Noise Power Spectrum for Firecrackers

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ABSTRACT

Frequency of noise can affect human beings in different ways. The sound of firecrackers is a type of intensive impulsive noise, which is hazardous. In this paper, the noise produced by firecrackers during celebration festivals in Aurangabad (M.S.), India is measured. The noise is analyzed from the study of power spectra for different types of firecrackers. Noise measurements of firecrackers show that they produce high sound pressure peak levels at their characteristics frequencies. Plots of noise power versus frequency for different crackers are presented and the inferences are discussed. Typical firecracker peak noise levels are given.

Keywords: Fourier Transform, Frequency, Impulse, Noise Power Spectrum, Sound

INTRODUCTION

Sound level, its frequency spectrum and its variation over time characterize noise (Alam, 2006). Noise can also be characterized by its frequency content. This can be assessed by various types of frequency analysis to determine the relative contributions of the frequency components to the total noise (Berglund, 1999). Conventionally the range of frequency of audible sound is considered to be from 20 Hz to about 20,000 Hz (Carl, 2006). There are individual variations in the frequency of sound that can be heard by different individuals. The study of sound related noise includes the study of noise levels at different frequencies. A standard well known method to find out noise power associated with different frequencies is to use the Fourier transform technique (Berglund, 1995). Fourier transform of sound reveals the amplitude of noise at the constituent frequencies from which one can estimate the corresponding power levels. The main principle of frequency analysis is that any selected frequency range is divided into a number of consecutive and discrete analysis bandwidths, such that the amount of energy present in each analysis bandwidth can be determined.

Firecrackers are used all over the world to celebrate different social as well as religious occasions. The firecrackers traditionally used for celebration are another major source of
excessive noise. They are used indiscriminately in residential areas, next to hospitals, schools, with little consideration for the effect on the well being of persons unable for a variety of reasons to bear the high level of noise created. Bombs, chain bombs, etc. are permitted for manufacture provided they do not exceed 125dB – the level of a jet engine taking off at 25 meters (Noise Free Mumbai). Firecrackers generate instantaneous impulsive noise, which when measured in free field condition gives high sound pressure level. An impulse is much more harmful than a continuous noise (Khopkar, 1993). A sudden noise generated with high pitch or intensity but with a life-time of less than one second is called as impulse. Impulses caused by an exploding bomb (190 dB), naval gun-shooting, firing crackers and metal beating, are capable of producing noise to the extent of 140 dB. An unexpected thud of sound with a short life has high impulse and is dangerous. It is quite obvious that a number of crackers when bursting serially can easily form a band of continuous noise in the presence of reflecting surfaces (West Bengal Pollution Control Board, 2005). Noise pollution due to bursting of firecrackers during Diwali was surveyed at 11 cities in the state of Maharashtra by Maharashtra pollution control board in the year 2005 and found that the noise levels in Aurangabad city are higher than the stipulated limits (Deshpande, 2005).

The present work deals with the analysis of recorded audio data from the point of view of the power levels present at different frequencies.

Methodology

The study comprises analysis of various types of sound including noise recorded from bursting firecrackers. The sound was recorded in standard Windows wave file format with .WAV extension. This format in addition to all the recorded audible data contains information about the sampling frequency and other related technical details. These sound files in wave format are opened and read in MathCAD program. Most of the data files used for this purpose were recorded at a sampling rate of 44.1 KHz with single channel and 16 bit resolution. This allows for a resolution of 1 part in 65536, a reasonably high resolution. Each sampling point therefore requires two bytes (16 bits of data), this results in a data rate of 88.2 K Bytes per second.
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