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 an 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].

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.
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.

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.

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.
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


BIOGRAPHY

Ms. Payal received B.Tech degree from MDU University, Rohtak and doing M.Tech in ECE from Amity University, Noida, India. She has presented papers in National and International Conference. She holds interest in wireless networks and image processing.