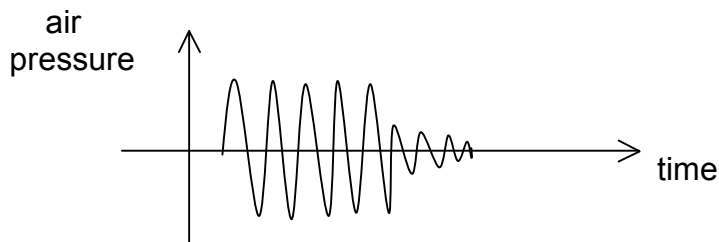


SOUND AND STUDIO SYSTEMS

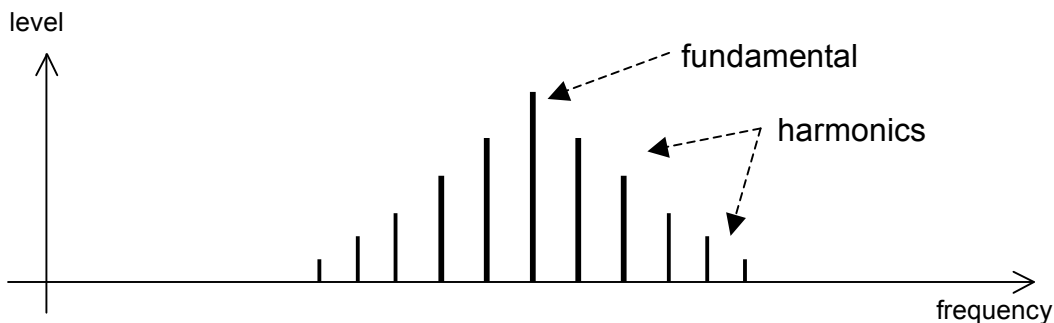
Sound and Recording

Sound in nature is created by vibrations, setting in motion the air molecules, producing a variation in the air pressure, which happens to be within a range of frequencies that can in turn vibrate our ear drums and feed signals to our brain.



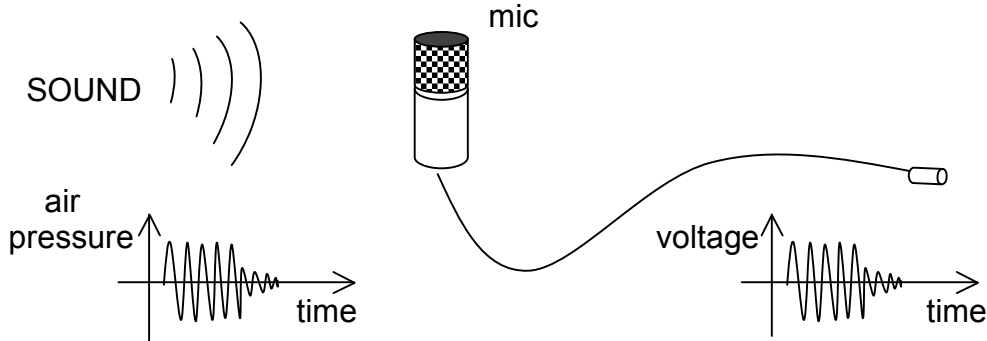
This range is between 20 cycles per second (or Hertz) and 20,000 cycles per second (or 20 kHz.).

We can also conceptualise sound as a frequency spectrum, since sounds can be thought of as being the sum of a number of frequencies or 'harmonics'. This frequency combination, each harmonic having an arithmetic frequency relationship to the fundamental at varying levels and time (or 'phase') differences, gives rise to different sounds having a distinctive character.



In the real world this has to be an instantaneous snapshot, as changes will occur over time as sounds evolve and decay.

To process and record this sound (the vibrations) it has to be in a form that can be manipulated and stored.



So acoustic vibrations are converted into electrical vibrations and, prior to the invention of digital audio, were then converted into magnetic vibrations stored by the iron oxide particles on a reel of recording tape.

Hence the term **analogue** signals, as the 'sounds' being electronically processed and magnetically stored were analogous to the original acoustic sound. Obviously how accurate those analogues were was a measure of the quality of the equipment used, beginning at the mic and ending at the reproducing speakers.

Today most recorders use digital technology, where the electrical waveform is sliced many times a second and each stored as a measurement (PCM digital), the storage then being a hard-disk of the type commonly used by current computers.

The Perception of Hearing

On this course we are about to discuss and investigate the equipment and techniques used to record quality sound, but of course we should also consider our most important tool: the ear and the human hearing mechanism itself.

