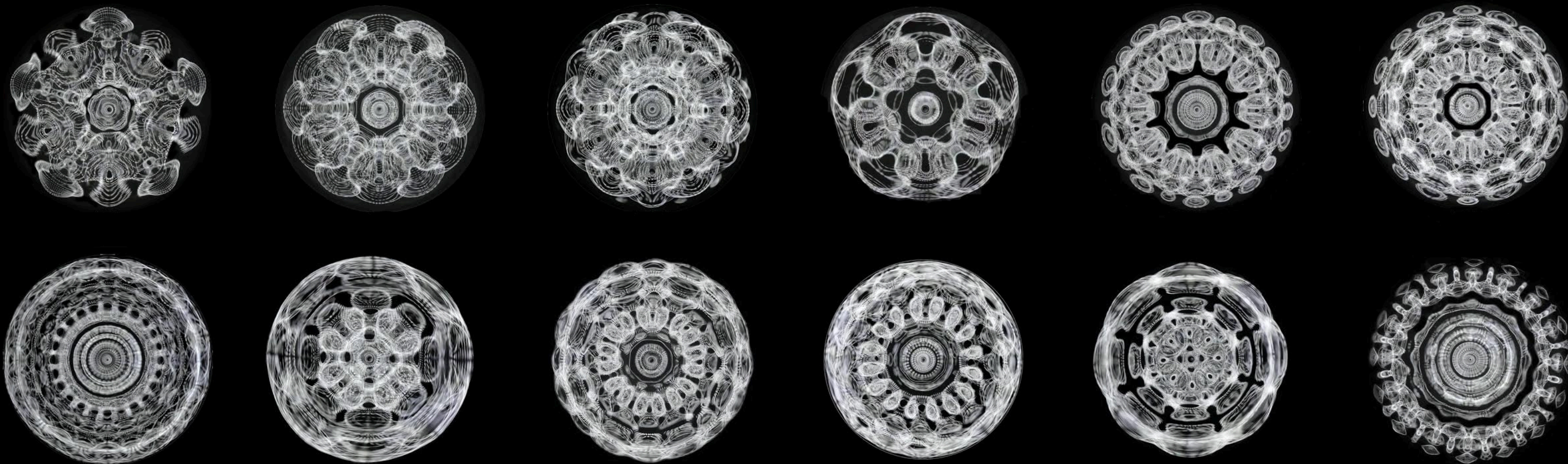


What is Sound? Part II



Timbre & Noise

PSYCHOACOUSTICS

ACOUSTICS

LOUDNESS



AMPLITUDE

PITCH



FREQUENCY

QUALITY



TIMBRE

Timbre / Quality

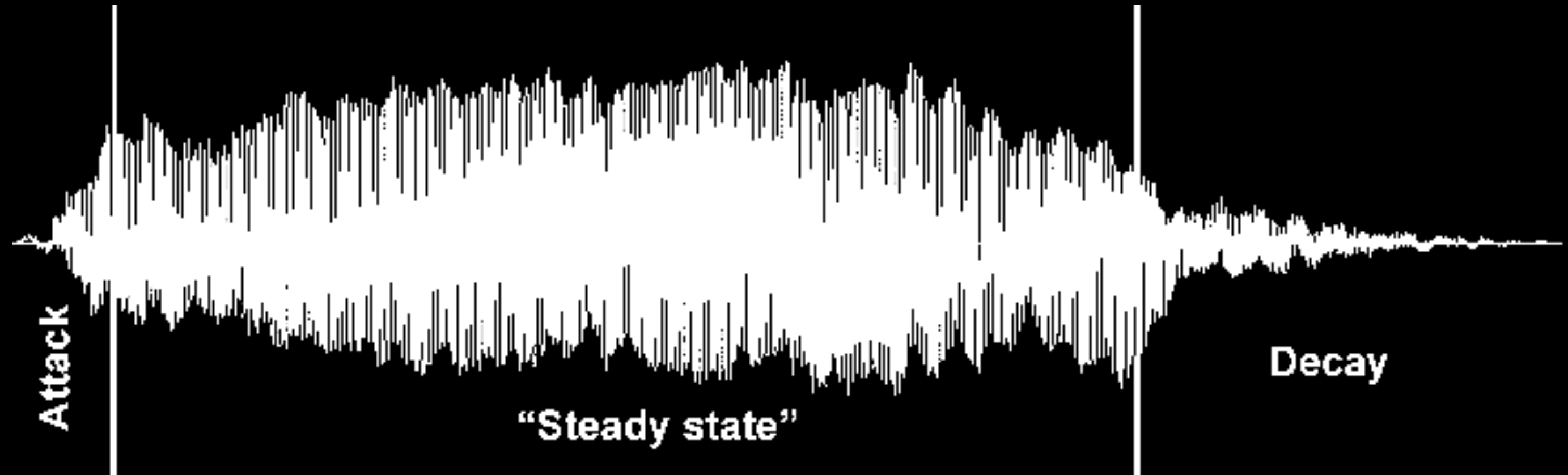
everything that is not frequency/pitch or amplitude/loudness

envelope - the attack, sustain, and decay portions of a sound

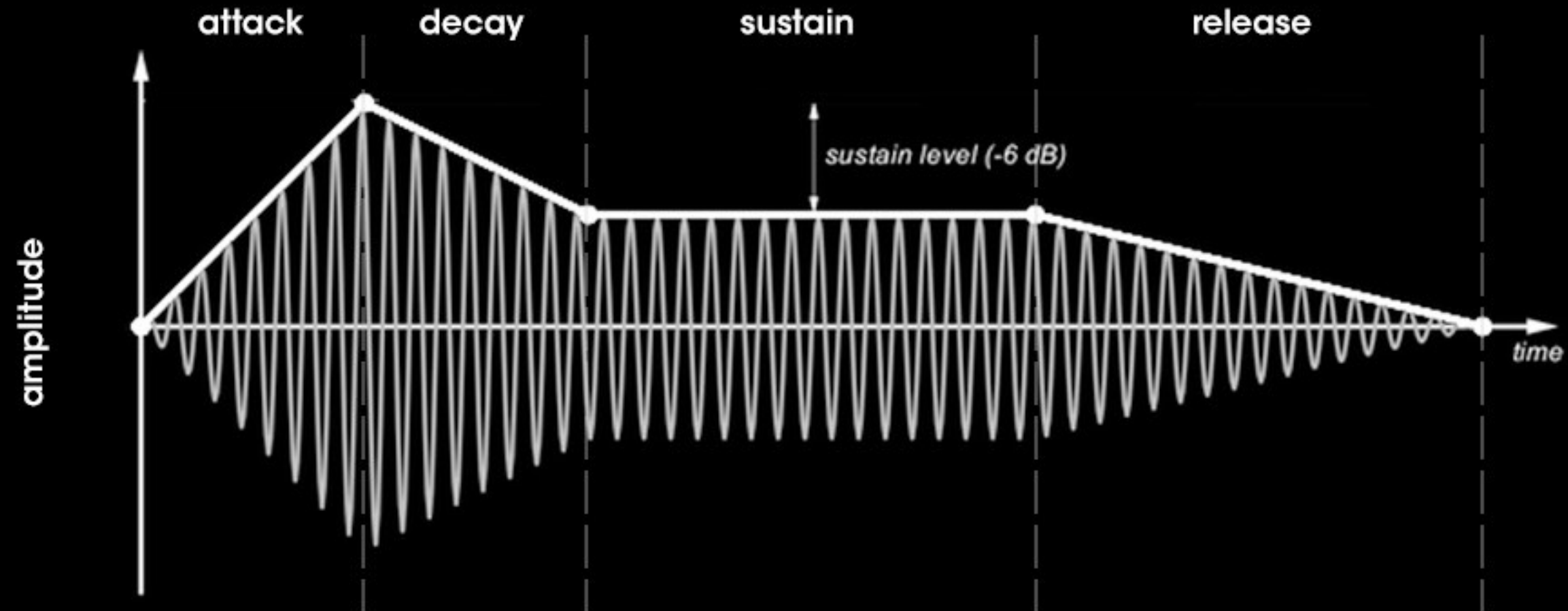
spectra - the aggregate of simple waveforms (partials) that make up the frequency space of a sound.

