Universidade do Porto
Faculdade de Engenharia
FEUP

# Perceptual parameters and acoustic features of the singing voice

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# Summary

- Objectives
- Quality parameters of the singing voice
- Perceptual parameters of the singing voice
- Formant estimation algorithm
- Formant tracking algorithm
- Next steps

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## • Objectives

– Clarification of subjective parameters used in singing performance.

– Construction of a data base of singing voice records concerning the most relevant quality/perceptual parameters.

– Development of a robust algorithm estimating formants in singing voice in particular the “Singer’s Formant”.

## Applications in perspective

– Finding a set of definitions suitable both for musicians and engineers and even easily understandable by the general public.

– Implementation of the algorithm for visual feedback recognizing the quality/perceptual parameters.

# Quality parameters of the singing voice

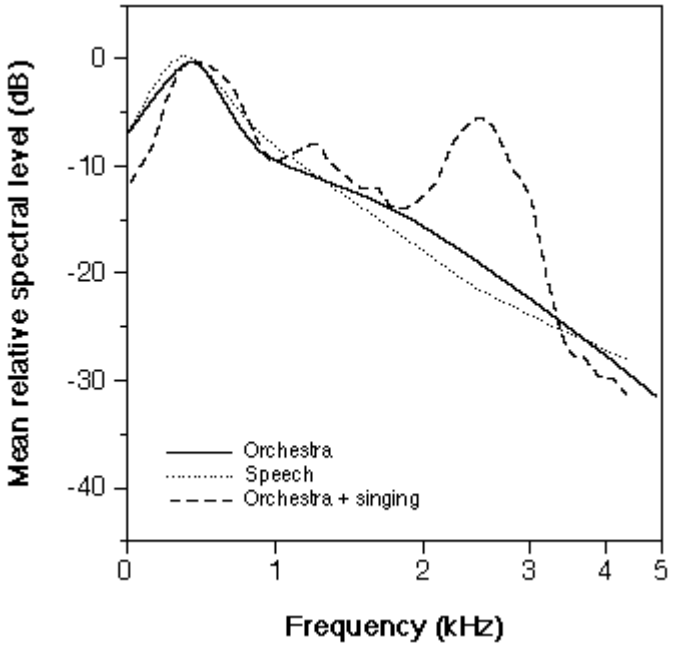
- example: The Singer's Formant

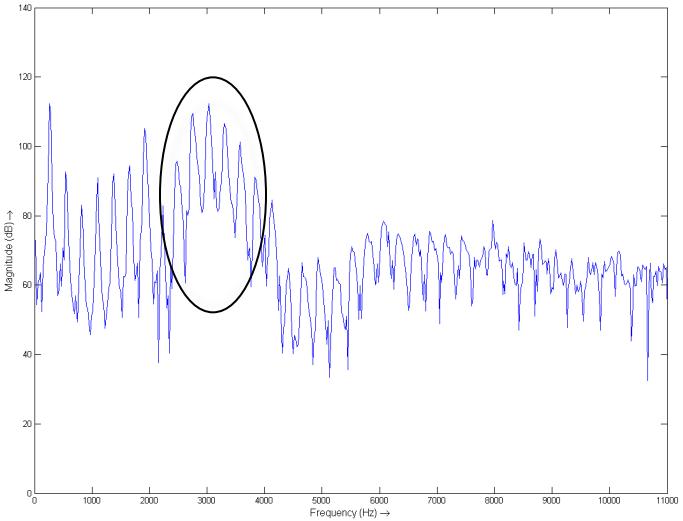
Soprano

Singer' s Formant vs. Smooth voice

Tenor

Singer' s Formant vs. Smooth Voice




- Responsible for the amplification of the frequencies around 2000, 3000 and 4000 Hz.
- Spectral reinforcement in the region around 3000 Hz, resulting from the concentration of formants F3, F4 and F5, which raises the overall spectrum (particularly the harmonic peaks) in that region.

