Sample solution for the tutorial: Spectral representation of vocal recordings

https://analyse.hfm-weimar.de/doku.php?id=en:tutorium_singing

Ray Charles: *Come Back, Baby*

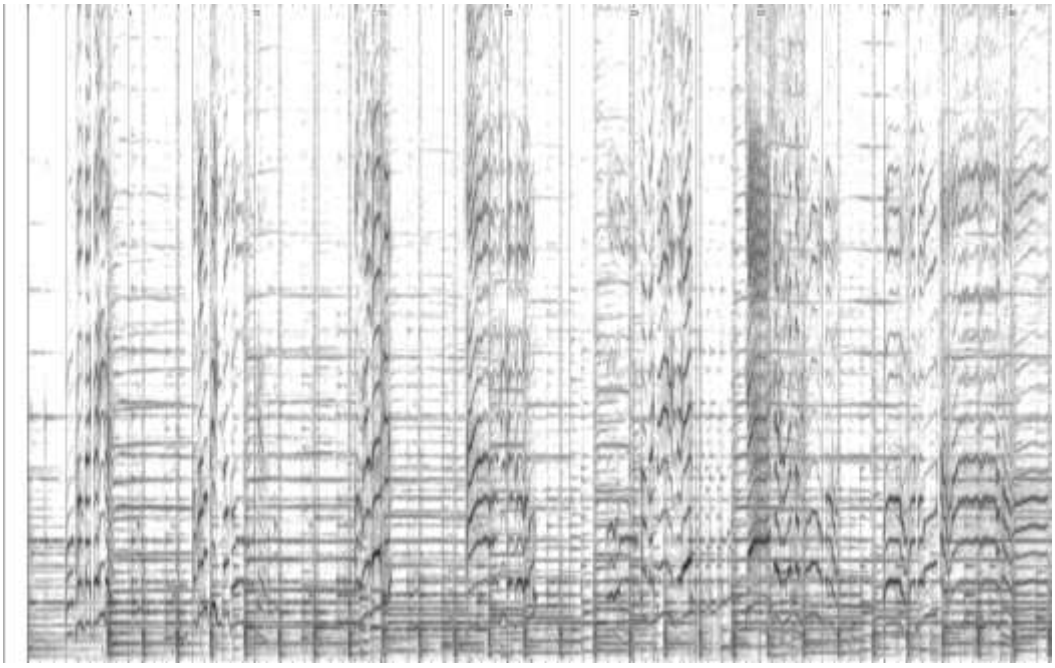
What stands out when you look at the vocal line?
How do the wind chords in the background compare?
In the recording, look for passages with
- a strong glide of the voice
- vibrato
- various ornamentations

Within the spectrogram passages with vocals can be clearly distinguished from those without: The vocals are visualized as curved, parallel, mostly diagonal or only approximately horizontal lines (fundamental and harmonics), while in the passages without vocals only parallel, strictly horizontal lines of the winds / brass as well as percussion impulses (vertical lines) are visible. In addition, more frequency components in the higher range (incl. gray "clouds") are visible in the vocal passages - these are completely absent in the much quieter brass and wind chords.

A strong glide of the vocal part can be detected in almost all vocal phrases; often phrases begin with a strong upward glide.

A fast, irregular vibrato is evident, for example, from 0:38; a short vibrato at about 0:19 and 0:24.5; later in the piece, for example, from 0:43 and 0:54.

Individual syllables are sung with rapid melodic ornaments that are recognizable as curved lines; for example, at 0:20 ("you never kno-o-ow") or immediately afterward from 0:24 ("o-o-oh come back ba-a-by-y")



Spectrogram up to 0:40, 10 Hz to 5 kHz, window size 4096 samples

Please enlarge the lower range of the spectrogram 0 - approx. 4000 Hz. Can you recognize the different formant ranges F1 and F2 in (loudly) sung vowels?

