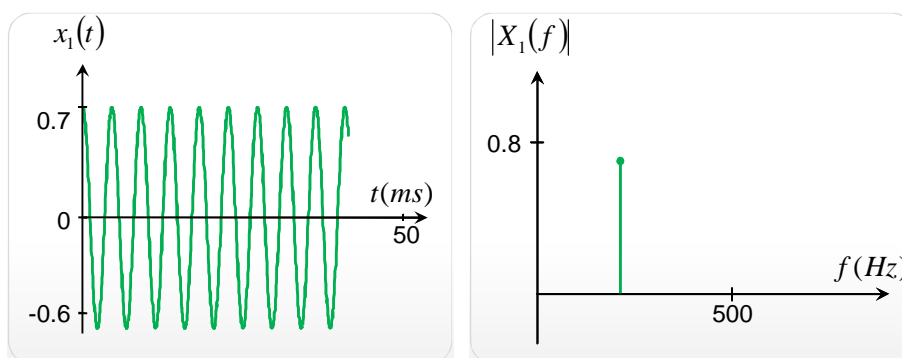


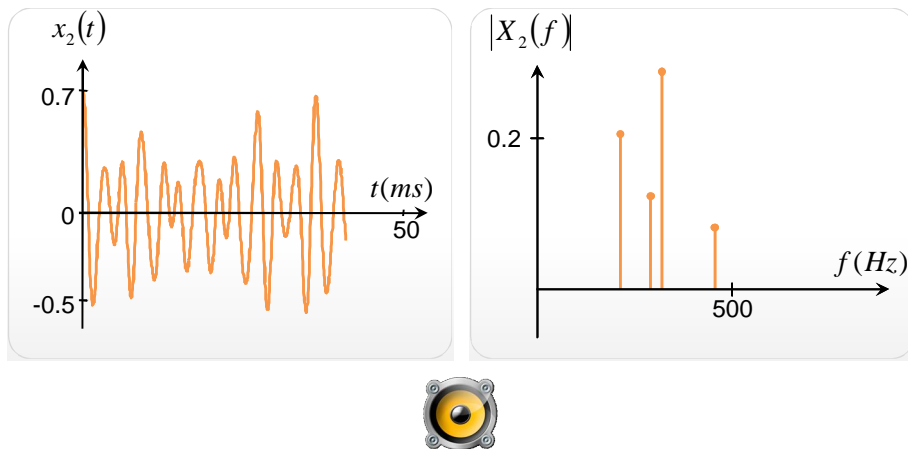
Sound of Fourier Series

Computing Assignment 2

