user-friendly signal generator developed using MATLAB.

The signal generator features an intuitive graphical user interface (GUI) that allows users to specify the parameters of the desired signal, including signal type (such as DC, ramp, sine wave, etc.), frequency, amplitude, duration, and more. Additionally, users have the option to perform various operations on the generated signal, such as amplitude scaling, time reversal, time shift, expanding or compressing the signal, clipping, and computing the first derivative.

The GUI dynamically adapts to the selected signal type, displaying relevant input fields and operations customized to the chosen signal characteristics. This enhances user experience and streamlines the process of signal generation.

Objectives

- **Develop a User-Friendly Interface**: Design and implement a user interface in MATLAB that is intuitive and easy to use, allowing users to interact with the signal generator efficiently.
- **Enable Parameter Entry**: Provide functionality for users to enter parameters of the signal, such as frequency, amplitude, duration, and waveform type, through text inputs, dropdown lists, or other suitable UI elements.
- **Support Multiple Signal Types**: Implement support for generating various types of signals, such as sine waves, ramp waves, triangle waves, and custom waveforms with several breakpoints, giving users flexibility in signal generation.
- Ensure Flexibility and Customization: Allow users to customize signal parameters according to their specific requirements, including frequency ranges, amplitude levels, signal durations, and any additional signal characteristics.
- **Visualize Signal Waveforms**: Provide visual feedback to users by displaying the generated signal waveforms graphically within the interface, enabling users to preview and validate the signals before generating them and after performing any additional operation on the signal.
- Facilitate Signal Generation: Enable users to generate signals directly from the interface by clicking a button or similar functionality, making the signal generation process seamless and straightforward.

Procedure

Several steps were taken in order to bring the mathematical knowledge of signals and how operations on signals are done to a real efficient project.

- A friendly user interface was programmed in order to give the user the opportunity to enter all the signal parameters at once
- Users have several lists to choose from the operations required to be executed
- Each signal was identified by its own parameters in order to generate an accurate signal
- Several operations on the signal that can be executed have been added to a list to give the user the opportunity to modify the generated signal
- At the end of the execution 2 graphs are given as an output, the first graph represent the original generated signal and the second graph shows the new signal if there is any operation done

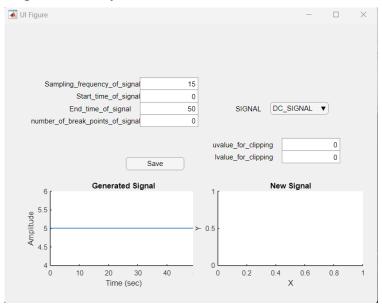
Code Output

Signal Generation

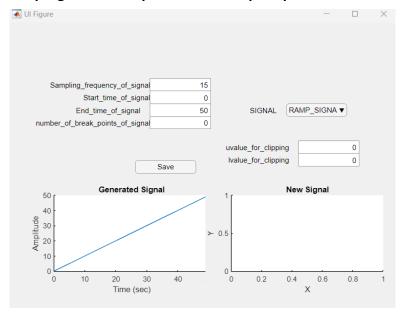
For the following parameters, several signals figures were generated to verify the efficiency of the code

- Sampling Frequency
- Start time of the signal
- End time of the signal
- Number of break points

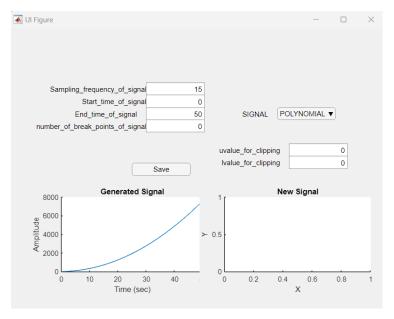
DC signal with amplitude 5



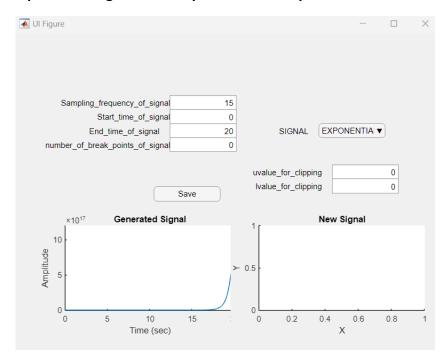
♣ Ramp signal with slope 1 and intercepted part 0