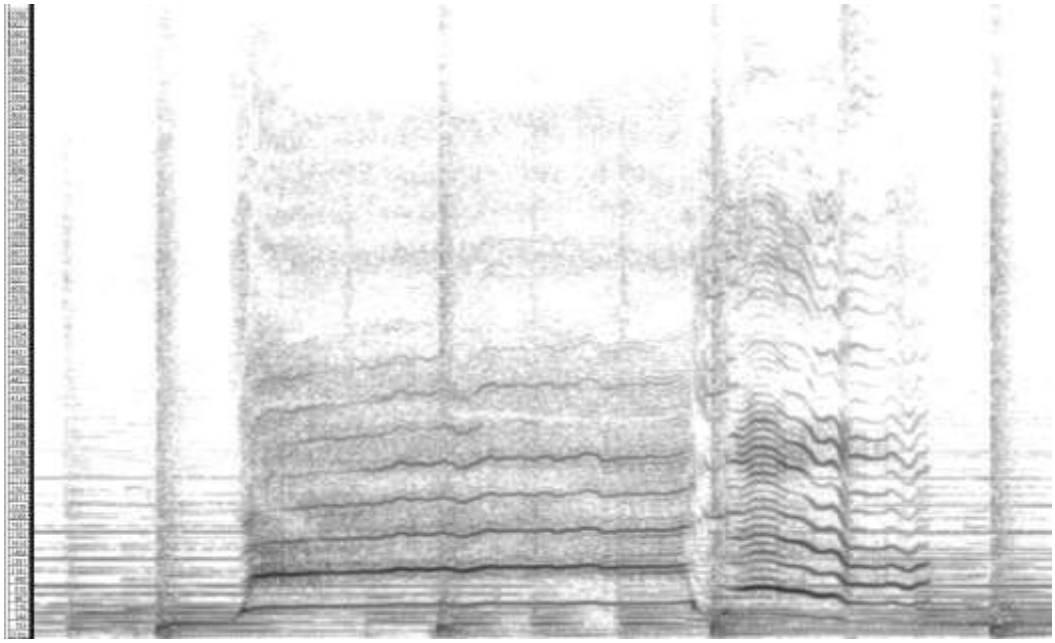
Since Charles sings very dynamically, it is difficult to detect major differences in the two formant ranges of the various vowels. On the other hand, higher formant ranges, e.g. between 3000 and approx. 3800 Hz, can be recognized very well, which are particularly prominent in the vocal passages and which provide a certain "brilliance" of Ray Charles' voice.

Where are sibilants clearly visible in the spectral representation of the recording?

Sibilants are relatively rare in the lyrics and therefore can only be detected in a few places in the spectrogram. Examples: At 1:18, the "ts" of "Let's talk it over" can be seen as a cloud in the 6-9 kHz range (likewise at 2:04, same lyric); at 1:32, the "s" of "say ..." can be seen in the 3-8 kHz range.

Take a closer look at the passage 1:42 - 1:46. What can be seen here?

From 1:42 on, the very noisy call ("yeah" in falsetto, visible as horizontal lines) is overlaid by a gray cloud (especially up to 5 kHz): a large share of roughness / noisiness covers the call. Afterwards (1:45) there are two additional lines between the partials of the second "ye-ah" call for a short time: the vocal tone is enriched here by so-called subharmonics and therefore sounds rough. These are two physiologically different ways of causing roughness in the singing.



Spectrogram 1:41 to 1:47, 20 Hz up to 1100 Hz, window size: 2048 Samples

What is the relationship between the rhythm of the vocals and the backing band?

The rhythmic playing of the accompanying band is very regular and exact. This can be seen above all in the regular basic beat of the drums (vertical lines), and in part also in its triplet subdivisions. But also the changes of the wind chords (parallel horizontal lines) and even the fills of the piano (e.g. at 0:28) very precisely and regularly placed.

In contrast, Charles breaks away from the metrical grid in many phrases, which supports the speech-like and expressive character of his singing. He places many vocal notes before or behind the beat, but on the other he also places some notes very precisely on the beat. His singing is therefore very variable in rhythmic terms.