noise - the inharmonic and unpredictable fluctuations in the sound / signal

envelope



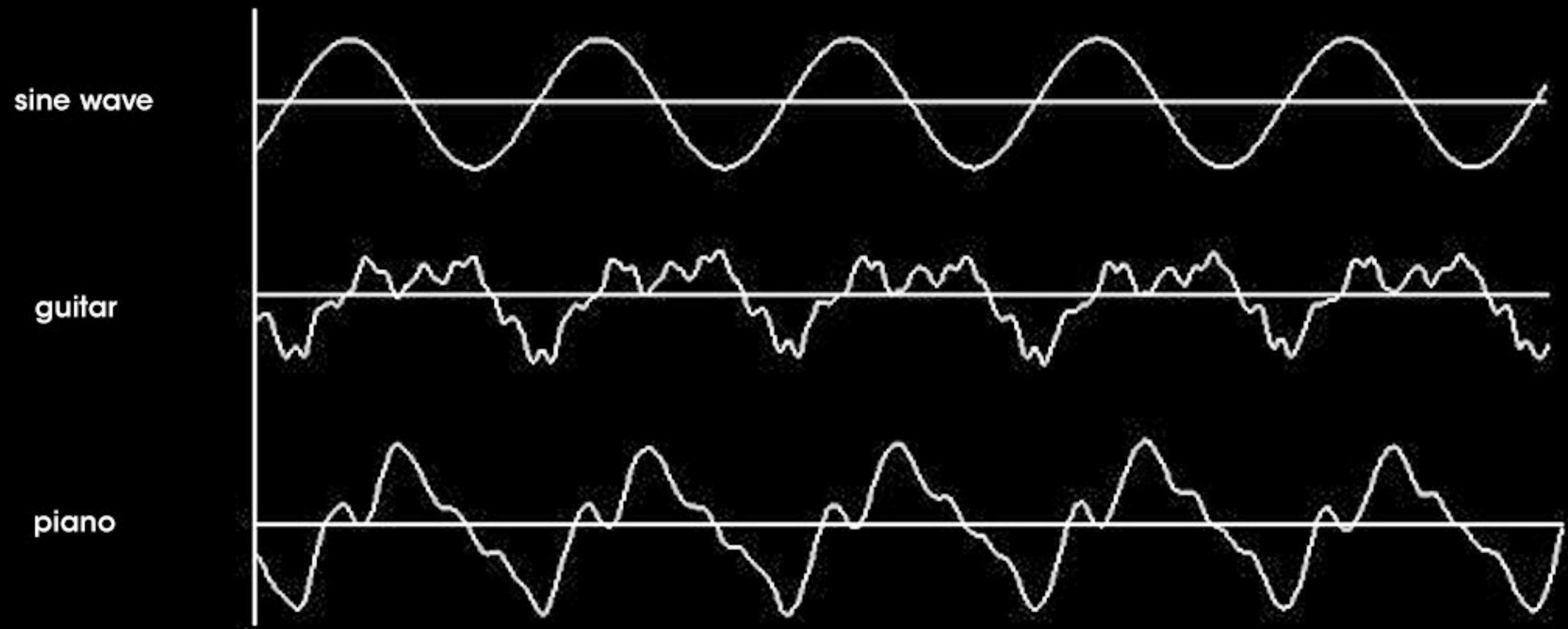
envelope



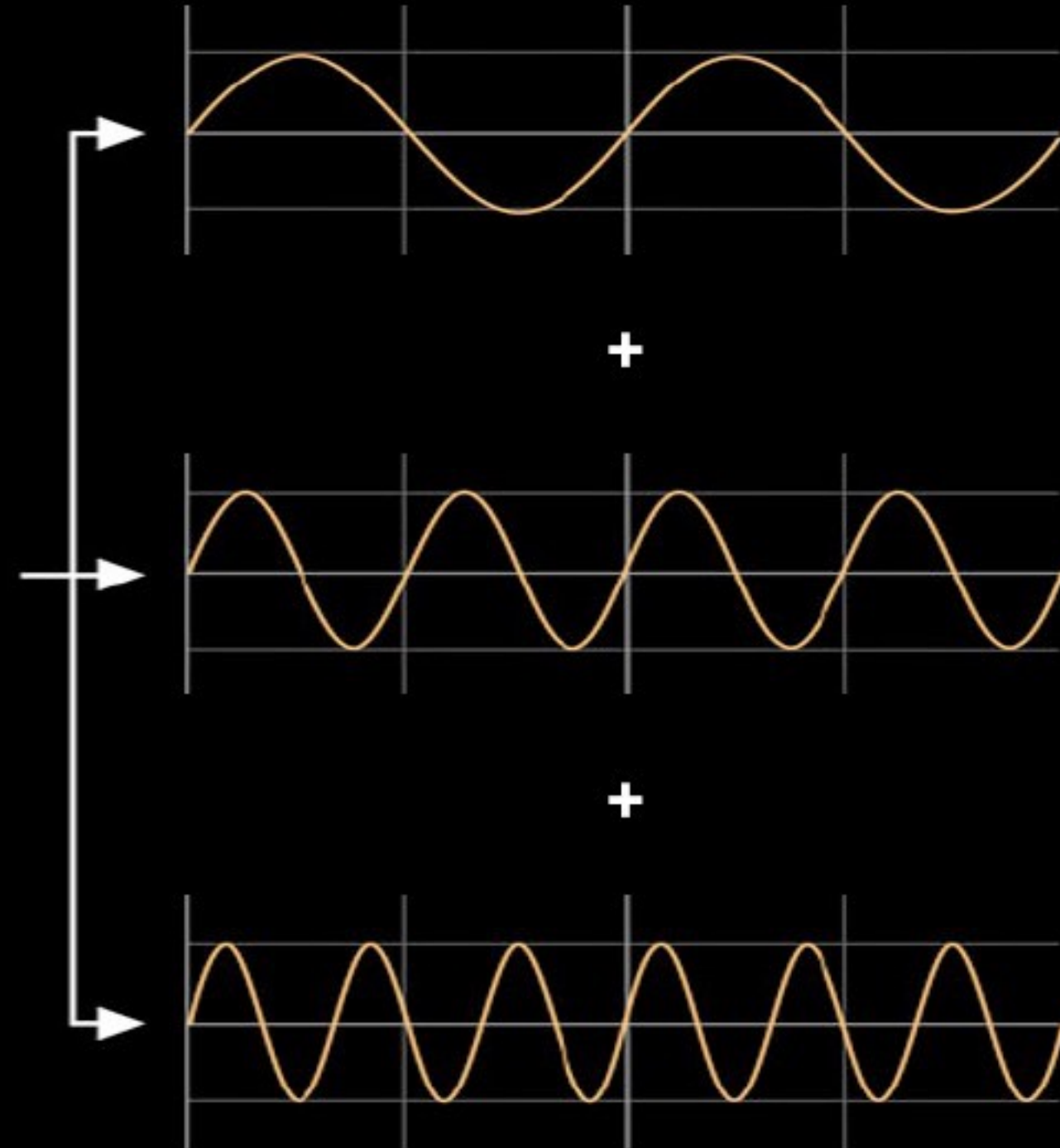
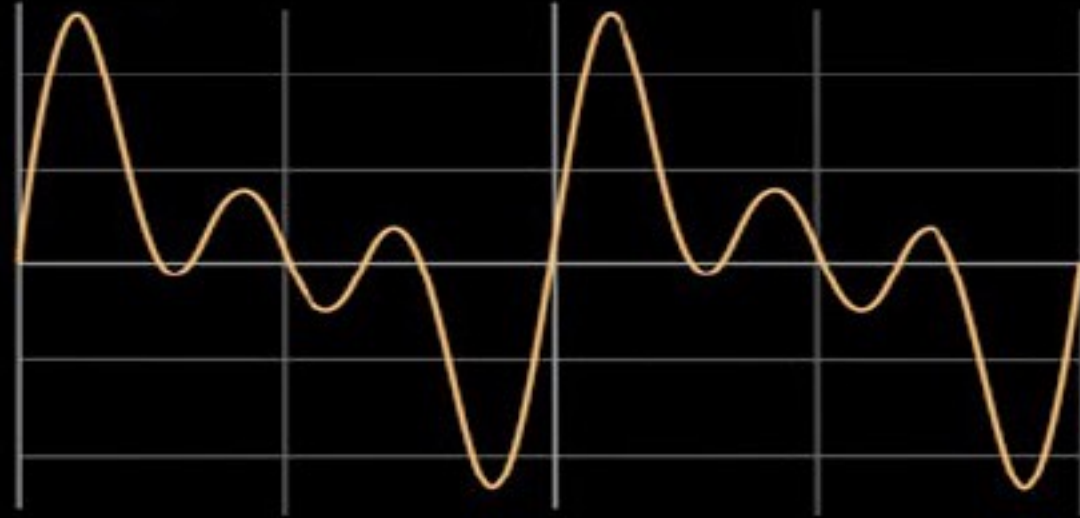
ADSR