Many books describe the mechanics and workings of the ear, but what are the practicalities relevant to the sound recordist?

The level sensitivity of the ear to different frequencies

Fletcher and Munson are famous for this research, they demonstrated that the human ear's sensitivity to low and high frequencies diminished compared to mid frequencies at low sound pressure levels.

Consequently many engineers, though they normally monitor at reasonable levels, check their recordings and mixes at low volume for consistent balance (often combining this with checks on different reproduction systems such as ghetto-blasters and car-stereos to ensure compatibility as much as possible).

How the ear deals with an extreme sound levels

Our ears are able to perceive a wide range of sound levels, from a gentle pindrop to a massive jet engine roar.

These delicate instruments (along with some psycho-acoustic adjustments) have to act in a 'non-linear' manner, implying some dynamic processing (i.e. a compression characteristic) and inevitable distortion artefacts.

These two properties of the auditory system go some way to explaining why some equipment (e.g. well designed valve circuitry, analogue magnetic tape) sounds 'good' despite perhaps less than ideal measured response, as their dynamic and harmonic distortion characteristics share a similar nature to our own ears.

This mixture of physical nature and psychological processing also gives rise to some aural 'data compression' (i.e. the dispensing with less important aspects of total sound available), producing an effect known as **masking** (e.g. try listening to that pin dropping as a no. 37 bus passes within 5 metres at 30 mph!).

Stated simply: LOUD SOUNDS DOMINATE.

N.B. This masking can also be extended to frequency bands when trying to make a mix of instrument sounds that contain similar proportions of particular frequencies; it can be hard to make all the different sounds clear and distinct.

Psychological factors that affect what we hear

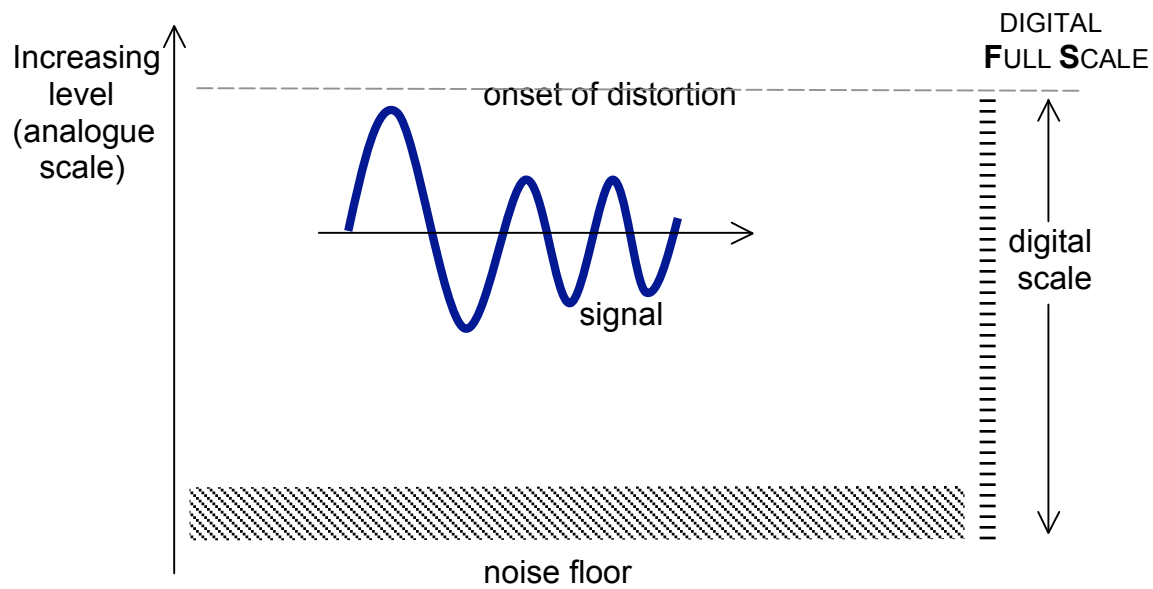
Fatigue can play havoc with human being systems and the hearing mechanism is no exception. Engineers commonly gripe about tracks they've mixed late at night as being too bright, our sensitivity to high frequencies tends to diminish with tiredness.

The focus of our minds can also play tricks with our perceptions, if we are concerned about certain aspects of the recording (or even of our lives outside of the studio!) then details can be distorted or missed entirely.

Now this section is not intended to induce paranoia (oh! that's another reality distorting condition!) with all the elements that can adversely affect our listening abilities. In fact this whole area is full of variables and is prime material for Ph.D.s and other extensive research programmes ... BUT ... as sound recordists we just need to learn to recognise when our perceptions are being pushed beyond accuracy, be aware of our limitations and not expect ourselves to be infallible.

