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A Data Acquisition and Detection Algorithm for Signal Analysis in Material Detection

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Abstract: With the increasing demand for security, the detection of explosives is of utmost importance. Rapid detection of the materials is possibly achieved in a standoff manner by using this technique. In this paper, we discuss about the detection of materials like TNT,DNT,C4,Acetone etc. with the help of labview software. This employs various additional features like spectral analysis and noise removal before processing the sample spectrum for detection. It proves to be a accurate ,small and a user-friendly reliable system which can be easily implemented for any sensitive detection. In this paper, we illustrate various VI with outputs and present results for signal analysis and detection in further sections.

Keywords: spectral analysis, explosive detection, Spectroscopy, data acquisition

I. INTRODUCTION

For material detection various methods are used like spectrometer technique, X-ray machines and neutron activation method. In the field of explosive detection, intensive research on the methods has increased the native land safety and guarantee sensitivity for terrorism attacks. Multiple number of methods are used nowadays for explosive detection but mostly deal with point detection that is at a short distance[6],[7]. In order to advance the detection procedure, standoff technique is to be used. It is known that best possible outcomes for standoff detection are achieved through optical laser techniques[8]. In this paper, we discuss about spectrometry technique in detail. In laser spectroscopy, we take into account only the inelastic scattering. The scattered photon possesses a different energy, then the process is known as inelastic or raman spectroscopy,as in[5].

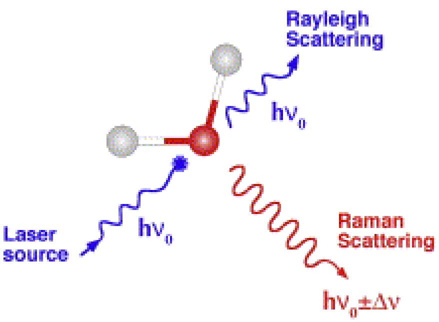

Fig 1. Raman Scattering

As shown in figure 1, the spectrum of the explosive is determined with the help of spectrometer. Based on Raman effects, various technological advancements are made in the field on explosive detection. A schematic experimental set up is shown in fig 2 illustrating the functioning of actual raman setup[1].

As raman spectroscopy is limited by a factor named as fluorescence (background noise at similar spectral points as raman spectra),as in [2]. In order to remove these unwanted effects, various spectral analysis are required for better detection.

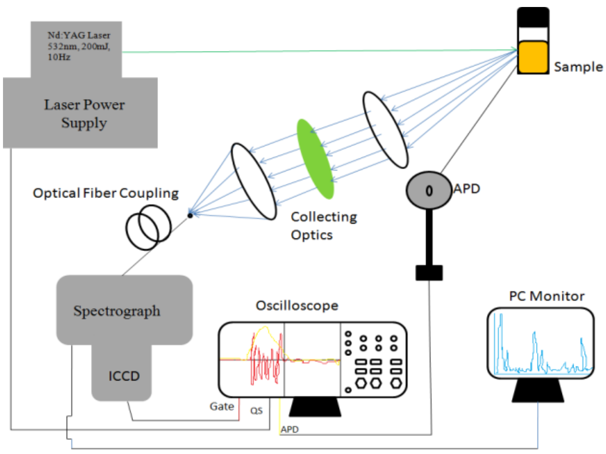

Fig 2. Schematic of experimental set-up

II. working

A. Spectral Analysis

The analysis of spectra deals with the process of capturing spectra for a particular explosive and analysing it in the form of amplitude, phase, frequency[4]. The steps followed for designing a VI for spectral analysis is as follows.

1. Open a blank VI
2. Select input as "simulate signal" and adjust the parameters as default except frequency that is changed to 50 Hz.
3. In order to determine FFT select "Spectral Measurements" from the analysis domain. Change the parameters as magnitude (peak) and confirm OK.
4. Connect the output of FFT, phase and sine to the waveform graph. Graphs are displayed in the front panel.
5. Output is displayed on the front panel. Power Spectrum can also be viewed by changing the settings of the spectrum measurement.