# Quality parameters of the singing voice

- example: Front Voice/Back (Swallowed) Voice

Related to the exploration of the nasal sinuses

- Front Voice (or “in the mask") - the largest projection and greater perception of vocal characteristics, both timbre and dynamics.

- Back Voice - feeling of throat tightening and without perspective of voice projection. Results in a fuzzy voice.

Voice in the mask (S)

Back Voice (S)

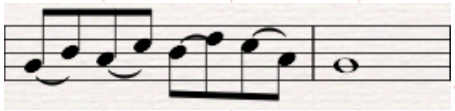
Voice in the mask (T)

Back Voice (T)

- Possible causes:
  - Weak exploration of the nasal sinuses
  - Weak or absence of respiratory support during the vocal emission.
  - Is easily mistaken for nasal voice.

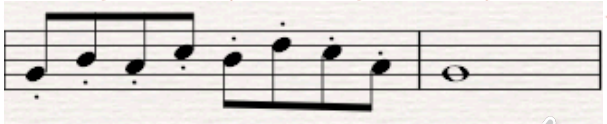
# Perceptual parameters of the singing voice

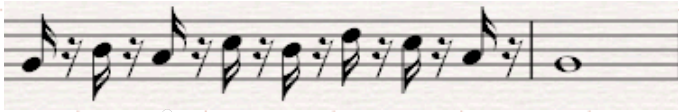
- example: Dynamics - Legato/Staccato
  - ***Legato*** – Continuity of the vocal line without perceptual gaps in the emission of the voice in the passage to other frequencies.



*Legato* (S) *Legato* (T)

  - ***Staccato*** – Means "Separated". Consists of short pauses between the notes.



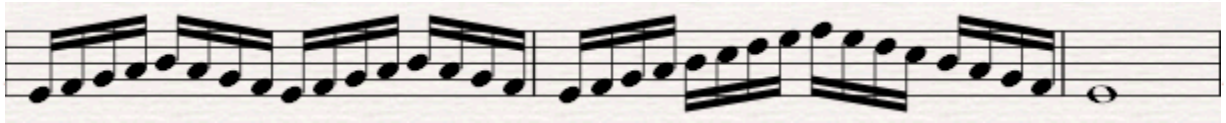


*Staccato* (S) *Staccato* (T)

# Perceptual parameters of the singing voice

- example: Coloratura

***Coloratura*** – Realization of multiple notes in one syllable



Coloratura(S)

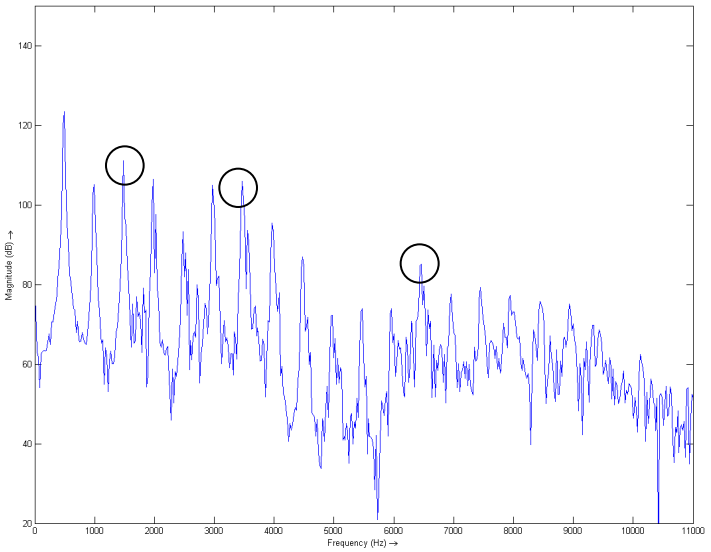
Coloratura(T)