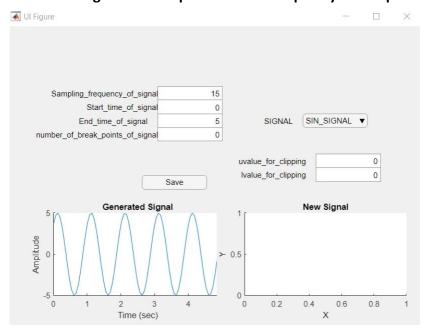
4 Polynomial function $3x^2 + 2x + 1$



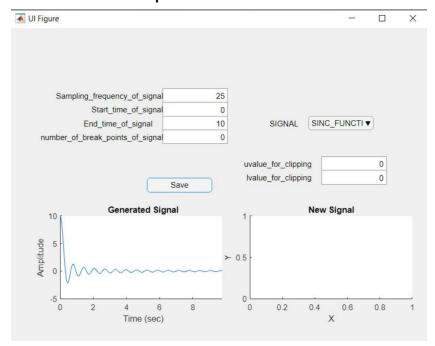
★ Exponential Signal with amplitude 5 and exponent 2



♣ Sinusoidal Signal with amplitude 5 and frequency 1 with phase Pi/4



Sinc function with amplitude 10

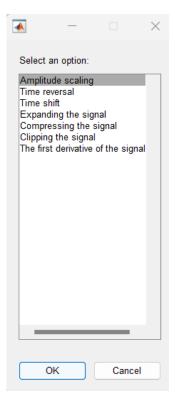


♣ Triangular Pulse with amplitude 5 and width 5

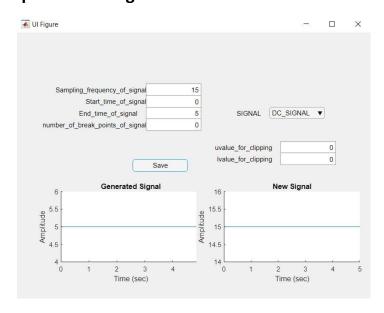


Operations on signal

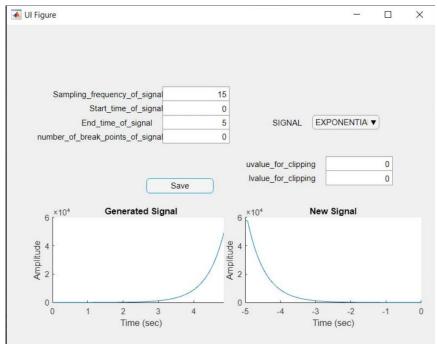
A list of 7 operations is provided to the user to give the user the opportunity to modify on the generated signal



