

City Talk



HOW TO ENGINEER THE SWEET ART OF MUSIC

If you ever wonder what sound and music are made of, let me explain some of the engineering aspects of it.



Nuts and bolts

Edmund Leung

Sound waves transmit mainly through air, and when received in our ears and interpreted in our brains, they become sound that we can hear. The speed of sound varies with temperature and the medium through which a sound wave is propagated. In a normal temperature range, sound travels at about 340 meters per second in air.

The main ingredients of sound are amplitude and frequency.

Amplitude is the degree of loudness, or simply the volume of sound.

It depends on the mass and the exciting force acting on an object. The frequency is a function of the configuration and material properties of the vibrating body.

Sound waves go through more cycles to travel the same distance if the length per cycle, or wavelength, is short. The number of cycles per second is called the frequency. Hence the shorter the wavelength, the higher the frequency or the pitch of the sound.

If the sound wave has a single frequency, it is a monotonous note. When sound waves comprise random frequencies and irregular beats, they become noise, which we invariably hear, but do not enjoy listening to.

However, in some cases sound comprises harmonics, which is a function of the base frequency but in its logarithmic progression. When we listen to notes with harmonics, we hear sweet tones as they please our ears. Together with certain beats, they become music.

The interesting thing about music is, no matter whether it is classical or pop or jazz, they are basically a combination of amplitude and frequencies arranged in certain order that, when played, become attractive and soothing or exciting to us as listeners, unlike noises that could be jarring to our ears.

Apart from human voices in the form of singing, most music is produced from musical instruments. There are three basic types of musical instruments, namely percussion, string and wind.

Common percussion instruments include drums, pianos and xylophones.

Sound waves are produced from them by striking membranes, panels or wires. The vibrations of these media produce music as they are carefully calibrated to produce notes in harmonic scale.

String instruments, such as violin, violas, guitars and similar instruments, produce notes by strings that are excited by a bow or plucking. They normally produce a lot of harmonics, amplified through the sound boxes and are therefore louder and more melodious.

Wind instruments, such as flutes, trumpets and saxophones, produce notes by membranes excited by air flow blowing through a pipe. The body of the instruments are shaped in a way to amplify the sound in the membrane to produce harmonious notes.

The richness of the notes is the result of a combination of tuned vibrating mass amplified by the sound box, and such devices are refined in evolution to be melodious to our ears.

Even more interesting, an orchestra can produce good music because they are able to mix sound from different instruments of various tones to form a complex but pleasant combination of sound to bring us an enjoyable musical piece.

Now, who says engineering cannot be an art?

Veteran engineer Edmund Leung Kwong-ho casts an expert eye over features and forces in modern life

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