

## Spectral features of vowels; spectrograms (*ảnh phổ*)

Cơ sở âm vị học và ngữ âm học

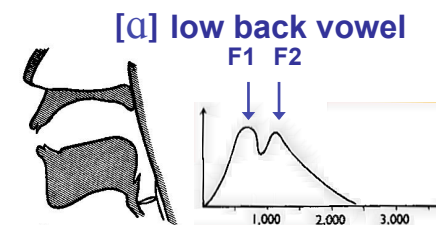
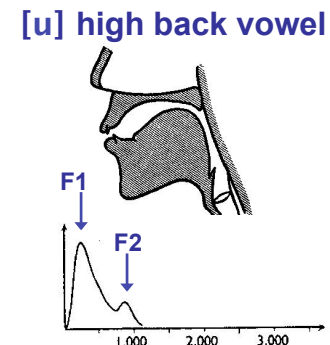
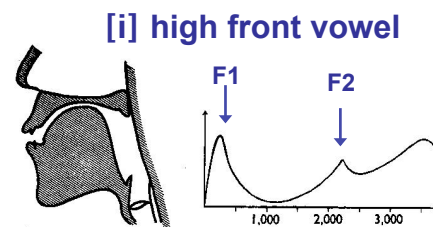
### Lecture 13

## The story so far

- Vowels can be distinguished acoustically by characteristic **formant patterns**
  - Formants are *bundles of high-amplitude harmonics* (*những giải tần có cường độ lớn*)
  - Formants *change with articulatory settings*
- “Rule of thumb”: rough-and-ready relation between vowel height/backness and F1/F2
  - The higher F1...
  - The lower F2...

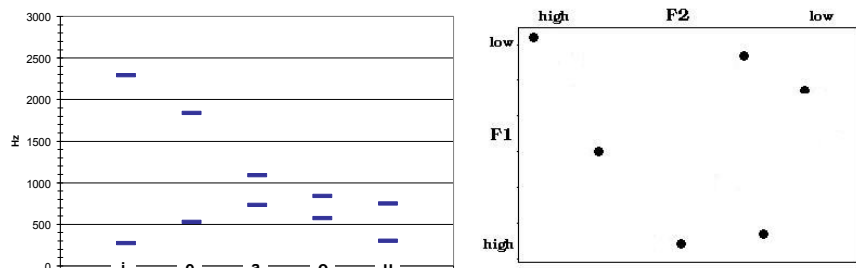
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From Ladefoged (1996)  
*Elements of Acoustic  
Phonetics.*

## Interpreting formants



## Diphthongs

- **Diphthongs** (*âm đôi*) are vowels with two different targets: the tongue moves during the vowel

- [iə] in *thìa* consists of [i] and [ə] components
- [ʊə] in *thưa* consists of [ʊ] and [ə] components
- [uə] in *thua* consists of [u] and [ə] components
- ...etc

- What are the spectral characteristics of a diphthong?

## Diphthongs

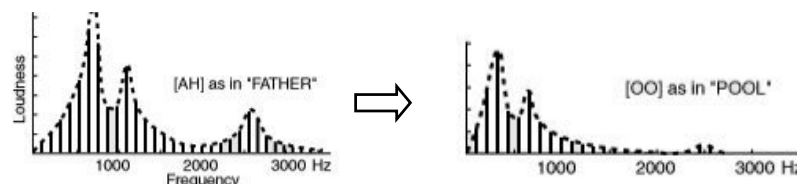
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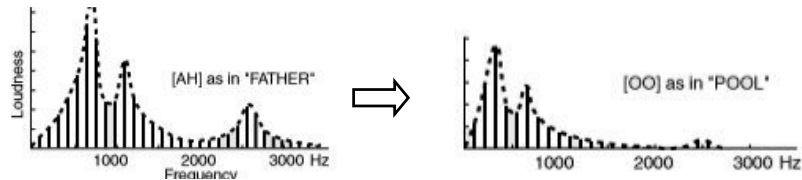
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- It is not possible to represent this change using spectra.
- Need a way to see frequency component structure over time.