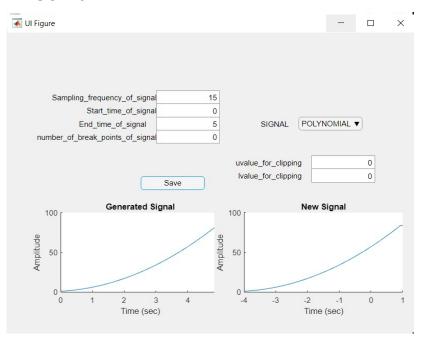
o Amplitude Scaling



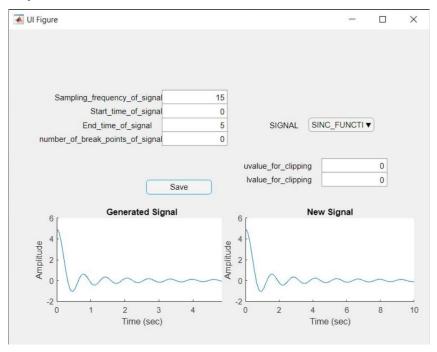
Time Reversal



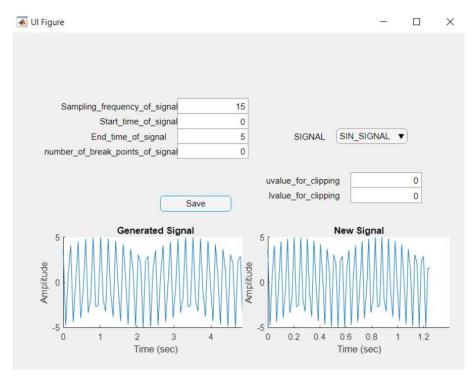
o Time Shift



Expansion



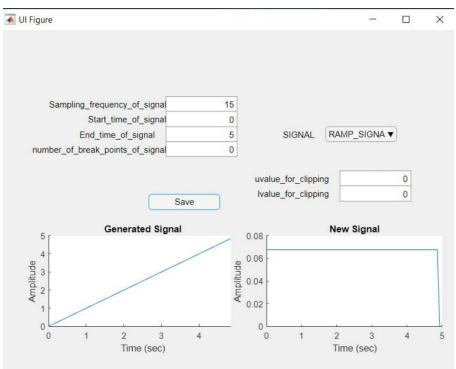
Compression



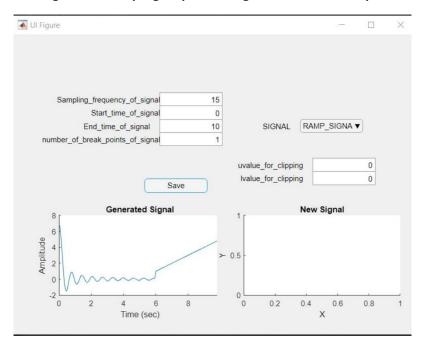
Clipping



First Derivative



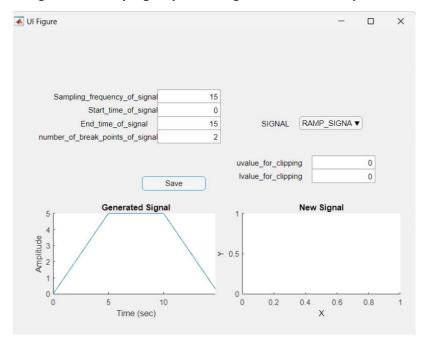
- > In addition to several operations, different signals with any number of break point can be plotted together and any operation can be executed on both signals at the same time
 - Sinc signal and ramp signal plotted together with 1 break point



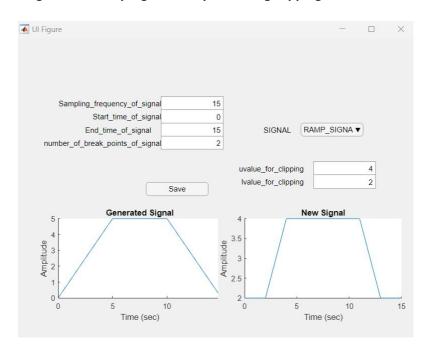
o Sinc signal and ramp signal with after performing first derivative on both functions



o DC signal with ramp signal plotted together with 2 breakpoints



o Dc signal with ramp signal after performing clipping on both functions



UI Design

GUI design emerges as a critical component, it enhances the entire user experience, as a well-structured user interface improves the whole user experience while using the program making it accessible and intuitive for users to input parameters and interact with generated signals. By carefully crafting elements such as input fields, dropdown menus, and interactive buttons. The UI allows users to effortlessly customize and generate signals to their specific requirements.

Ultimately, the significance of UI design in a signal generator project lies in its ability to enhance usability and elevate the overall user experience.

DESIGN

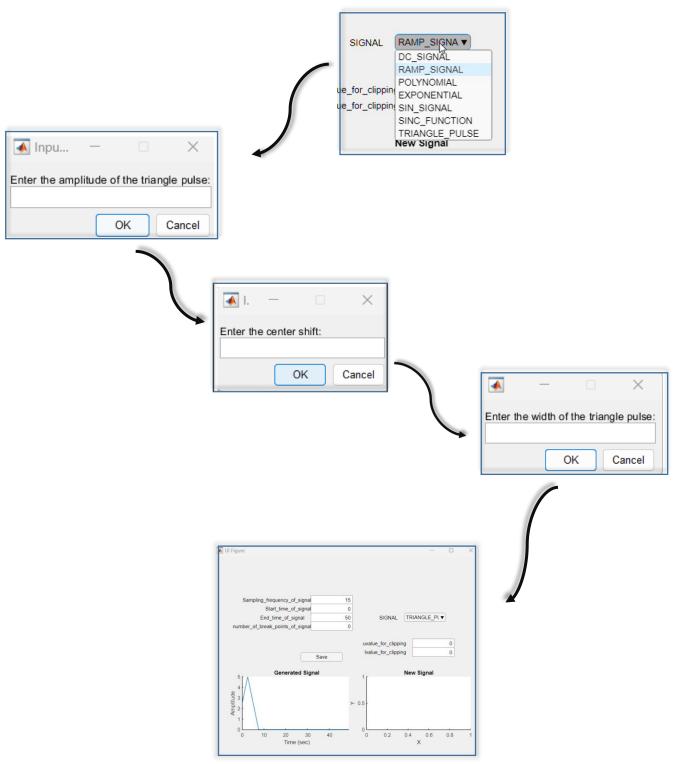


As shown in the design the user is given the opportunity to enter all the signal parameters at once and chose the type of the signal from the drop down list. Moreover the signal visibility is shown in two graphs, the first graph is to plot the original generated signal and the second graph is to plot the signal if there is any additional operation executed on the signal.

User Experience

After entering all the main parameters of the signal the user has to choose the type of the signal required to be generated from the drop down list.

Input dialogue pops to allow the user to enter all the parameters of the chosen signal



After the signal is generated, the user is asked if there are any additional operation is required to be executed on the main signal.

If there is additional operation, a drop down list is shown to allow the user to choose the operation required and then asked further questions depending on the operation chose.

