Fourier Synthesizer for Time-Periodic Signals

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1.0 Introduction

This report has been written in order to give you a brief summary of our project for this year, which describes a Fourier Synthesizer for time periodic signals by using Matlab Program.

1.1 What is the Fourier Synthesizer?

Fourier synthesis can be known as the inverse of Fourier Analysis, in other words we can generate a signal by adding the fundamental frequency to the harmonic components.

1.2Fourier Series of Periodic Signals.

Fourier Series is defined as the decomposition which means that take the function and break it to it's component of a periodic signal into discrete frequencies (harmonics), each is a multiple of same basic frequency known as the fundamental frequency. Fourier series is valid only for periodic signals; this periodicity in time- domain forces the Fourier series coefficients to be discrete in the frequency-domain.

The Fourier series represents an infinite number of frequency components which added together yield the time domain, these frequency components constitute a discrete spectrum and the amplitudes of each discrete frequency are given by the coefficients an bn.

2.0 Goals of objective

Design and implement a Matlab-based program for synthesizing different periodic signals. This involves:

1- Finding the Sinusoidal Fourier Series of commonly-used periodic signals.

2- Convert derived expressions into Matlab code.

3- Analysis of Matlab program to study effect of increasing harmonics.

4- Build a Graphical-User Interface to facilitate the use of the program.

3.0 Project specification

Use Matlab – Why?

Matlab is a program used for computation and visualization .It is based in powerful commands. There are hundred of predefined commands and functions and these functions can be further enlarged by user-defined functions . Matlab also has powerful tools for two , three dimensional graphics and graphical user interface

$$a_n = 1/T \int_{-T/2}^{T/2} p(t).\cos(nw_o t)dt$$

$$b_n = 1/T \int_{-T/2}^{T/2} p(t).\sin(nw_o t)dt$$

$$G(t) = \sum_{n=1}^{\infty} a_n.\cos(nw_o t) + b_n.\sin(nw_o t)$$

Input & User Interface

The program will calculate the Fourier series constants an & bn of the periodic signals After that it will calculate the Fourier series summation of the periodic signals.
As shown below this is the equation we put it in the program .

Output

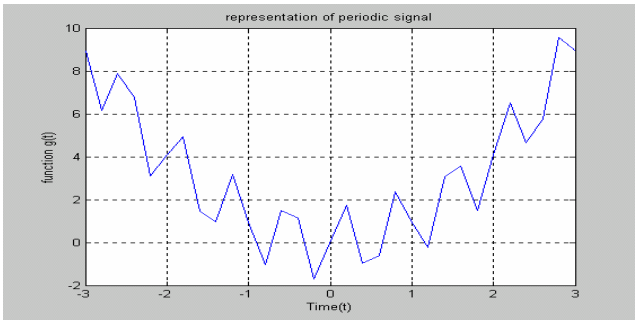
The Matlab plot the approximate shape of the entered signal ,The project includes also many methods to select the good harmonics and reject the others .

Functions of System

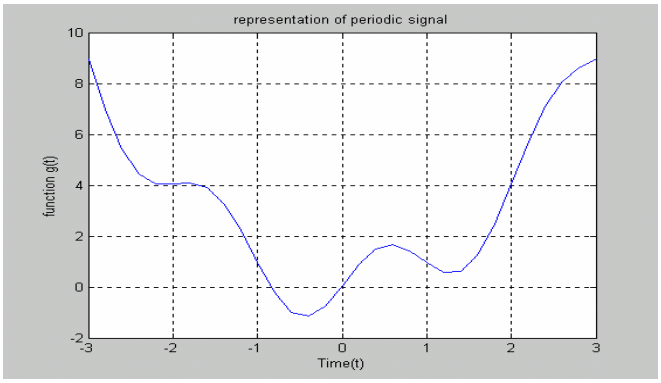
As the number of terms or harmonics is increased the graph of the output (the shape of the signal become more accurate .