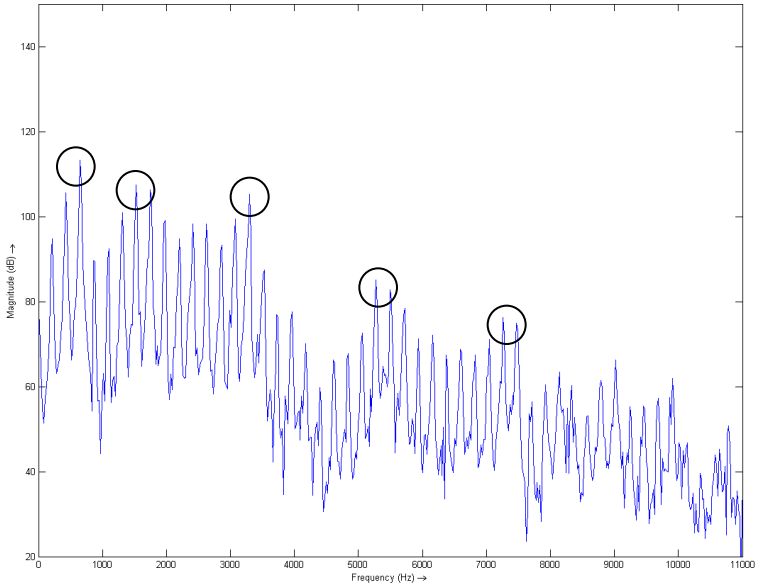
- Main problems:
  - Breathing troubles.
  - Preserving the fundamental sound.
  - Quality of the note's articulation and vocal agility.

# Formant estimation algorithm

- It is relatively easy detecting formants by human observation.

- An automatic computer program performing the same task is difficult, especially for high fundamental frequencies.