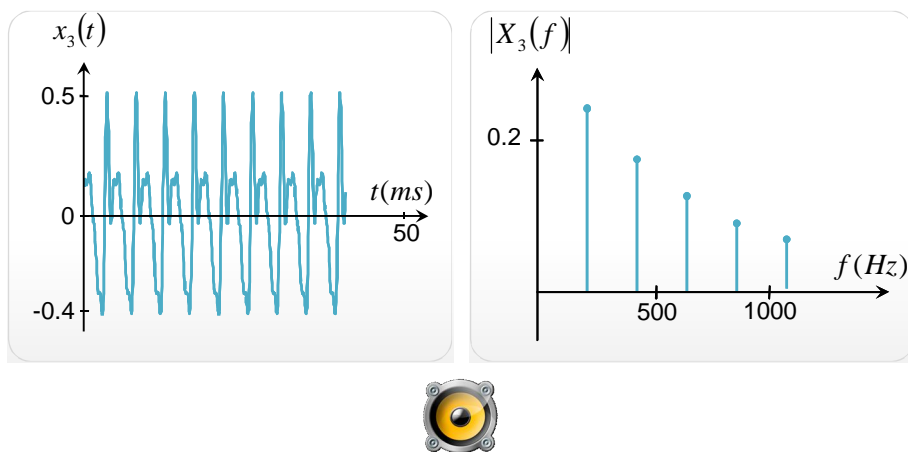
Sound "atoms" : Single tone signal

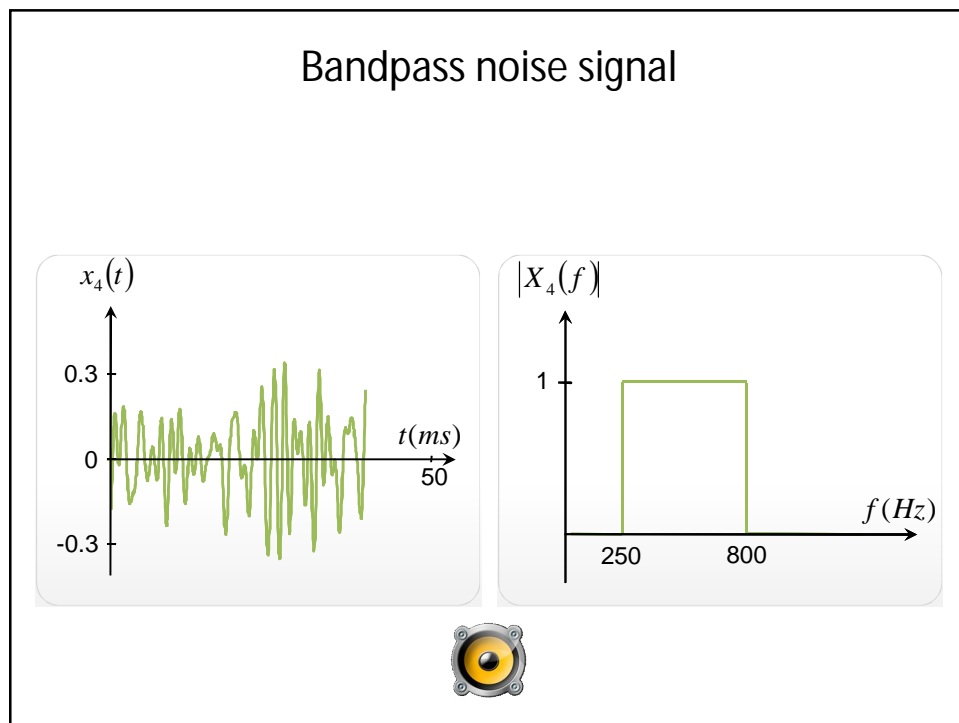
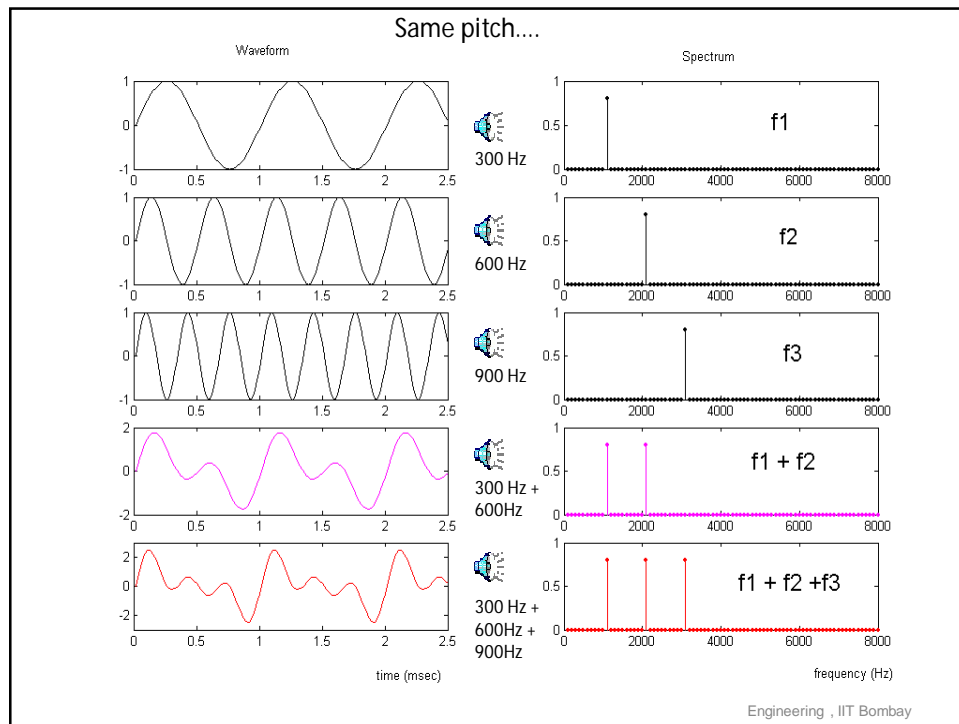