Example

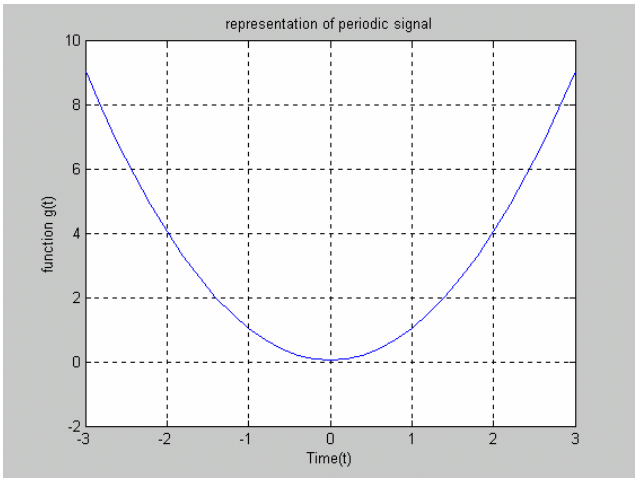
No of harmonic component = 5

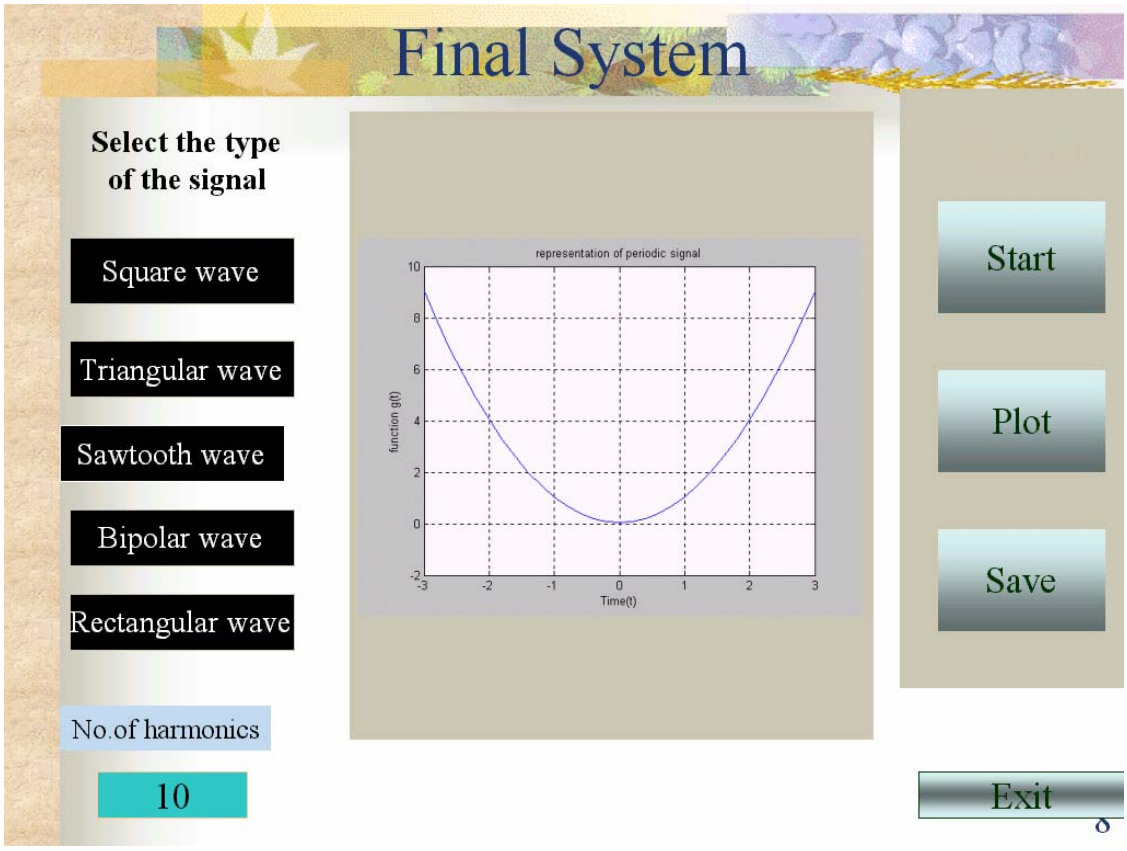


No of harmonic component = 10



No of harmonic component = 30





Firstly the user can choose from the menu what's the type of the signal ,
Also as we said before , the output depend on the number of harmonics so the user can select the number of harmonics ,
And there is many options in the right side for starting simulation or plot the signal ,save the work or Exit from the program .

Conclusion

- The Fourier series represents an infinite number of frequency components which added together yield the time function i(t). These frequency components constitute a *discrete* spectrum and the amplitudes of each discrete frequency are given by the **coefficients** a_n b_n. All the frequency components are harmonics of the fundamental frequency I IT and the total range of the frequencies is the bandwidth of the signal.

- Though the frequency spectrum may consist of an infinite number of discrete frequencies, there amplitudes get smaller with larger values of n and in practice it is sufficient to consider only a finite number of the frequencies as adequate for communications.

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- Smaller with larger values of n and in practice it is sufficient to consider only finite number of the frequencies as adequate for communications

Reverences

- Norman Morrison ,introduction to fourier analyses ,john wiley &SONS, INC , USE