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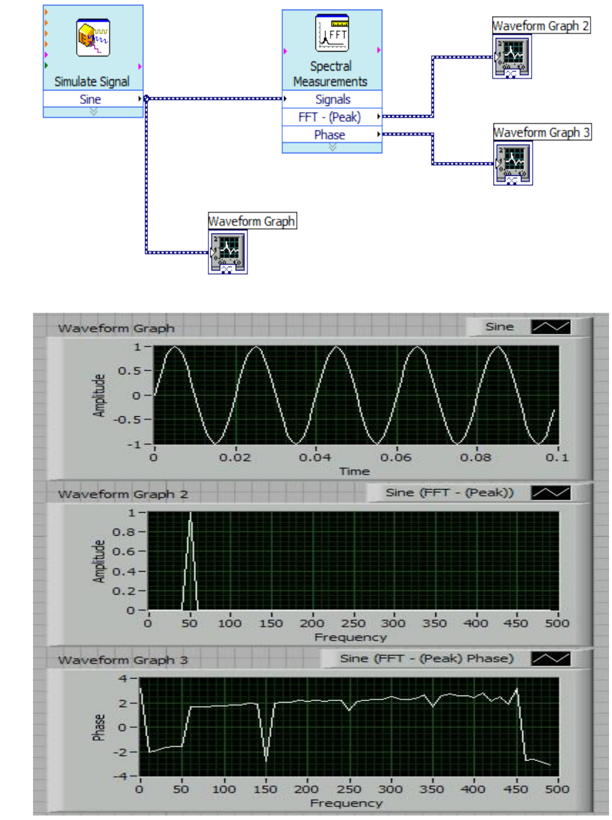
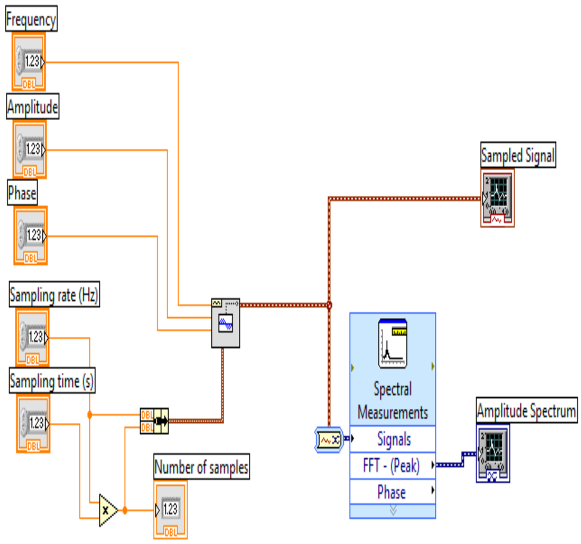


Fig 3. Block Diagram and Front panel

B. Spectrum Aliasing

The main aim of signal analysis is to acquire the signal correctly and ascertain the correct dissemination of the frequency in a spectra. For this, process is regulated by following certain rules like removing background noise, eluding aliasing errors, de-emphasize broadening and reducing random noise.

1. Fig 4 shows how spectrum aliasing takes place and it is removed by apprehending samples for a high level frequency. A sub VI is also used in this process before giving input to the spectral measurements.



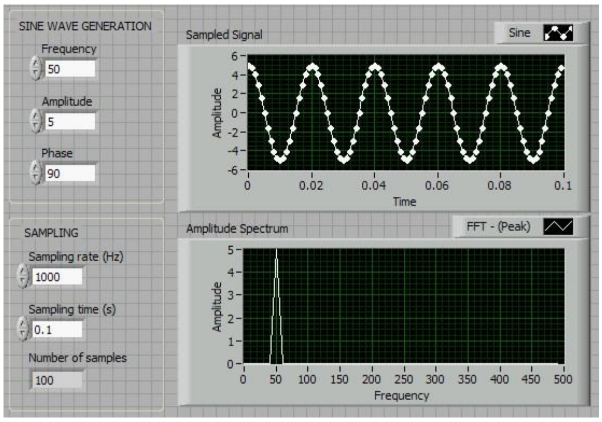


Fig 4. Block Diagram and Front panel

2. For dealing with random noise, averaging of the signals is done in which random noise are averaged to zero and the true signal corresponds to a true value. More the number of averages the more closer the spectrum of its actual value. A while loop is coordinated in collaboration with spectral analysis VI.