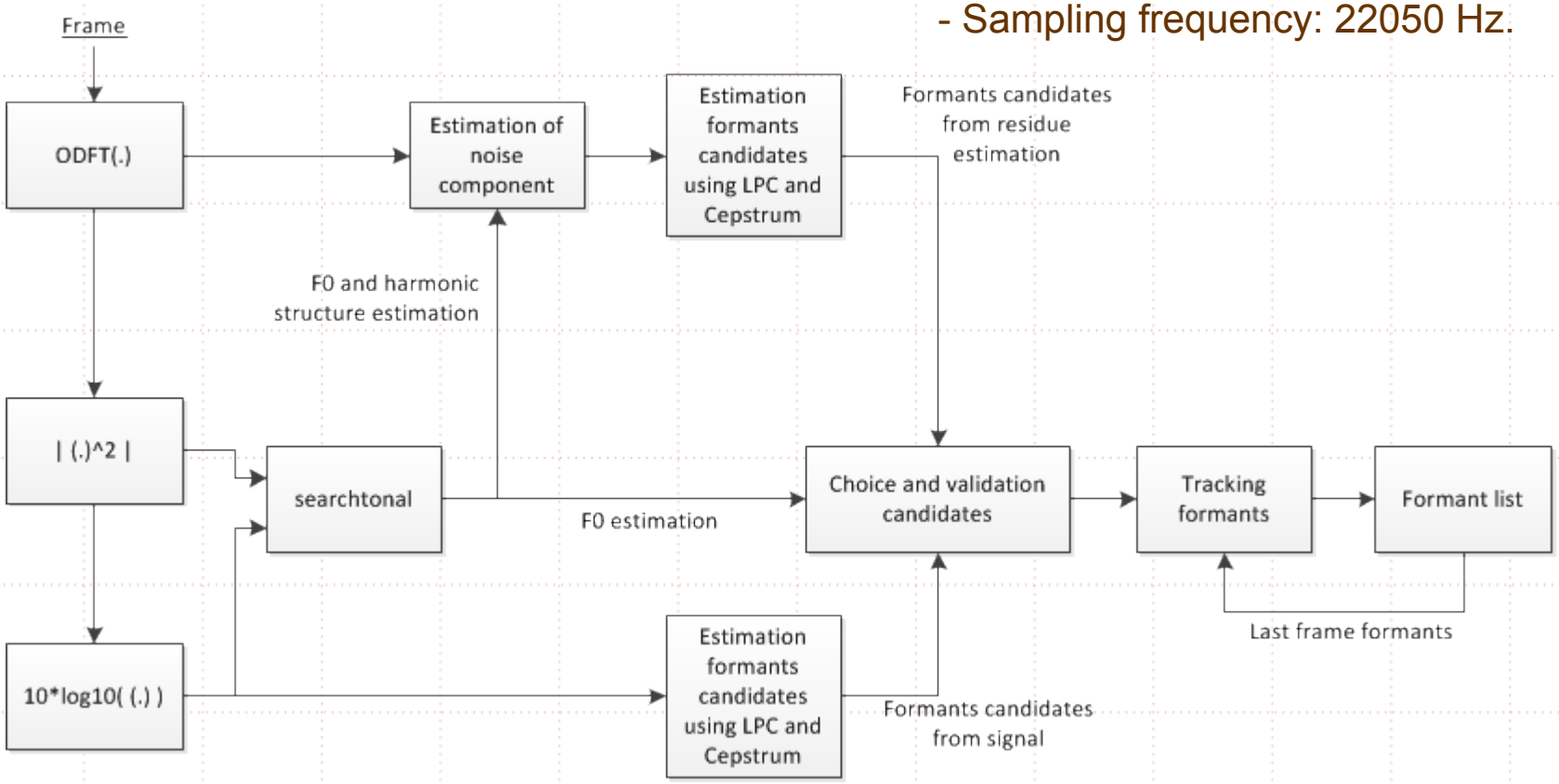


# Formant estimation