Non-tonal signal

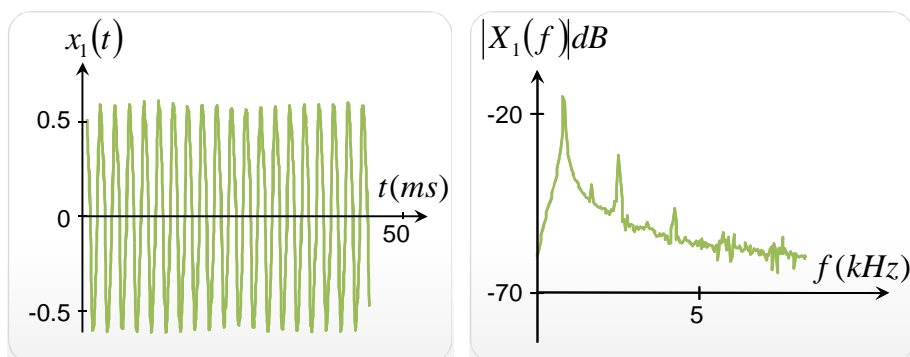


Complex tone signal





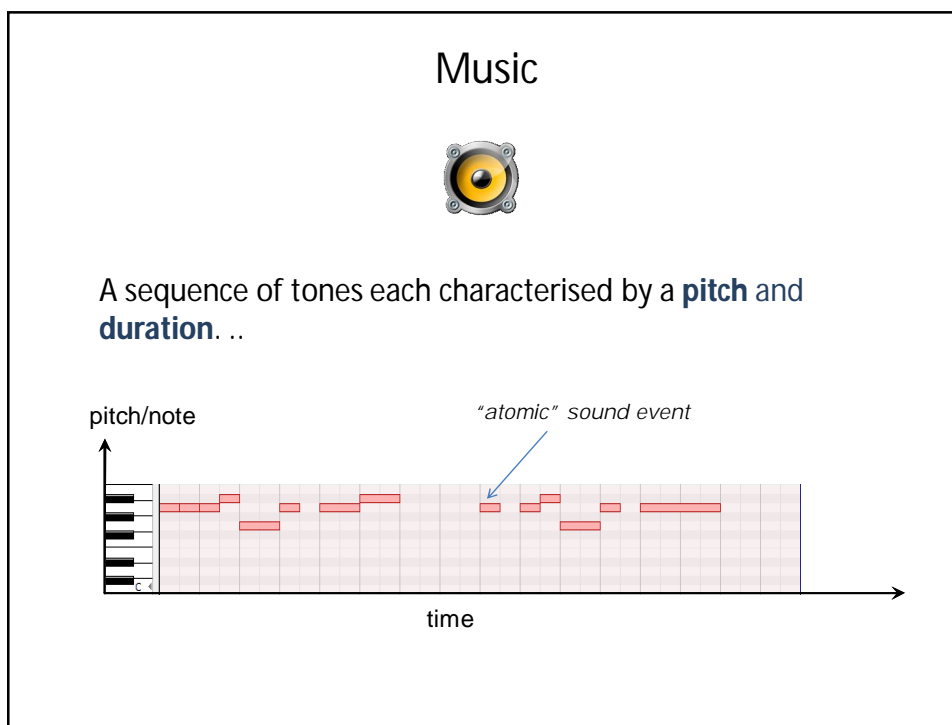
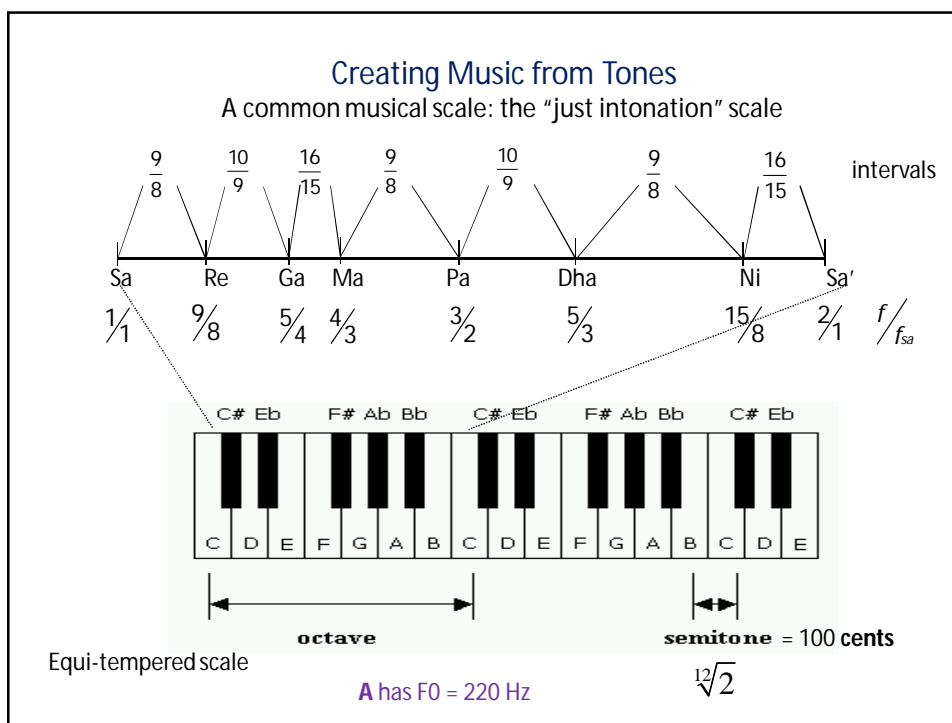
A flute note