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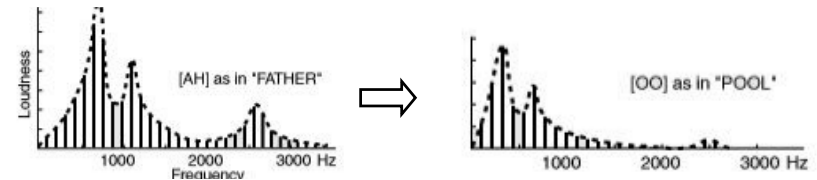
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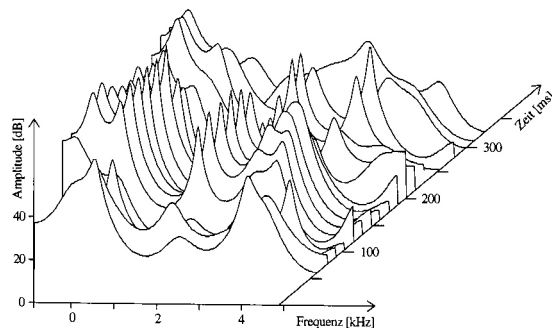
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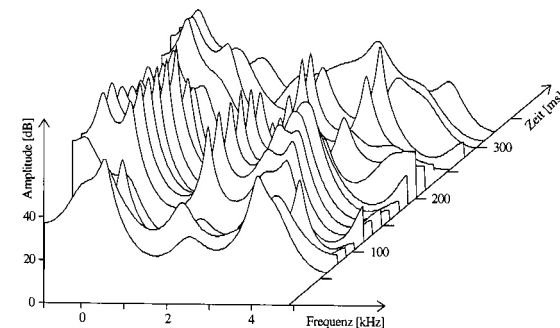
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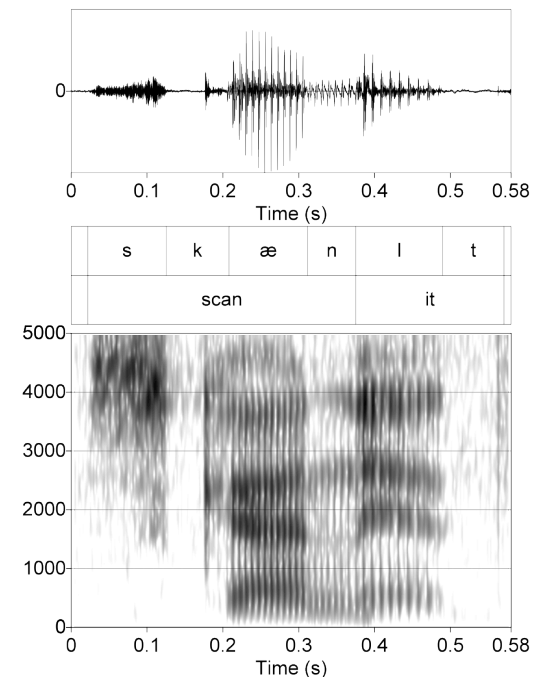
- The **waveform** shows changes in amplitude over time.
  - Good for distinguishing broad sound classes
- The **spectrum** shows intensity over frequency, indicating the frequencies at which a sound has energy.
  - Good for identifying vowels, but no time dimension
- The **spectrogram** combines the advantages of both. It indicates intensity over frequency over time.