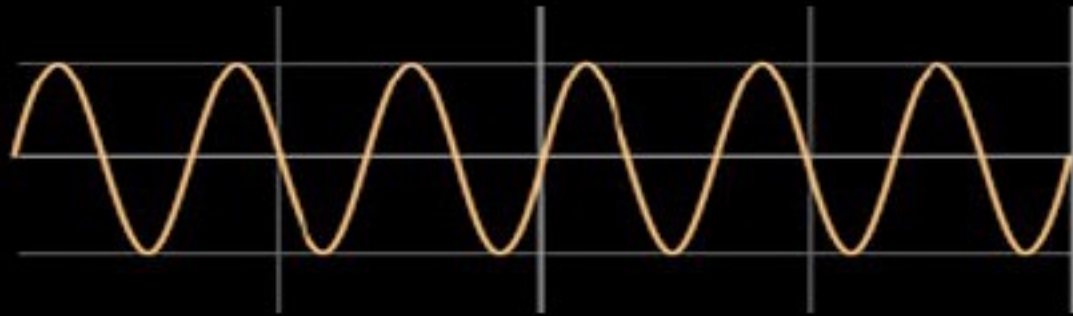


Frequency Spectrum

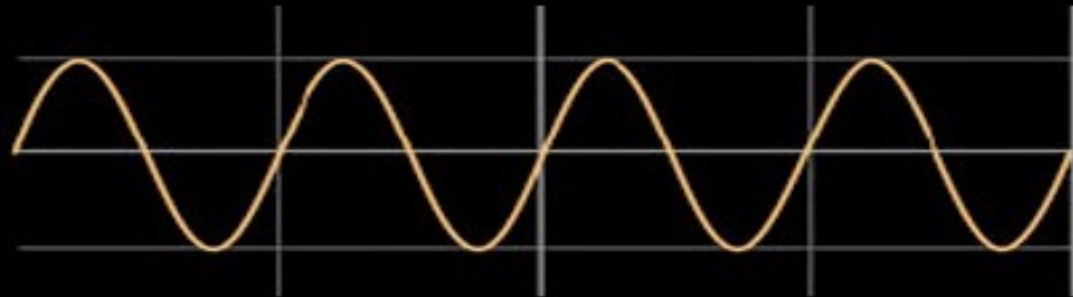


Spectral Analysis

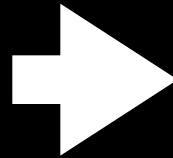
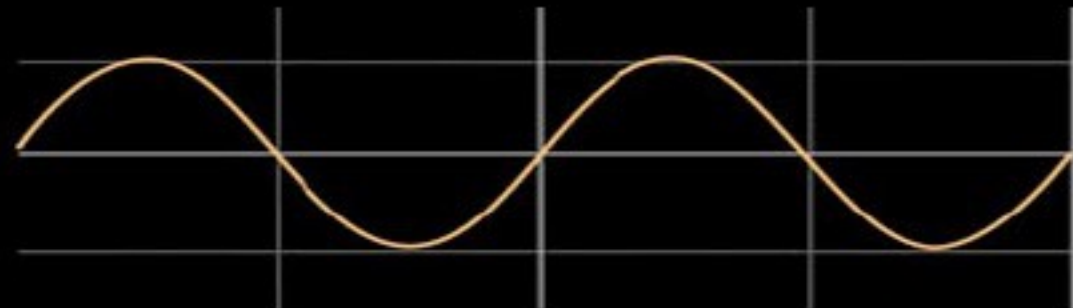