algorithm

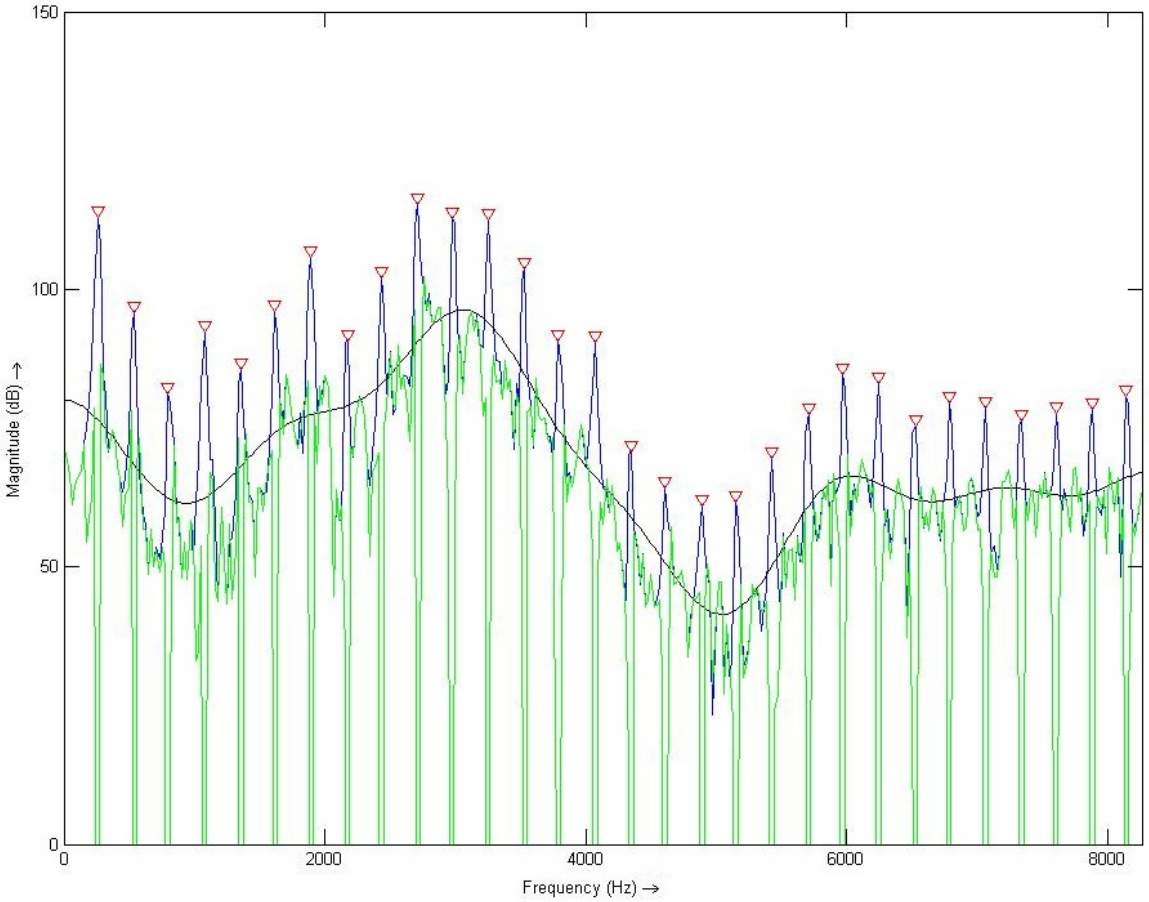
Features:

- Analysis window : 1024 samples, 75% overlap, sine window.
- Sampling frequency: 22050 Hz.



# Formant estimation algorithm

- Noise and harmonic structure estimation

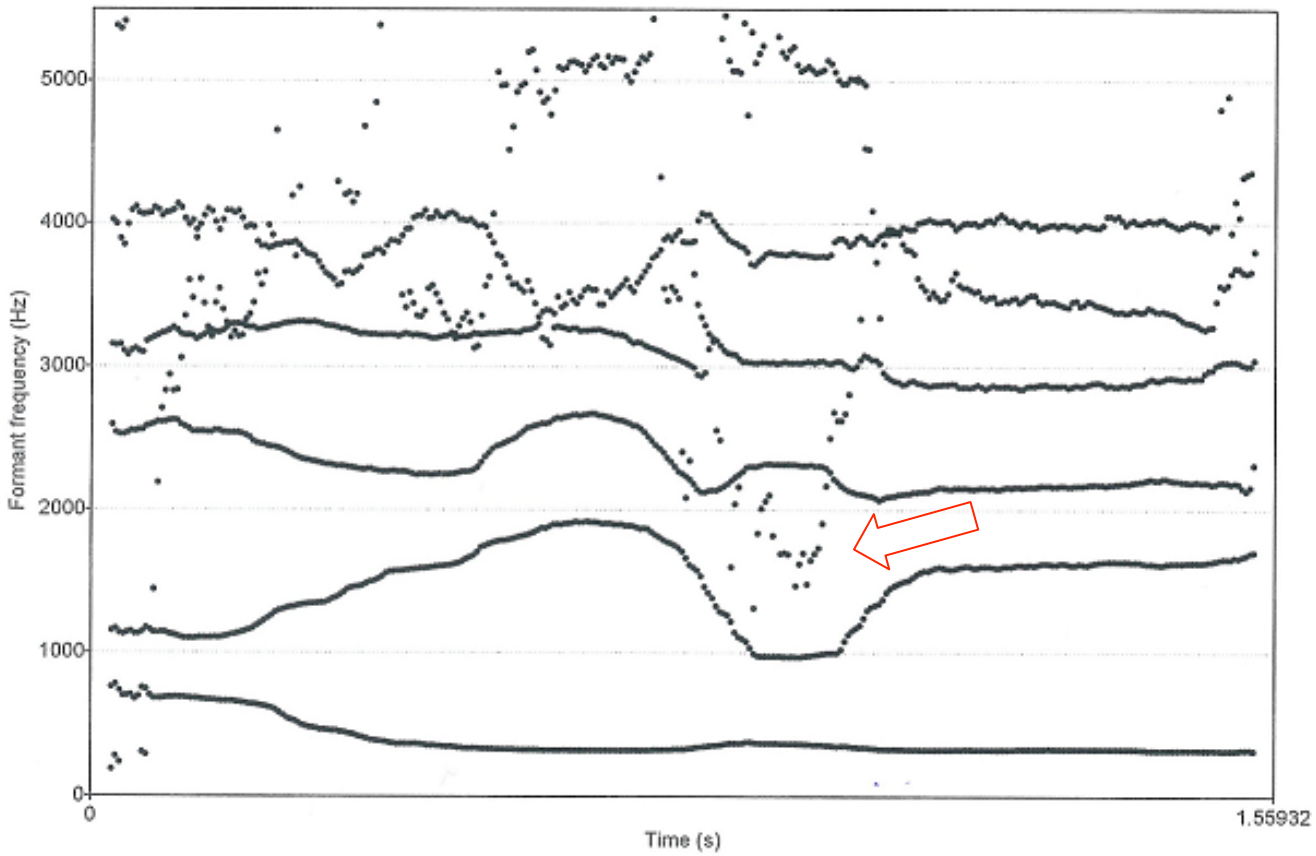



Observation:

- Both the noise and harmonic structure are modeled by vocal tract.

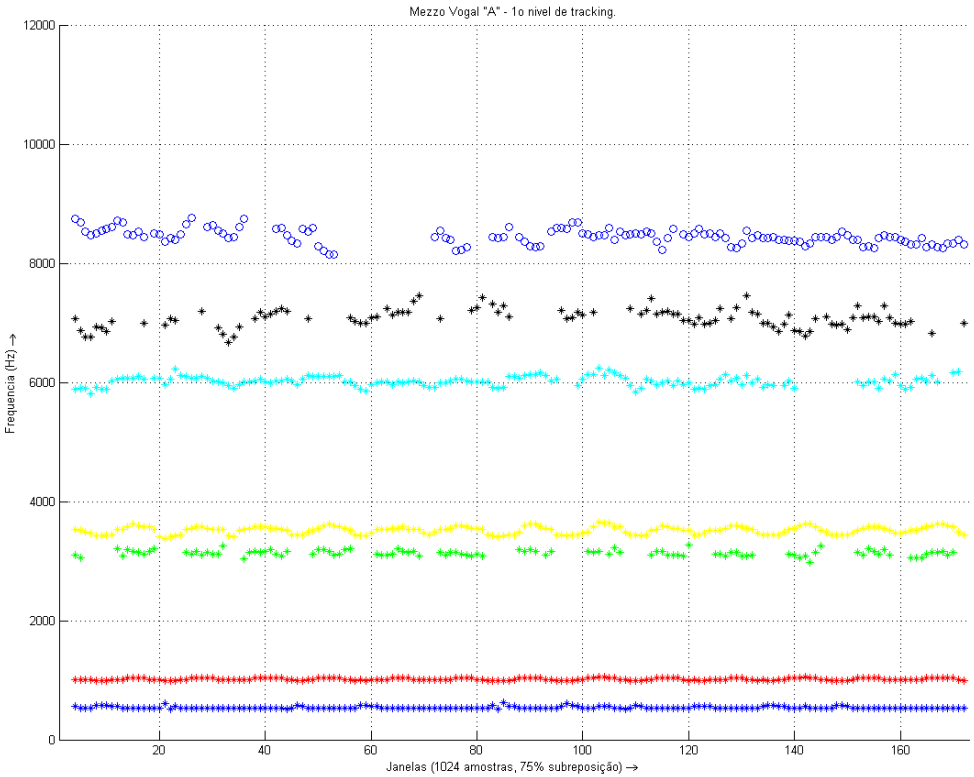
# Formant tracking algorithm

Some typical errors of formants tracking.



# Formant tracking algorithm

- Use the higher amplitude formants.
- Use the formants of the last frame to help estimating the new candidates.




Some difficulties:

- The closeness between two or more formants.
- Make a clear distinction between different formant tracks.

# Next steps

- Integration into ***SingingStudio*** of the formants estimation and tracking module.
- Develop a singer's formant detection module, as well as other modules for possible visual representation of other relevant perceptual parameters.