



Research Article

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ZOOM FFT technology based on analytic signal and band-pass filter and simulation with LabVIEW

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ABSTRACT

This paper deals with the study of a new detailed analysis and realization method of spectrum based on labVIEW, by using labVIEW's powerful mathematical and signal analysis function on the basis of the traditional polyphony refining analysis method, which provides a new way for realize the detailed analysis of frequency in the virtual instrument by means of the software platform-labVIEW. The simulation and engineering example shows that the method can meet the engineering requirements for the signal frequency's refining analysis.

Keywords: analytic signal; band-pass filter; ZOOM FFT; labVIEW.

INTRODUCTION

Like C and BASIC, LabVIEW is general used in system programmable, it has a huge library which can do any programming. LabVIEW library includes data collection, GPIB, serial port control, data analysis, data LabVIEW logo display and data storage, etc. LabVIEW also has the traditional debugging tools, such as setting a breakpoint, to display data and subroutine results by the way of animation, step execution, etc. Facilitate the debugging of program [1]. LabVIEW (Laboratory Virtual Instrument Engineering Workbench) is a graphical programming language with icon instead of lines of text to create applications [2]. The traditional text programming language determines the order of execution of the program according to the sequence of statements and instructions, while the LabVIEW uses data flow programming, the data flow between the nodes in the diagram determines the order of execution and the function of VI. VI refers to the virtual instrument, is a program module of LabVIEW. LabVIEW provides a lot of controls whose appearance similar to traditional instruments (such as oscilloscope, millimeter), and can be used to easily create user interface [3]. The user interface is called the front panel in LabVIEW. The icons and connection can be used to control the objects on the front panel through programming. This is the graphical source code, also known as the G code. LabVIEW graphical source code was similar to the flow chart in some extent, so it is also called the block diagram of program code [4].

This paper is mainly to study a method of implementation of labVIEW based on the analytic signal and the analysis filter spectrum zoom band pass.

Frequency Refinement Technique

Rapid Fourier transformation (FFT) is an important tool in signal processing. Spectrum signal is calculated by FFT algorithm for the resolution: $\Delta f = fs/n$, where fs is the sampling frequency of the system, n is the number of sampling points. The analysis of the frequency ranges from DC to $fs/2$. The signal spectrum in this range has the same resolution. In the project, we sometimes encounter the signal frequency which has very wide range, but it requires occasions that the narrow frequency band need to be carefully observed. Using Analysis of the conventional FFT algorithm, if we want improve the frequency resolution, then need to increase the number of sampling points of N data

(FFT in length), Since the multiplication computation for FFT of point N is $(N/2)\log 2N$, it also increases the calculation of FFT, which leads to sharp increase of calculation amount.

Implementation Steps of LabVIEW

The implementation steps are as follows:

1. Signal processing: take the time-domain signal $x(t)$ for anti-aliasing filter processing, turn the signal into signal frequency co.
2. Sampling: turn the signal into the sampled time series through sampling, set a sampled data points for $D \max * N$.
3. Hilbert transform: make the sampling sequence of Hilbert transform, generate the analytical sequence.
4. Band pass filter: generate narrowband signal.
5. Spectrum of mobile: setting signal $x(t)$ corresponding to the spectrum for $X(f)$, time series obtained after sampling for $x(n)$, the discrete spectrum for the corresponding $X(k)$.
6. Resampling: resample the data of narrowband sequence $x'(n)$ which the frequency interval was $[f1 - fc, f2 - fc]$ data resampling, CO pumping N (N for FFT length), get the time sequence of $x2(n)$, sampling frequency of the original $1/D$.

Theoretical flowchart as shown in Fig 1, the actual flow chart as shown in Fig 2.

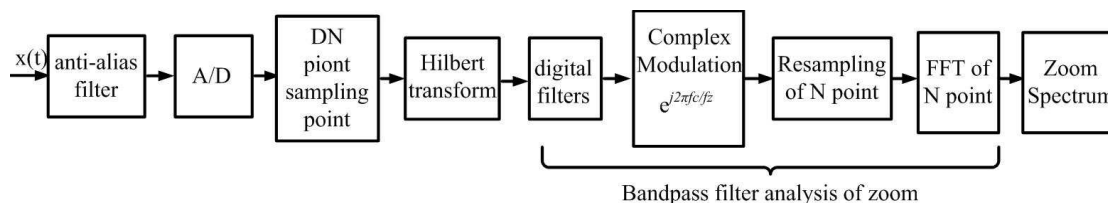


Fig. 1 the theory of refinement data processing flow based on the analytic signal and band-pass filtering.

