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Characterizing musical sounds with the aid of linear algebra through MATLAB

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This study mainly gathers a way of understanding sound (music / noise) using concepts of linear algebra. This is interesting, because music is an art while mathematics is a science. Moreover, there is lack of findings on defining musical notes in a mathematical way and relationships between music and mathematics are limited. With the aid of a simple MATLAB programme, we analysed any sound. Especially sounds from Dual-Tone Multi Frequency (DTMF) system on telephones and different musical instruments were analysed. The previously recorded sounds were used under this study. Fourier analysis played a major role here. The MATLAB programme converts a signal from its original time domain (wave propagation) to a representation in the frequency domain. Computed Fourier transform of a sound helps to determine the component frequencies and then the musical notes (which is an artistic concept). At the same time through the frequency domain, sound can be written as a sum of simpler trigonometric functions. As an immediate result this enables us to view a sound as elements of a linear space generated by an orthonormal basis. The reason to analyse the sound waves in terms of sinusoidal plane waves lies in the differential equation for simple harmonic motion. Two musical notes are said to be consonant when the ratio of their frequencies is a ratio of two small integers. Further, reasons for the sound difference when the same note is generated by two different musical instruments were analysed. Musical instruments do not vibrate at a single frequency. A given note involves vibrations at many different frequencies often called harmonics. The relative pitch and loudness of these harmonics give the note a characteristic sound. The relative strength of the different frequencies is the difference between two sounds.

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