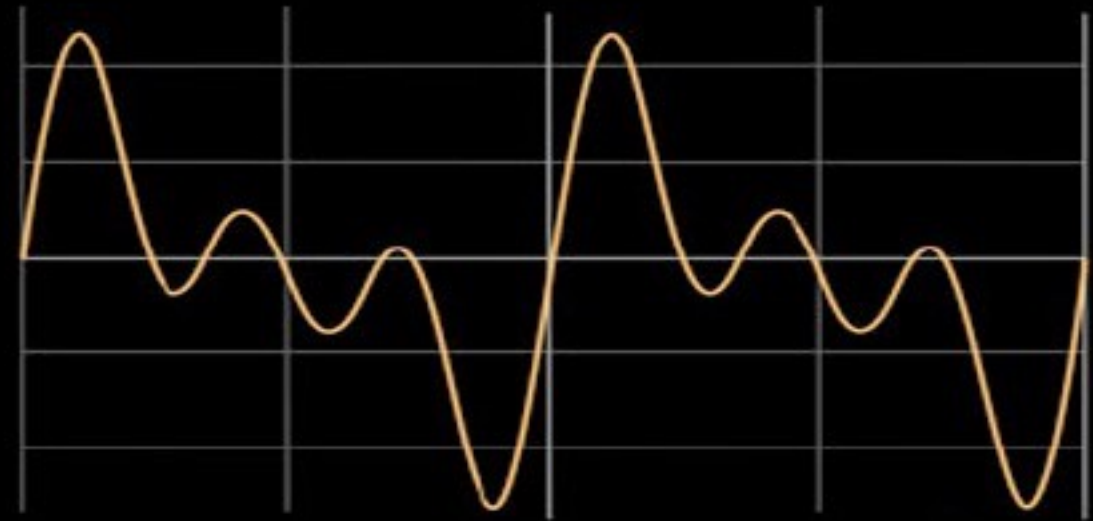
+

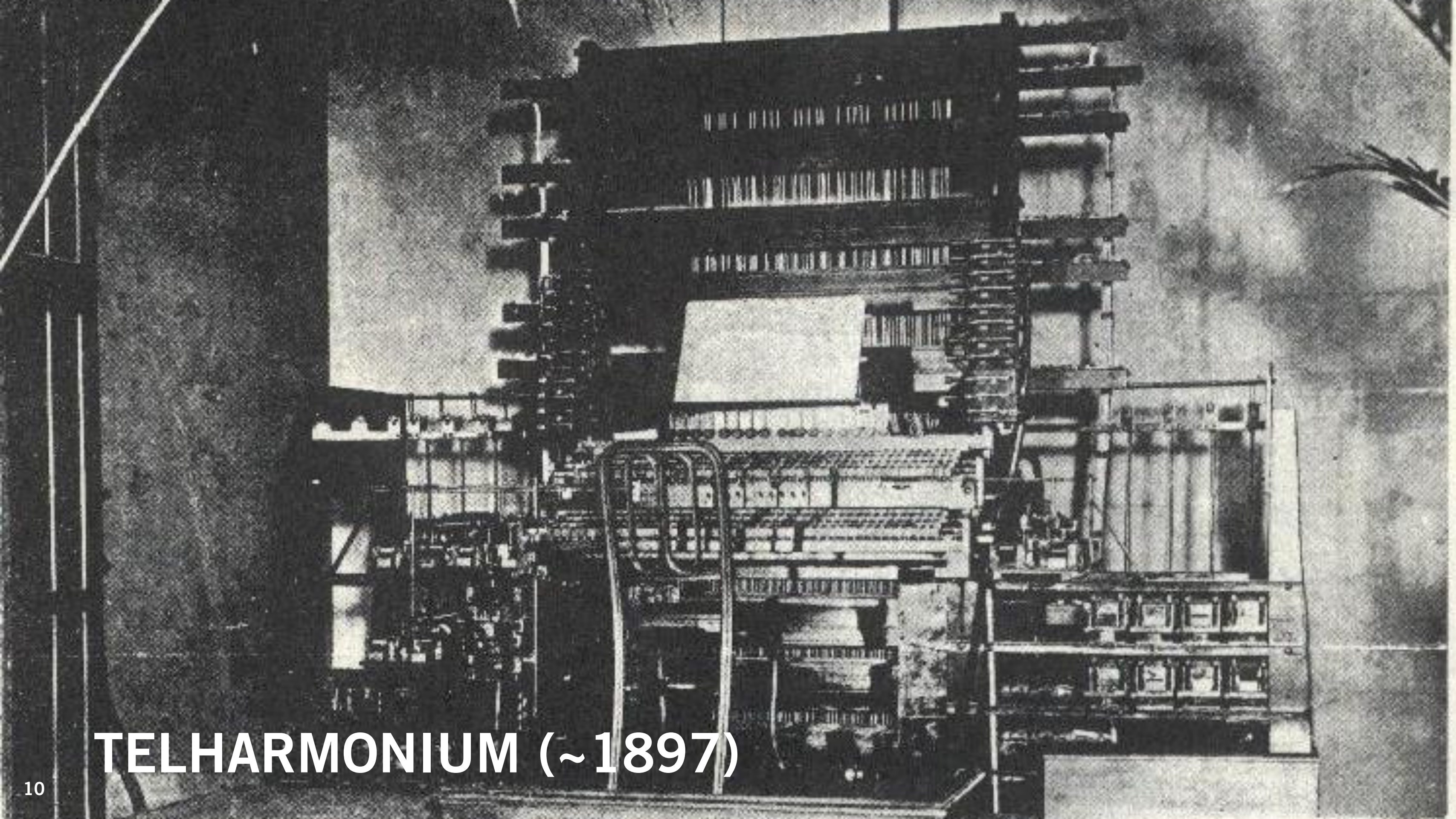


+



Additive Synthesis





TELHARMONIUM (~1897)

Hammond Organ (1935)

Jimmy Smith



A photograph of Jimmy Smith, a Black man with a mustache, playing a three-manual organ. He is wearing a green cardigan over an orange shirt. His eyes are closed, and he has a focused expression. The lighting is dramatic, with strong highlights on his face and hands against a dark background. In the background, another person is partially visible, playing a guitar.

Jimmy Smith

came to prominence in the late 50s



Organ Harmonics

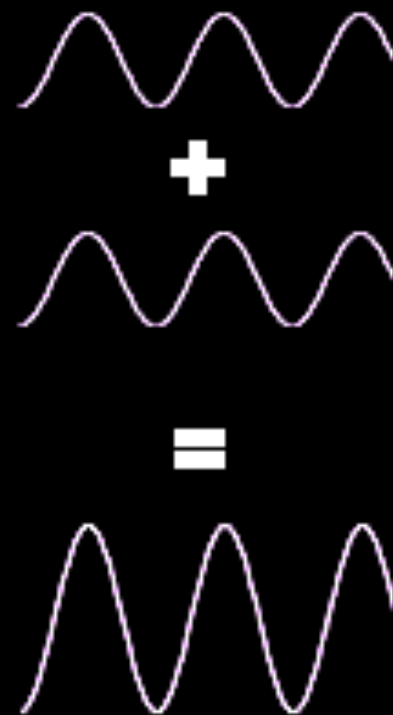




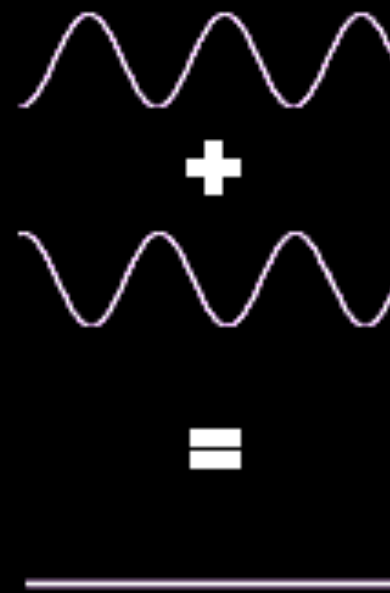
Cancellation and Reinforcement

In-phase, out-of-phase and composite wave forms

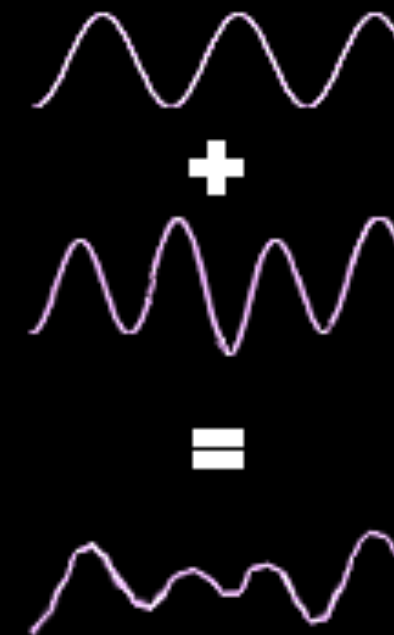
In Phase
Waves add together



180° Out of Phase
Waves cancel each other

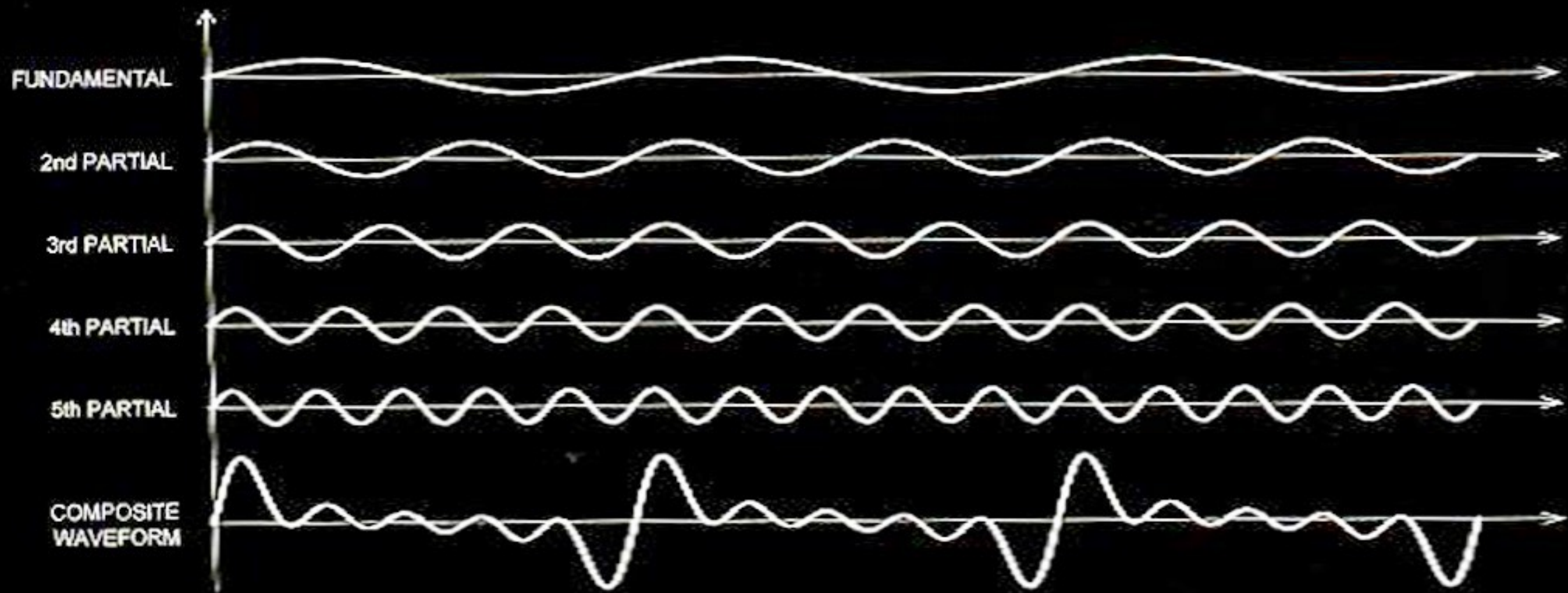


Different Waves
New wave created



(max patch)