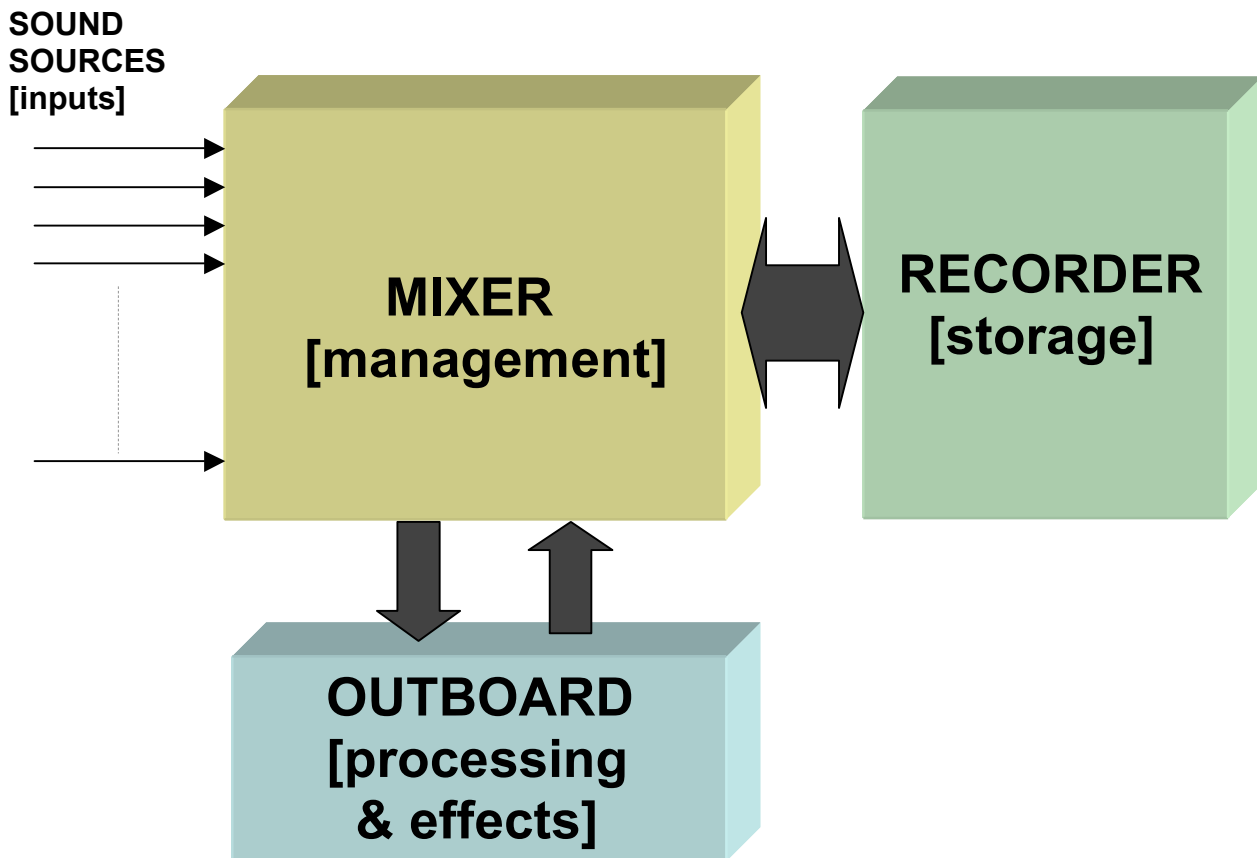
The Electrical Signal Path

Every piece of equipment in the studio that passes audio adds some noise and distortion (including the cables!), and has an optimum range for the signal level:



So audio signals are best recorded at a high level, to be as high above the inherent noise floor as possible (maximising the **Signal-to-Noise Ratio**) but the peaks of that signal not exceeding the 'onset of distortion' point.

Studio Systems



In the diagram are illustrated the overall building blocks or 'elements' of the studio. All studio equipment falls into one of the named categories.

Today incidentally, a 'studio' can be a fully designed and equipped commercial premises, a simple computer system with the basic software and necessary peripheral hardware, OR anything in between.

PRACTICAL: Listen to your favourite commercial tracks and try to demonstrate to yourself the 'perception' main points. Also identify and familiarise yourself with the 'elements' of the studio in your own setup (or a system you have access to) i.e. which bits of equipment fall into which category.