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Lab 1: Generation and operating of signals on matlab and python

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Abstract
This report presents the final results of the simulation for the differents forms of signals Just like senusoidal,pulse, triangular, quadratic, that are present nowdays in any kind of engineering aspects also the ways that exist to tranform those parametres mentioned. A GUI was desgined using the Matlab App Designer Tool and all the mathematic models fpr the signals were also implemented.
Keywords: Signals, operation, scaling, downsampling.

1. Introducción

This laboratory practice was done in order to have a better understanding of signals and their transformation just like scaling ,reflection, compresion, expantion, downsampling, upsampling and others. This time modification on the ride of this proyect will be plasmaded on the software Matlab.On the fist part it was required to demostrate the diferrent signals just like senoidal, Quadratic,Exponetial signal and others with the purpose of generation any kind of signal on this software. This part of practice requires a basic understaning of matlab programation in such a way to reach the purpose of this laboratory, on the other hand, The last part of this project was to portray the transformation that the user wants to aplicate on the signal generated. For this requeriment it was implemement an algorithm"forïn each type of transformation (Downsampling, Upsampling) .Those two parts mentioned before, were a excelent method of pratice to develop the habilities of programming and designing.This laboratory was made with the expectation to study the generation and tranformation of any kind of signal.[[1]]

2. Procedure

This section will present the development of this laboratory by describing each activity that was required on it.

2.1. App Design

On the app design, it was done with the idea to make an app comfortable and easy capable to be manage by everyone, The app design consists on the different elements just like:

1. Axes:In total two axes were used to archive the purpose of this laboratory, one was used to portray the generation of the signal requested for the user, and the other one to time scaling the signal graphed.

2. Dropdown: In total Two dropdown were used, Those dropdown were used to show the different options that the user has in each part of the lab.On the first part, this dropdown represents the diffents signal that the app provides to the user and were request on the laboratory guide just like senusoidal, Exponetial and pulse, The last

dropdown indicated the transformation solicitaded for the user just like displacement, scaling and reflection.

3. Button: In total were two buttons on the app with the purpose of run the options chossen for the user in each part of the laboratory.

4. Edit field: The were few of this component in the jouney of the project but basically were used to provide to the user and space to describe the conditions that the signal has to accopmlish.

5. Switch: In total there were three switches on the app, The funtion of it was to assign the direction of the operation either on the y axes of x axes.

2.2. Code Design

In this second part, it was created differents callback for each element used, on the first part that was the generation of signals It was proceed to generated the respective code of it, on the dropdown was to make the variable visible depends on the parameters that each function has, For example in the square signal the parametres provide for the user are frequency and amplitude but for A lineal Signal the user has to provide three parametres, to make that change it has to be visible and unvisible the editfield, that was something that was took into account for making the code below the dropdown.This idea it is represented on the first figure below:

```
if strcmp(s, 'Senoidal')
    app.aEditFieldLabel.Text='w';
    app.Label5.Text='Frequency';
    app.bEditFieldLabel.Text='a';
    app.Label6.Text='Amplittude';
    app.bEditFieldLabel.Visible=true;
    app.bEditField.Visible=true;
    app.cEditField.Visible=false;
    app.cEditFieldLabel.Visible=false;
    app.Label.Text='You selected:';
```

Figura 1: Dropdown's code

Later on, The code below the button has the description of each signal, in other words, it includes firstly the differents parametres on the editfield has to be taken into account to develop the graphice of it just like frequency, amplituded and others,also another aspect to take into account is the time vector that differs in each type of graphice, and a last element, is the formula that describe each signal. the variable used and mentioned on the dropdown callback has to be written on this "newçode for the button, for example w, the variable that represents the frequency then the function "plot"will graphice the respective signal based on the condition that the the user supply.The description of the code will be represented in Figure2 and Figure3 below were it can be seen how those parametres change in each signal.

The code has a typical condition that has to be conected to the dropdown that is the reason why each parameter used on the dropwdown it is also used at the button code, at the moment when the dropdown change from on signal to another has to incluide the differents changes that were mentioned before, for it it was used conditional for those changes to facilited the fluency on the app on each change and also a compare string to relate each signal for another.

```
elseif strcmp(s, 'Exponencial')
    a = app.aEditField.Value;
    b = app.bEditField.Value;
    app.t = 0:0.1:2*pi;
    app.y = a*exp(b*app.t);
    plot(app.UIAxes,app.t,app.y)
```

Figura 2: Button's code for Exponetial signal

```
elseif strcmp(s, 'Lineal')
    m = app.aEditField.Value;
    b = app.bEditField.Value;
    app.t = 0:1:10;
    app.y = m*app.t+b;
    plot(app.UIAxes,app.t,app.y)
```

Figura 3: Dropdown's code

2.3. Signal Transformation

The second half of the practice consisted in adding a signal operations option to the GUI designed in the first part. For this subsection, the global variables were considered, since the data from one callback action to another is not saved. The private properties for 'y' (signal) and 't' (time vector) were created and then implemented into the code, as well as replaced in the previous commands to use that information for the mathematic operations.

```
properties (Access = private)
    y % function
    t % time
end
```