Tone as the sum of partials



harmonic / overtone series

the **fundamental** is the lowest partial - perceived pitch

A **harmonic partial** conforms to the overtone series which are whole number multiples of the fundamental frequency(f)

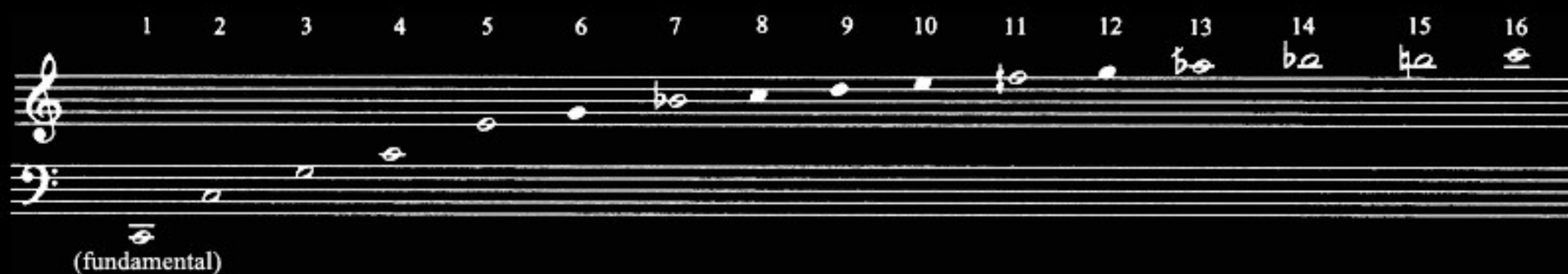
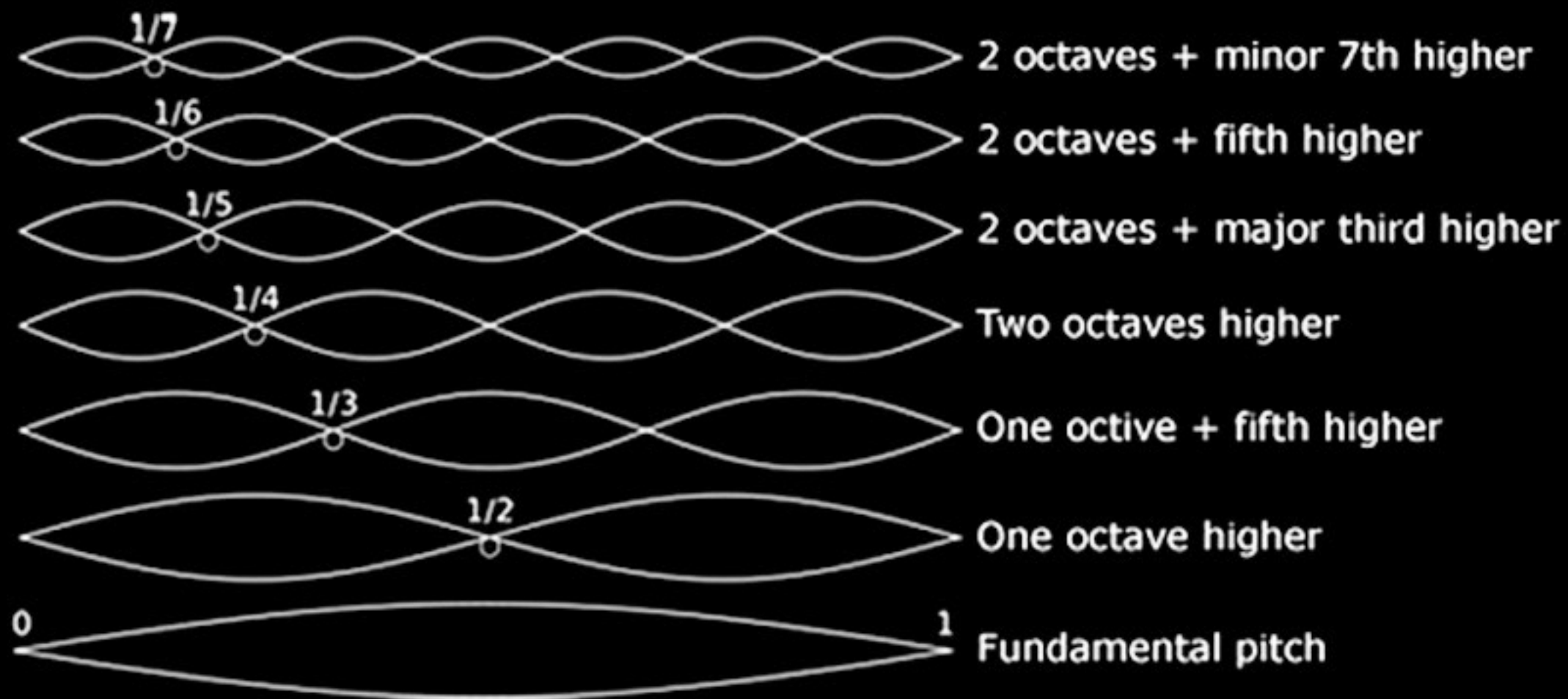
$(f)1, (f)2, (f)3, (f)4, \text{ etc.}$

