

FORMANTS (described by Rune Sterling, student of music)

Definition of formants. Formants are boosts of overtones in the vocal tract. The vocal tract is the area from the larynx to the edge of the lips and nostrils. The formants are generated at four to six different places in the vocal tract. We write the formants like so: F1, F2 etc.

The formants can be seen at different places in the spectrogram and have an effect on the colour of and amount of overtones in a given note. The formants frequency differ according to the vowel sung and the technical abilities of the singer. One can learn to control the formants and thereby control the overtones and decide what colour the note should have.

Different vowels make different spaces of resonance in the vocal tract. These spaces all have influence on the frequency of the formant.

The vowel /i/ (as in "me") enlarges the space in the larynx, which makes the frequency of F1 to be lower than on the vowel /o/ (as in soft) where the space in the larynx is smaller. The bigger the space, the lower the frequency and vice versa. The placement of the tongue decides the creation and character of the formants in both speech and singing.

By making patients aware of the existence and function of the formants, one can make it clear to patients, how important it is that their voice works properly. For example, few formants indicate an inhibited, restrained voice or unwanted tension in the neck and the body in general, bad breathing, not deep enough, and no awareness of how important it is to use the diaphragm not only when singing, but also when one is speaking. Formants can be used to explain what the spaces in the vocal tract do, and that unrestrained airflow is important.

Formant analysis, during speech, is conducted as an average of the spoken text. Standard is 4 formants up to approximately 5000 Hz. Five and six formants also occur. Their strength can be read in db and the note by which they are measured is given in Hz.

The vowel /i/.

To shape the vowel /i/, as in "me", the tip of the tongue shoots forward to the lower front teeth and the back of the tongue rises. This creates a small oral cavity. Meanwhile a large space is formed in the larynx. Since the tip of the tongue is in the front of the mouth, this is called a front vowel. In this particular vowel the first formant, F1, is placed low in the spectrum. This is caused by the large cavity formed in the larynx. The second formant, F2, has relatively high frequency, caused by the small cavity in the front of the mouth. A small space results in a higher frequency than a large one.

The vowel /a/

On the vowel /a/ one lowers the jaw which makes the tongue drop. The tip of the tongue is placed under the front teeth and the back of the tongue raises itself a little. This is called a back vowel. It creates a large cavity in the mouth and a small cavity in the larynx. The spectrogram will show a typical pattern of a back vowel with a high F1 and a low F2. The high F1 is due to the small cavity in the larynx and the low F2 is due to the large cavity in the mouth.

Thus, small changes in the anatomy can cause great difference between the characteristics of the resonance of the two vowels. The brain registers the acoustic effect of these differences by calculating the placement and velocity of the formants. With this information the brain recognises different vowel sounds. Changing articulation, i.e. changes in the resonance cavities, change the formants, which provides a great variation of sounds. Language has an overwhelming variation of

resonance cavities. The formants in two accents of the same language will be different, but similar enough for one to recognise words spoken with different accents.

A special formant is the singers formant. It is being used especially by classical/opera singers and makes them capable of singing along a symphony orchestra without amplification. The formant is a merge between at least two formants, possibly F3 and F4 (and/or F5). The formant is created between 2400 and 3200 Hz. It creates a sort of brilliance in the voice. With male singers it is usually quite steady around 2800 Hz. By enhancing this area the singer is placing himself differently in the spectrum in relation to the orchestra, which fall in the area of 450 Hz for the loudest parts, thus he will be heard with apparent ease.

The main frequency of the formant is dependable on the length of the vocal tract. Therefore it will differ from one singer to another.

The circumstances for resonance is off course better with professionals than amateurs, because the professionals are conscious about how they must use their voice, control of muscles in the neck, face, mouth, jaw, between the ribs and off course the diaphragm etc., but both groups are very affected by hoarseness, cough, acid reflux, etc.

The formants are different in speech and singing, in the upper and lower register and different between sexes. Furthermore they are related to age, and change according to vowels as described above. There are no evidence based surveys on the subject of timbre with healthy and sick professionals and amateurs. The conditions with people who do not sing or are not musically gifted has not been researched either.

There are no evidence based surveys on the influence of any given profession, with neither healthy nor sick people.

Source: Voice- Tradition and technology, A state of the art studio, by Garyth Nair