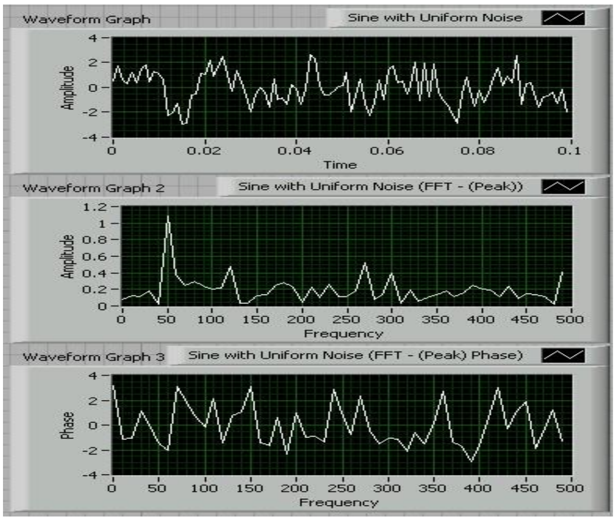


Fig 5. Front panel response to noise

C. Spectrum Detection

It is a process where the analysed spectra's are provided and further detection of the signal take place[3].It determines the material that is used with the help of spectrum matching with the database library. Steps for block diagram are as follows.

1. Read the data stored in the spectrum in the spectrum analysed file.
2. Define the X and Y points as wavelength and intensity.
3. Then build XY graph and check the spectrum.
4. Filtering is done in order to smoothen the signal resulting in less spurious signals.
5. Plot filter signal in XY graph.
6. Read the spectrum and save peaks above a particular threshold level.
7. Peak wavelength and number of peaks are determined for a specific explosive and displayed or written into a file.

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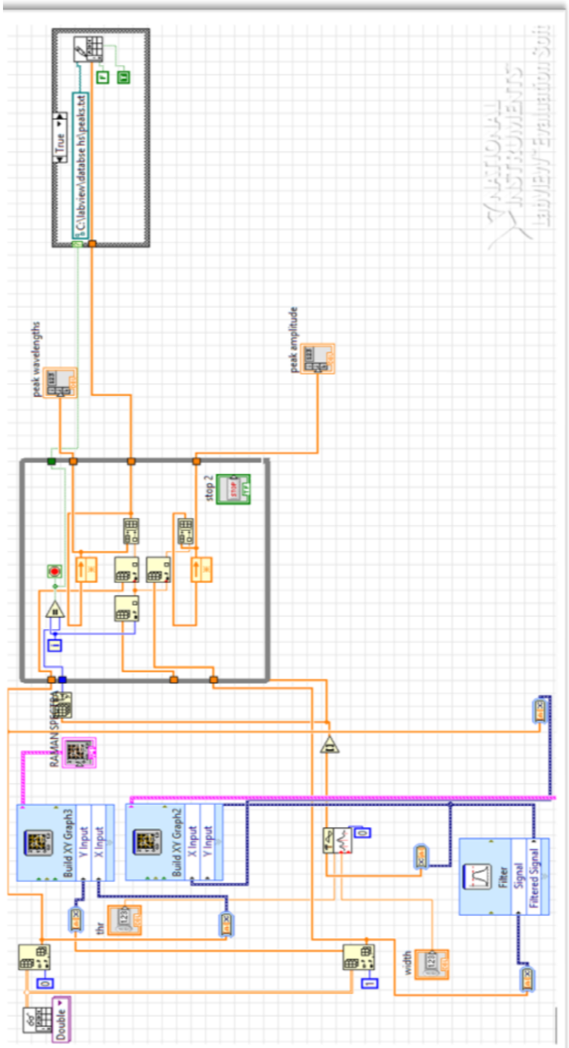