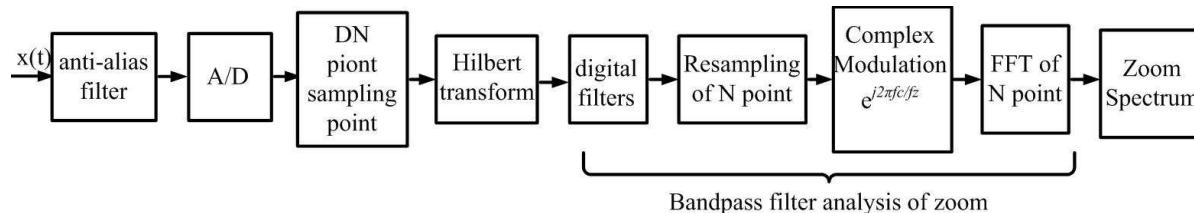


Fig. 2 the actual of refinement data processing flow based on the analytic signal and band-pass filtering

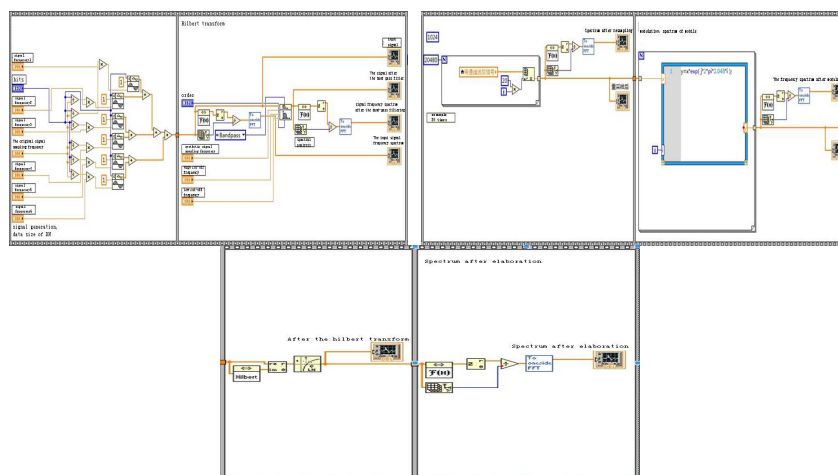


Fig. 3 LabVIEW block diagram

Establish LabVIEW Block Diagram

According to implementation of LabVIEW based on the analytic signal and band-pass filtering, LabVIEW Block Diagrams were established, as shown in Fig 3.

LabVIEW Program and Its Operating Results

LabVIEW program and its operating results are as follows:

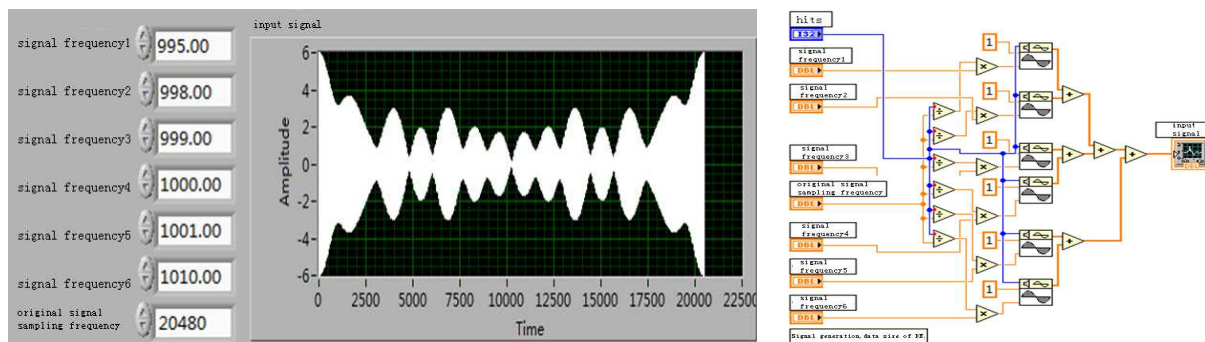


Fig. 4 Original signal $x(t)$ and A/D sampling procedure

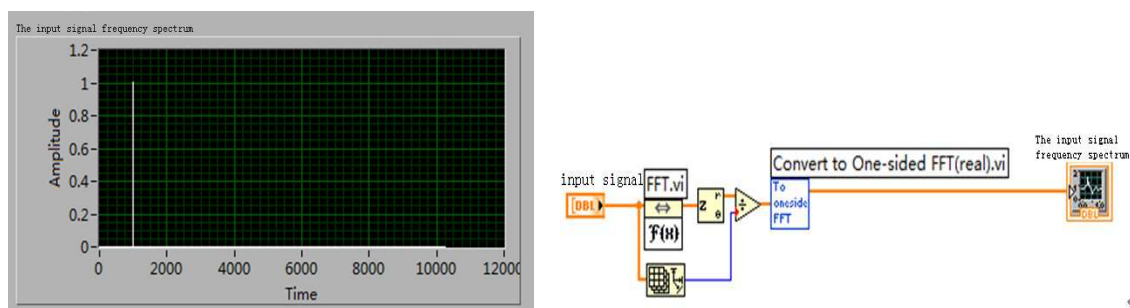


Fig. 5 The frequency spectrum of the input signal and the calculating program

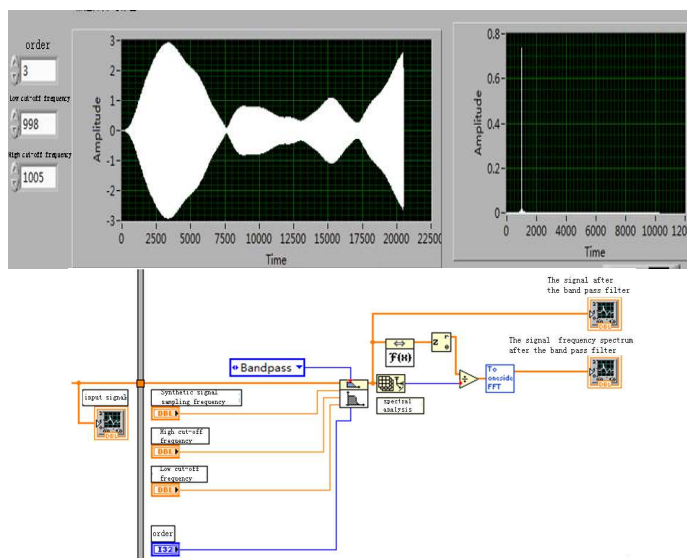


Fig. 6 Band-pass filtering and frequency spectrum after Calculation of filter (To keep frequency of 999, 1000 and 1001 after band-pass filtering)



Fig. 7 the Hilbert transform procedure (the input signal is on the left, the output signal is on the right)

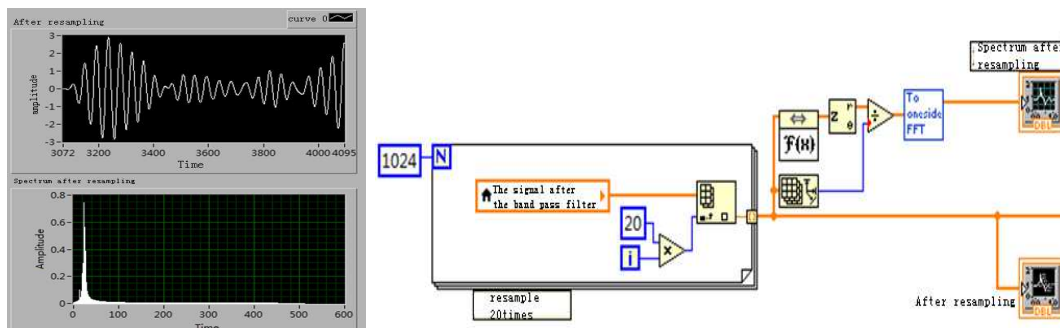


Fig. 8 resampling procedure (20 times)

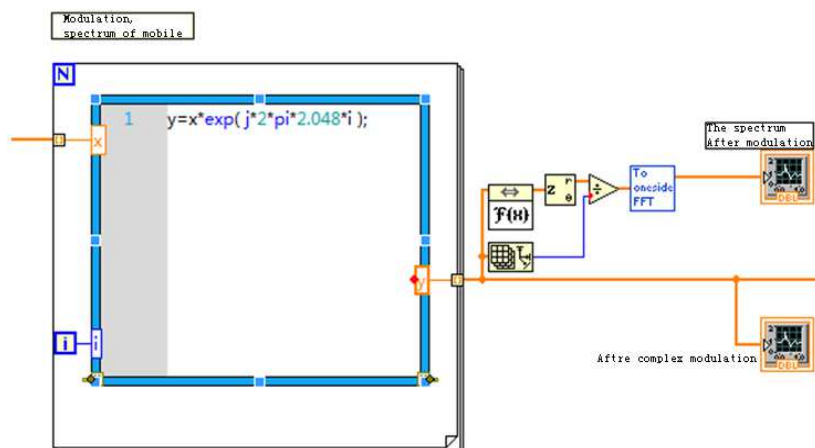


Fig. 9 Remodulation program

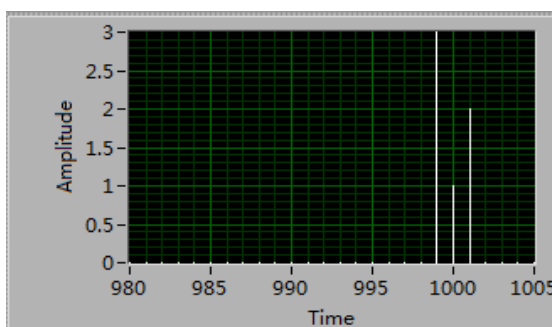


Fig. 10 Frequency spectrum after elaboration

CONCLUSION

The virtual instrument which takes the computer as a platform, is currently subject which emerges rapidly. The implementation of technical measures of virtual instrument used as a test function is directly related to the function performance of it. To achieve the function in refinement of FFT instrument of virtual instrument, this method provides a new and effective frequency refinement technology, using the analytic signal and thought the band-pass filter, the off-line measurement in spectrum analysis of speed is greatly accelerated, get a better solution to the problem of

restricting the computation speed frequency zoom multiples which restricted the improvement of traditional analysis of amplitude modulation, open up a new way of improving zoom multiple times under the same refinement time.

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