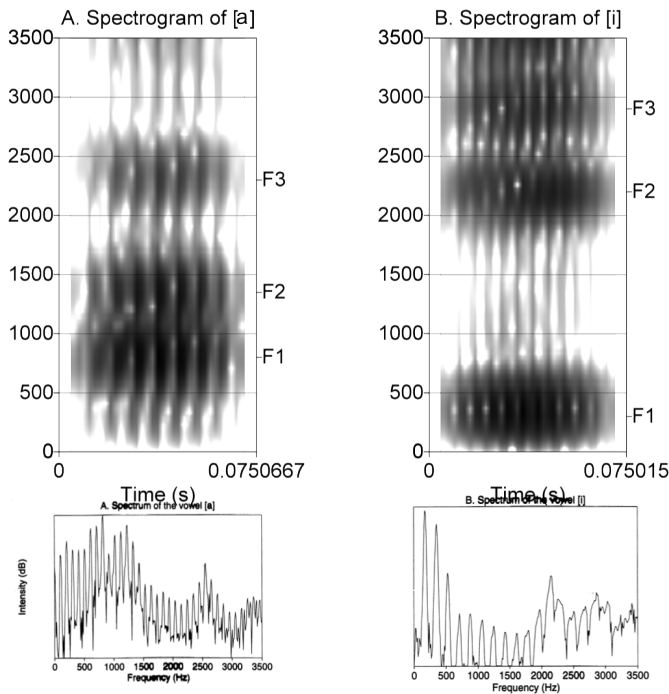
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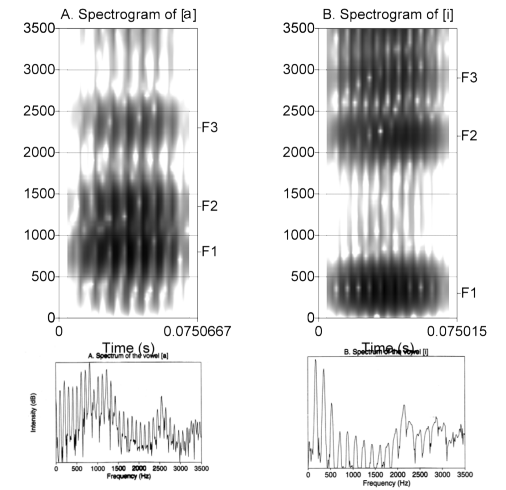
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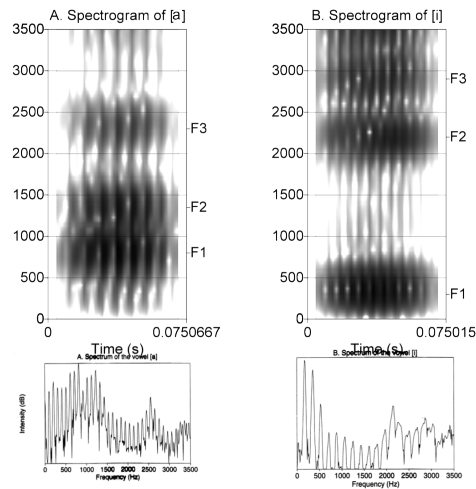