Figura 4: Private properties

After the private properties were added to the existing code, the new code for the singal operations was designed. Since the main purpose was to show the user the process of modifying the signal, a loop was added, to count the steps from 0 (or 1 for the escalation operation) to the value of the magnitude typed by the user to generate a modification in the signal.

```
s = app.OperationDropDown.Value;
ax = app.UIAxes2;

if strcmp(s, 'Displacement')
    d = app.dEditField.Value;
    sw = app.Switch.Value;
    if strcmp(sw, 'To the left')

        ax.XLim=[-d-5 d+5];
        ax.YLim=[-d-5 d+5];
        plot(app.UIAxes2,app.t,app.y);
        for g = 0:d
        plot(app.UIAxes2,app.t-g,app.y,'r--')
        pause(0.6)
        end
    elseif strcmp(sw, 'To the right')
        ax.XLim=[-d-5 d+5];
        for g = 0:d
        plot(app.UIAxes2,app.t+g,app.y)
        pause(0.6)
        end
    end
elseif strcmp(s, 'Scalling')
```

Figura 5: Signals operation code

The Figure 1 shows the respective code for the displacement to the left and the right. In this case, the time vector was moved to the direction required by the user on the switch, and for the scalling operations the value typed by the user was multiplied either with the signal or the time.

Then, the visual part of the laboratory was worked on, so for this part 5 graphics were used. One of the axes was the main one were the user is able to the see the operatiosn by separate. four extra axes were added to show multiple operations being done at the same time. This axes are initially hidden in the interface and once they are required the command app.UIAxes.Visible=true is executated.Part of this process is shown in the Fig 6.

```
op = app.OperationDropDown.Value;

if strcmp(op, 'Displacement')
    app.dEditFieldLabel.Visible=true;
    app.dEditField.Visible=true;
    app.dEditFieldLabel.Text= 'd';
    app.eEditFieldLabel.Visible=false;
    app.eEditField.Visible=false;
    app.fEditFieldLabel.Visible=false;
    app.fEditField.Visible=false;
    app.Switch.Visible = true;
    app.Switch.Items = {'To the left','To the right'};
    app.Switch_2.Visible=false;
    app.Switch_3.Visible=false;
    app.UIAxes6.Visible=true;
    app.UIAxes2.Visible=false;
    app.UIAxes3.Visible=false;
    app.UIAxes4.Visible=false;
    app.UIAxes5.Visible=false;
```

Figura 6: GUI visual adjust

3. Results and analysis

Once the GUI was completed, the proper testings were done in order to ensure the functionality of the code. the code of matlab started tu run it was verify the different signals.As it is represented in the next figure.

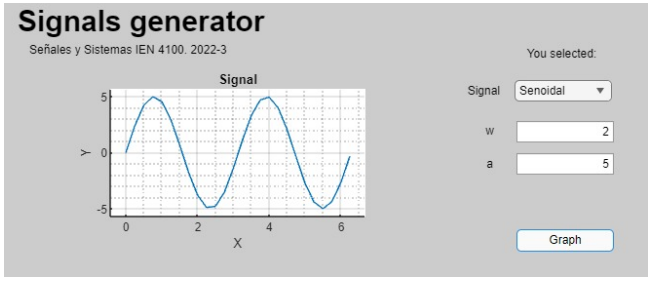

Figura 7: GUI visual adjust

In this image, it can be seem the different parameters that the user provide to the app, and how this it successfully is graph following the condiction that the user said. On the other hand, on this section can be analyzed that the design of it, was done correctly cause the axes show a good view of the graphice with a great amplitude. Later on, On the section of signal transformation it was verify and the results of one of the scaling of a sinuidal signal.

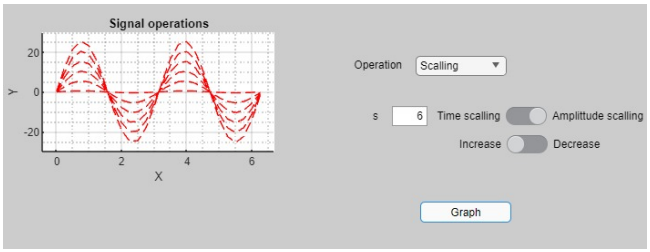

Figura 8: GUI visual adjust

In this figure, it can be seen the perfect scaling of the example mentiones before, and the process when this option it is apply.On this section it can be analyzed that the scaling funtion and transformation can be done using our cicle "for"to used and run this code succesfully.

For the last part,The designed and the call backs

4. Conclusions

It can be said that the main purpose of the laboratory was fulfilled, since the requirements were met. There was a process of learning since the beginning, because the there was a lack of code programming knowledge when trying to work with the Matlab tool.

The laboratory helped in the understanding of the signals and their transformations in time, this was a good way to let the theory previously learned sink. Finally, this was a very important practice to learn how to follow instructions guven and create a GUI, this knowledge can also be used in the future for next courses and even in the laboral.

Referencias

[1] Tello Portillo, J. P. Introducción a las señales y sistemas. Universidad del Norte [2016].