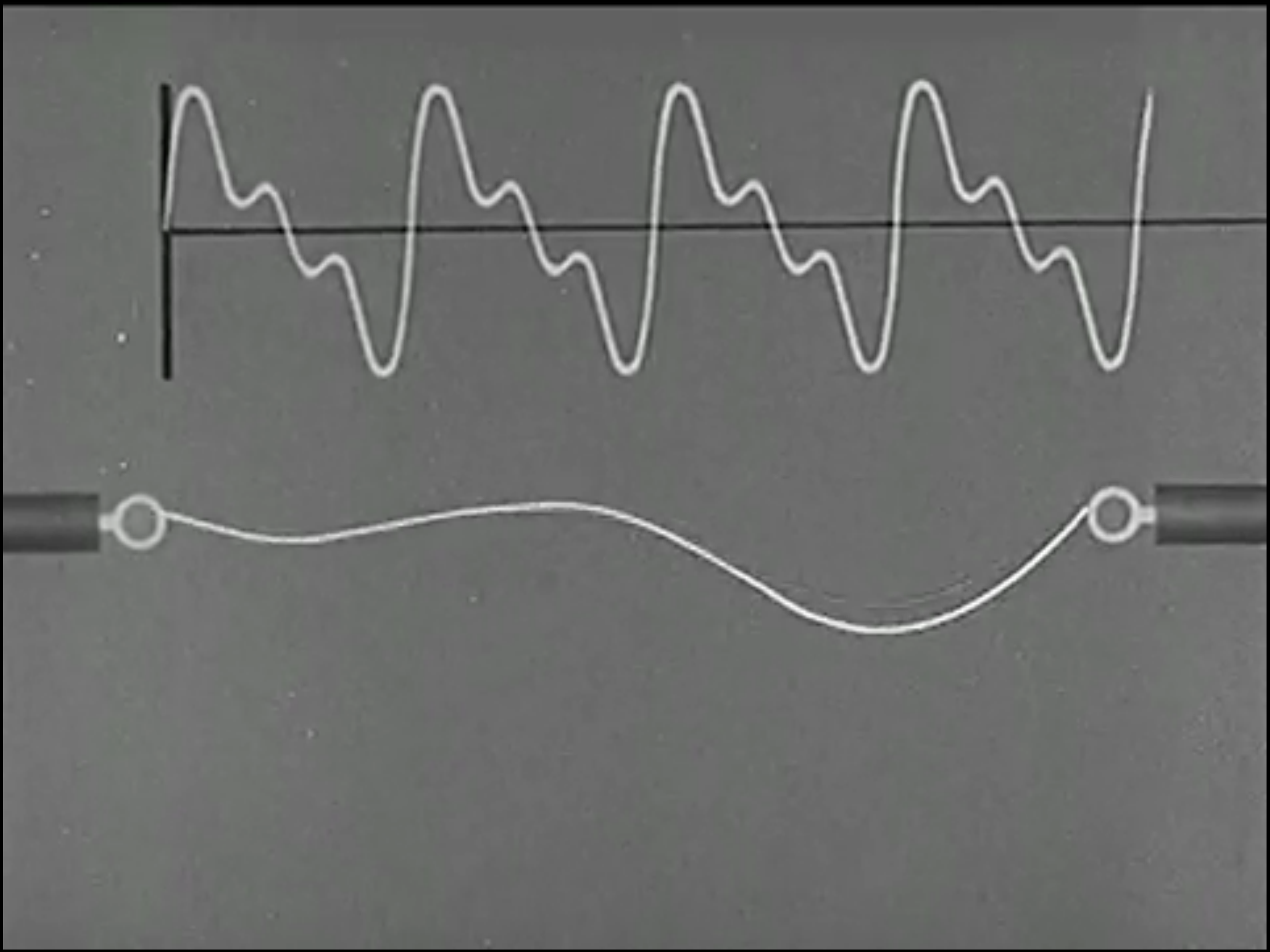
if $f=110$

110, 220, 330, 440

doubling = 1 octave

An **inharmonic partial** is outside of the overtone series, it does not have a whole number multiple relationship with the fundamental.