Fig 6. Spectrum Detection Block Diagram(peak detect)

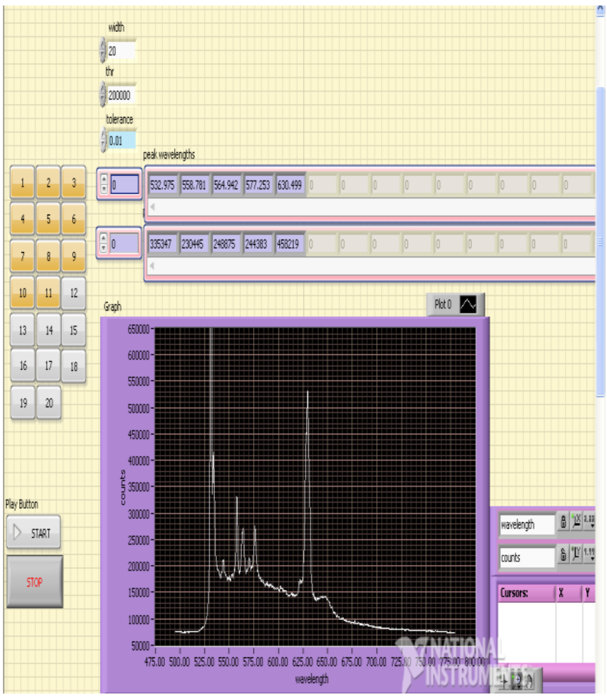

Fig 7. Output at front panel

III. CONCLUSION

Spectrum Analysis and accurate explosive detection is achieved with the help of lab view software. This technique is adaptable for various types of spectrum analysis and is reliable in terms of results. Results prove that this process proves to be better in dealing with various challenges like fluorescence, Background noise and aliasing. Basic limitation for the process is real time analysis is a hectic task and is not possible for huge data. It is more user friendly and cost effective process as low power is consumed for the analysis .Standoff detection is also achieved through this technique motivating us to future plan towards improving the distance for standoff detection and making the system more robust and small.

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REFERENCES

[1] D.S. Moore, "Instrumentation for Trace Detection of High Explosives," Rev. Sci. Instr., vol. 75, no. 8, 2004, pp. 2499–2512.

[2] T. Arusi-Parpar, D. Heflinger, and R. Lavi, "Photodissociation Followed by Laser-Induced Fluorescence at Atmospheric Pressure and 20° C: A Unique Scheme for Remote Detection of Explosives," Appl. Opt., vol. 40, no. 36, 2001, pp. 6677–6681.

[3] C.M. Wynn, S. Palmacci, R.R. Kunz, et al., "Experimental Demonstration of Remote Optical Detection of Trace Explosives," Proc. SPIE, vol. 6954, 2008, 695407.

[4] Application of Virtual Instrumentation which Based on Lab VIEW in Electronic Measurement Technology Coursel 2011 International Conference on Electronics and Optoelectronics (ICEOE 2011) Yujun Bao School of Electronic Information & Electric Engineering, Changzhou Institute of Technology CZU Changzhou, China 978-1-61284-276-9111/$26.00 ©2011IEEE.

[5] R.L. McCreery, Raman Spectroscopy for Chemical Analysis (Wiley interscience 2000).

[6] M. Gaft and L. Nagli, "Standoff laser-based spectroscopy for Explosives detection," in Proc. SPIE Conf. Ser., Oct. 2007, vol. 6739, p. 673 903.

[7] S.Wolf, P. J. Wrzesinski, andM. Dantus, "Standoff chemical detection using single-beam CARS," in Proc. Conf. Lasers Electro Opt./Int. Quantum Electron. Conf., 2009, pp. 1–2, ser. OSA Technical Digest.

[8] S.Wallin, A. Pettersson, H. Östmark, and A. Hobro, "Laser-based Standoff detection of explosives: A critical review," Anal. Bioanal. Chem., vol. 395, no. 2, pp. 259–274, Sep. 2009.

BIOGRAPHY

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