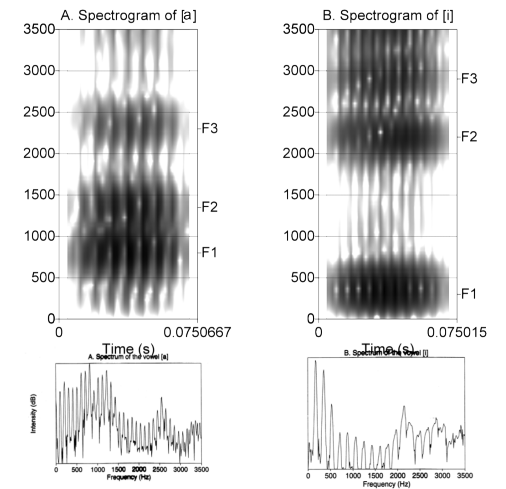
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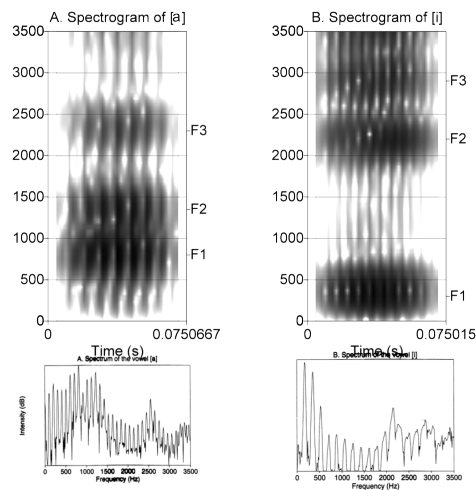
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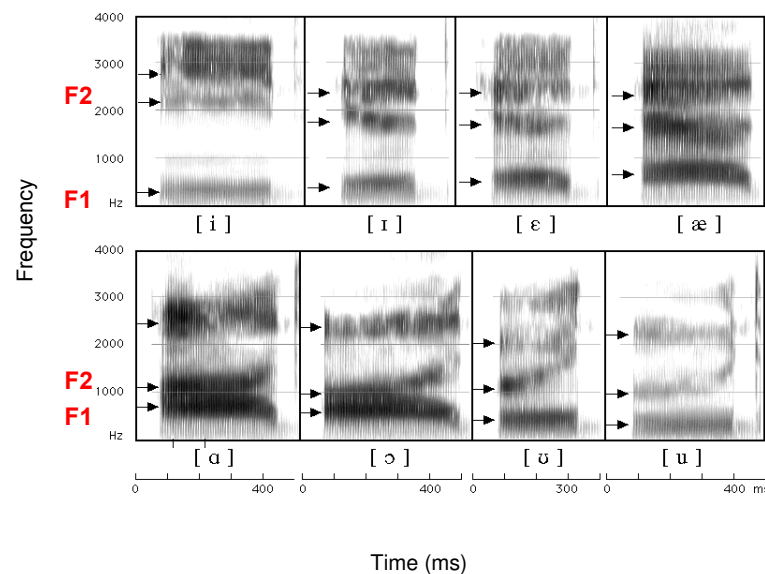
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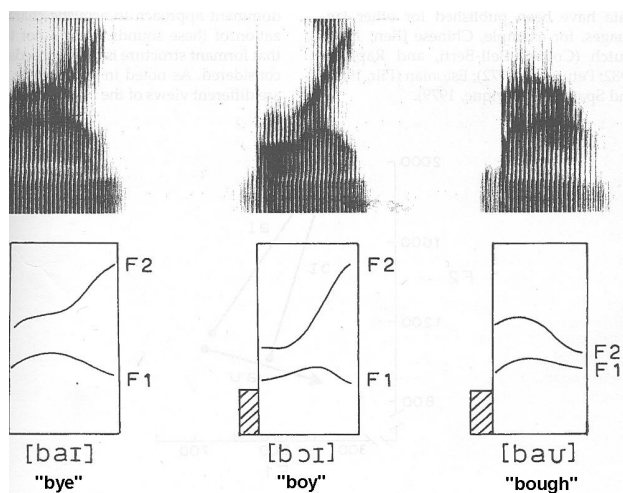


## F1/F2/F3 patterns for common vowels



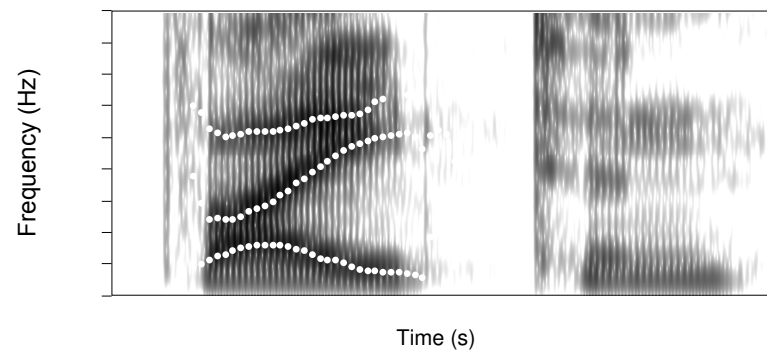
From Ladefoged (2006) *A Course in Phonetics*

- With a spectrogram, it's easy to visualise diphthongs:



## Vietnamese *thái* [t<sup>h</sup>aj]

1/4 into vowel: F1 = 803 Hz, F2 = 1387 Hz  
 3/4 into vowel: F1 = 410 Hz, F2 = 2042 Hz



from UCLA Phonetics Lab Archive, <http://archive.phonetics.ucla.edu/>.