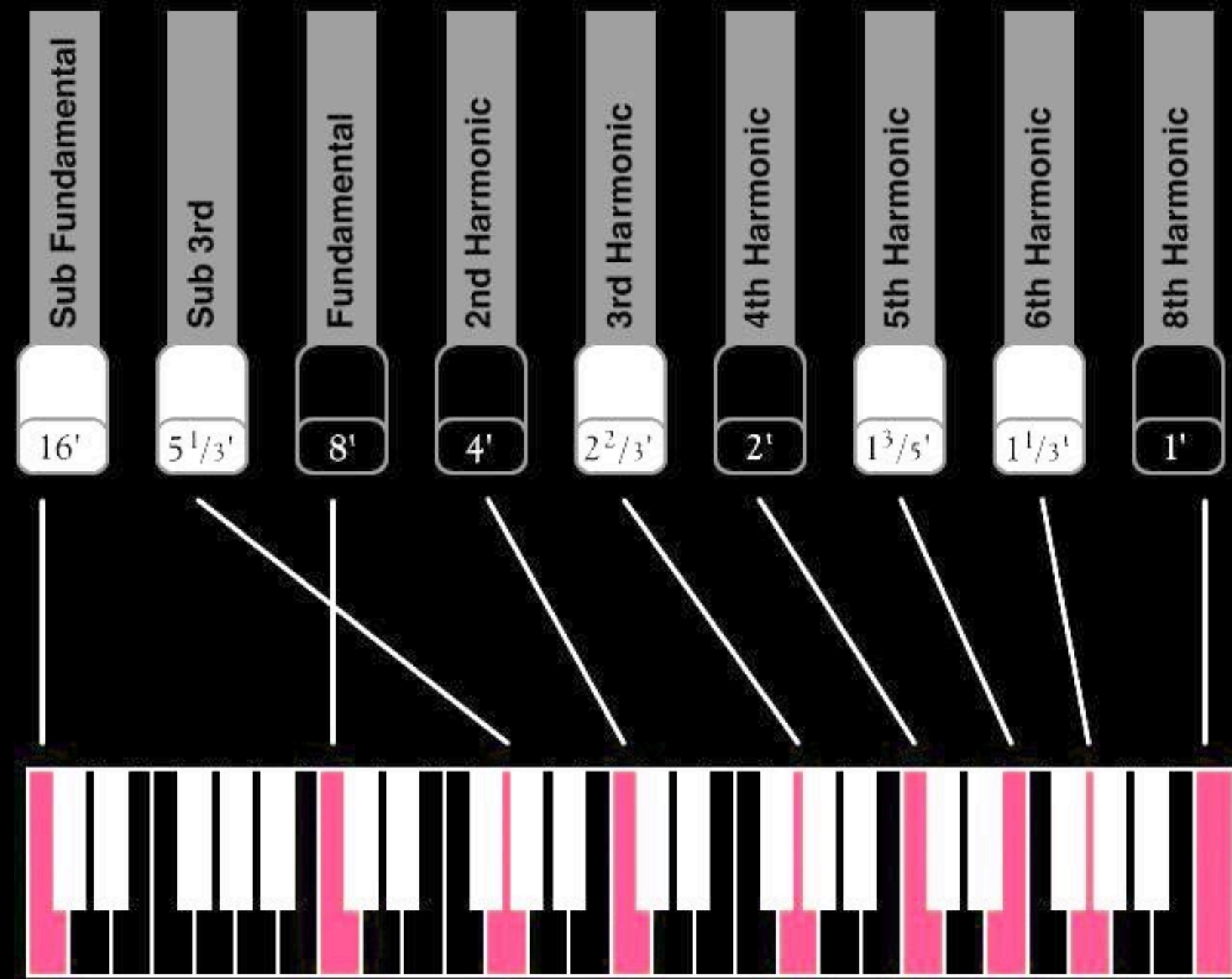




Hammond Organ

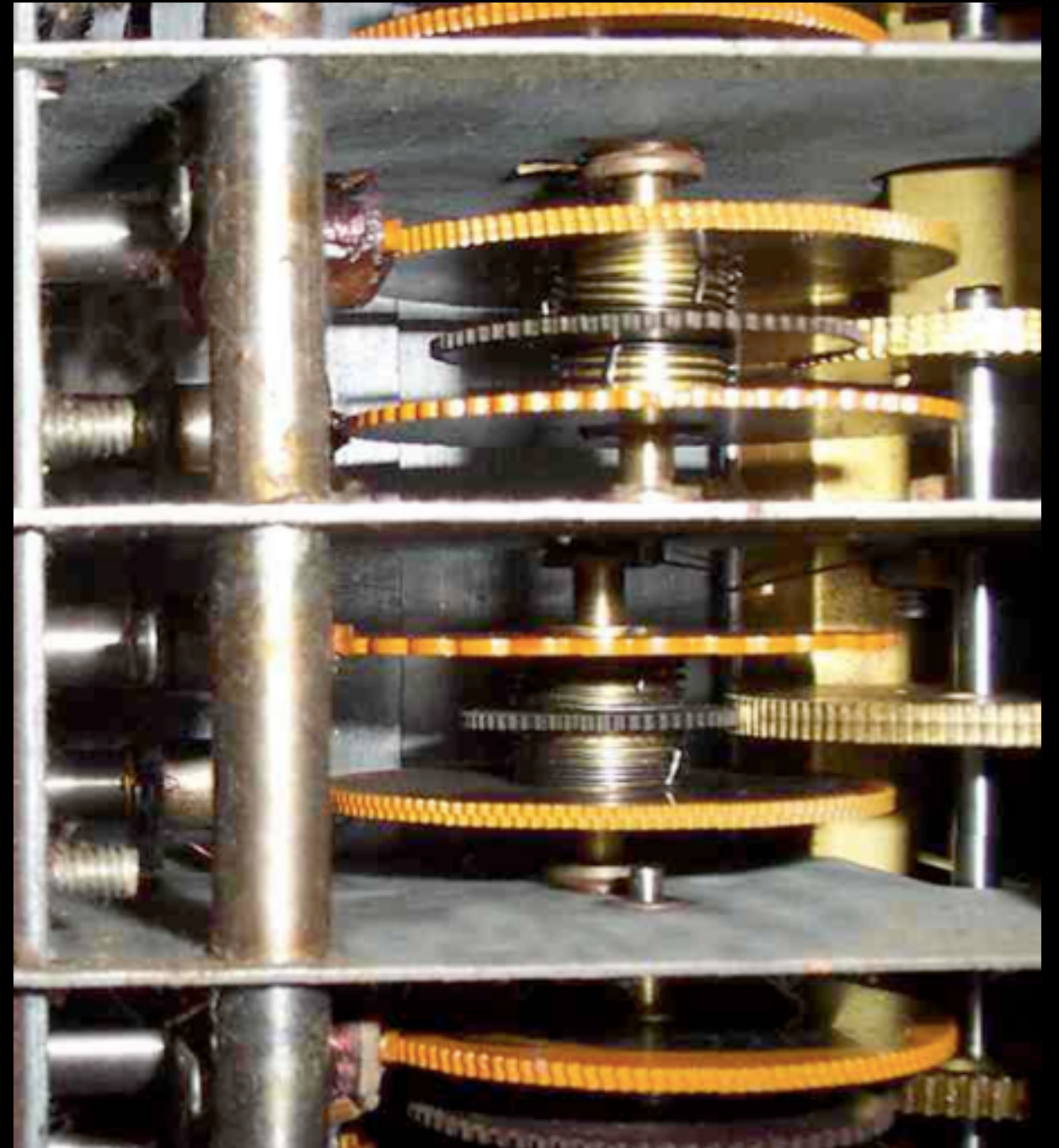
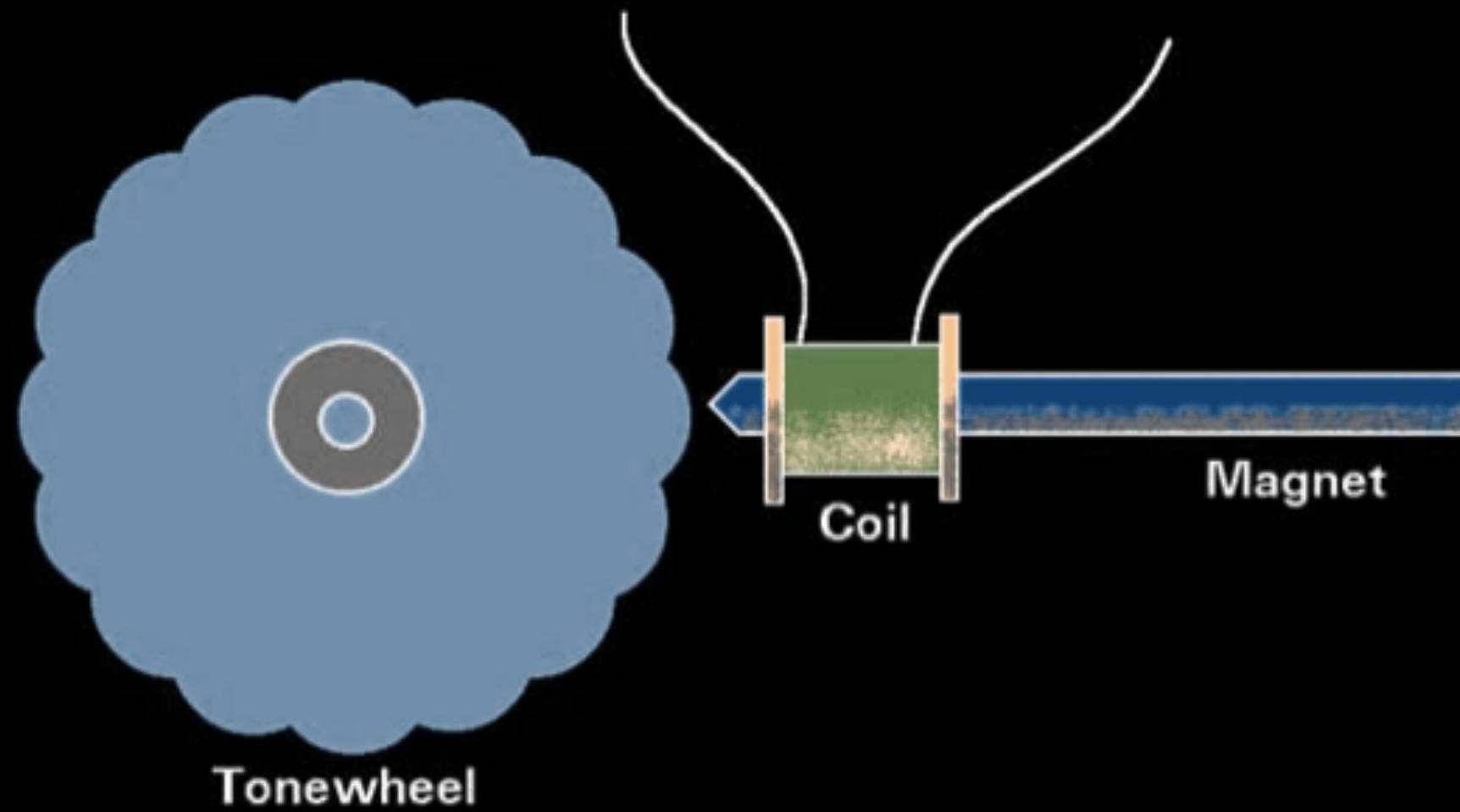
Laurens Hammond

Drawbars



Drawbars control amplitude of harmonics

Tonewheels



Basic Waveforms

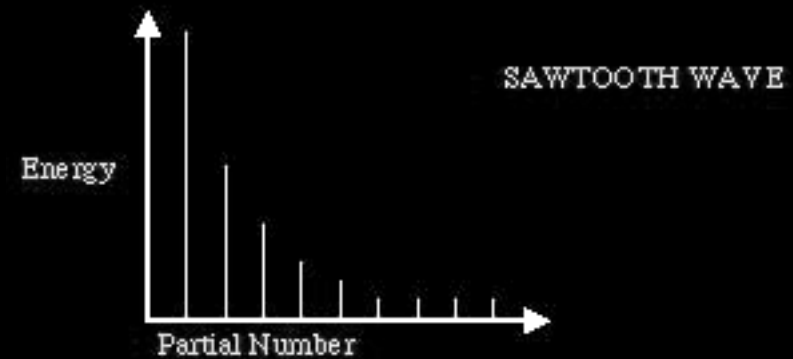


fundamental only, no additional harmonics



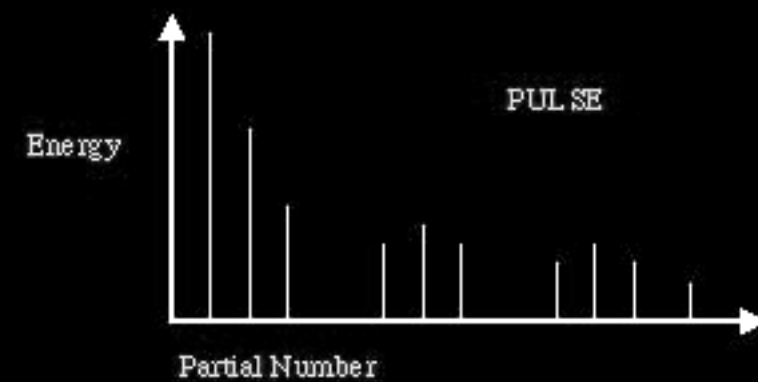
odd partials only (1,3,5,7...)