Creating Music from Tones

What are the Elements of Music?

- “Notes” belong to a small set of discrete pitches (F_0)
- Isochronous timing (uniform time intervals between notes)
- Universal across cultures



Role of musical instrument: the Guitar

Source = Plucked String

=> Periodic vibration

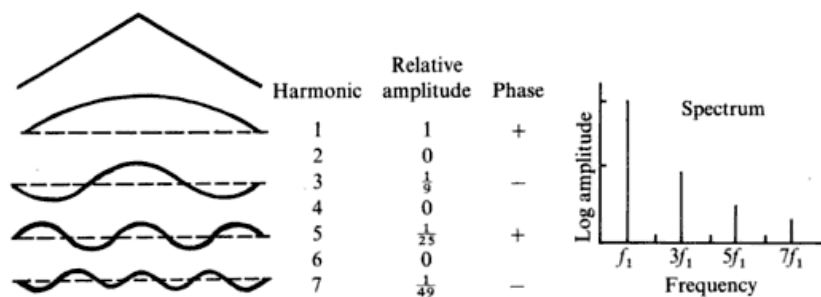


Fig. 2.5. Frequency analysis of a string plucked at its center. Odd-numbered modes of vibration add up in appropriate amplitude and phase to give the shape of the string.

From: Rossing & Fletcher, Principles of Vibration and Sound

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LTI system = Guitar body

=> The body is an LTI system that modifies the amplitudes and phases of the string harmonics according to its natural resonances.

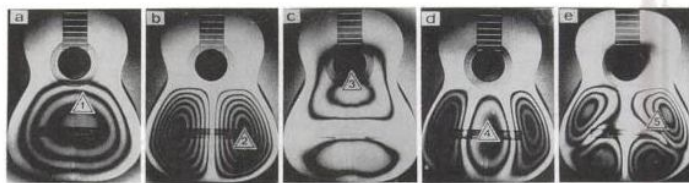


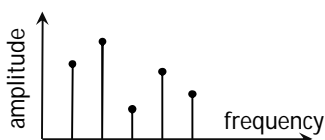
FIGURE 9.8. Vibration modes of a classical guitar top plate glued to fixed ribs but without the back (Jansson, 1971).



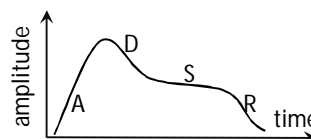
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Timbre

- Tone “quality” or colour is linked with the identification of the instrument producing the tone. Influenced by the acoustics of the instrument + environment.
- A multidimensional attribute. Important dimensions are:
 - spectral envelope
 - time envelope “**ADSR**” => Attack, Decay, Sustain, Release
 - presence of irregularity and noise



spectral envelope



temporal envelope

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Fourier spectrum and perceived sound

You can create a tone with multiple harmonics (sinusoids) to achieve a desired pitch, timbre, loudness and duration as follows.

Sound sensations

Physical quantities

- | | |
|-----------------------------|---|
| ○ <i>pitch</i> | <i>fundamental frequency (spacing of harmonics)</i> |
| ○ <i>timbre (“quality”)</i> | <i>spectro-temporal properties (relative amplitudes of harmonics)</i> |
| ○ <i>loudness</i> | <i>intensity (amplitudes of harmonics)</i> |
| ○ <i>duration</i> | <i>time from onset to offset of sound</i> |

Computing Assignment 2: Music Synthesizer

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