$1 / p^2$ (3rd partial has 1/9 the energy of the fundamental)



all partials

$1 / p$ (3rd partial has 1/3 the energy of the fundamental)

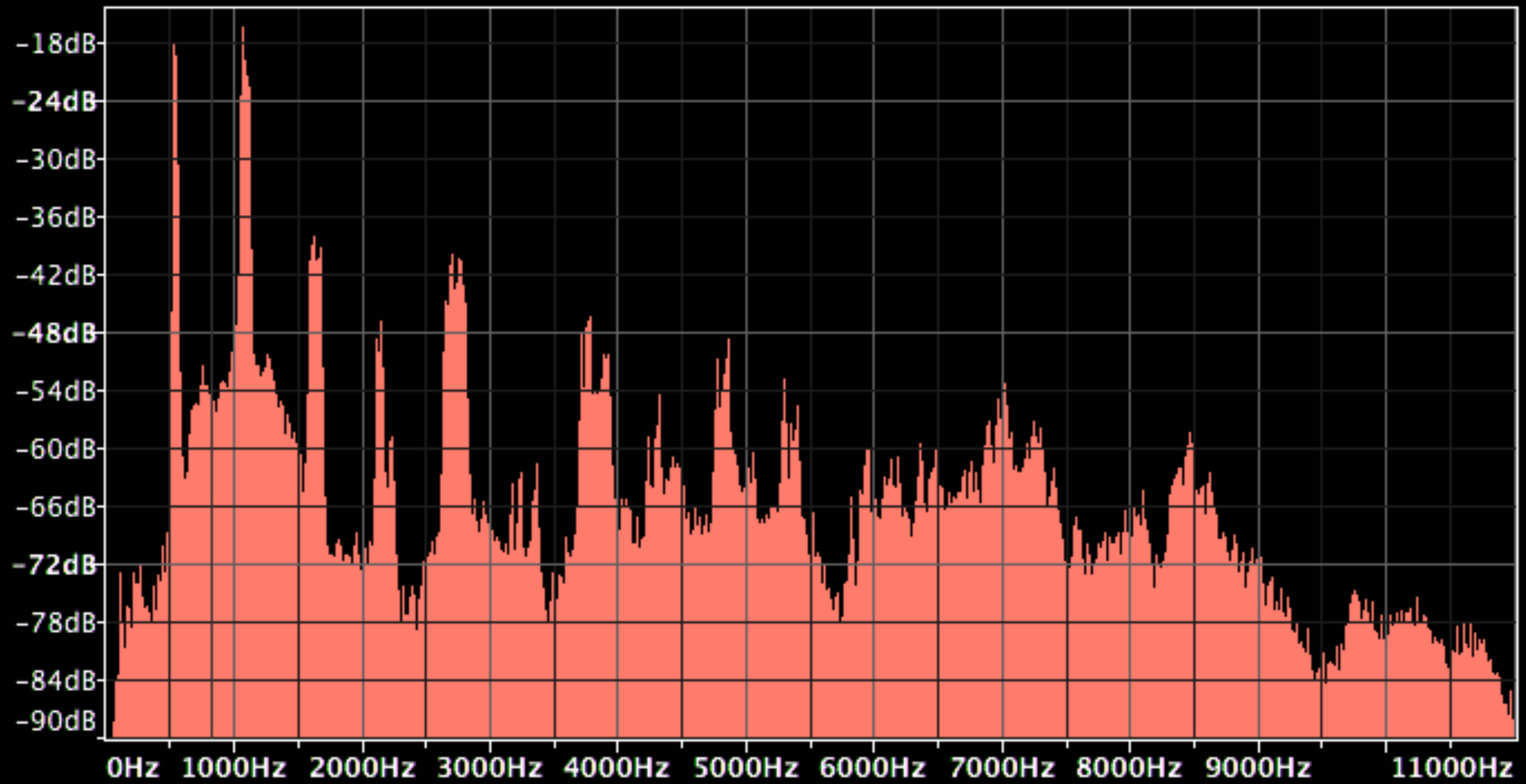


only odd-numbered partials

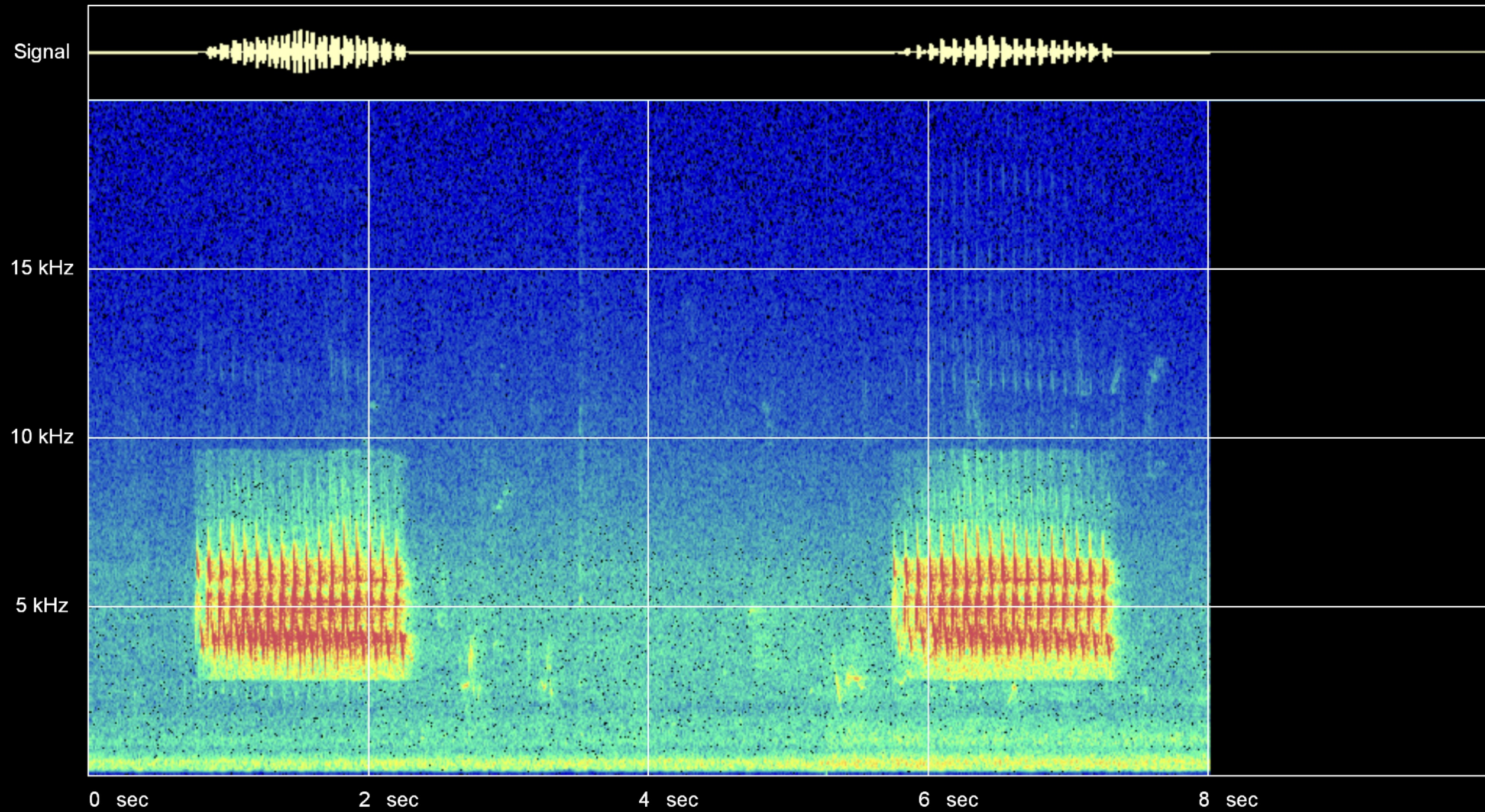
$1 / p$ (3rd partial has 1/3 the energy of the fundamental)

(max patch)

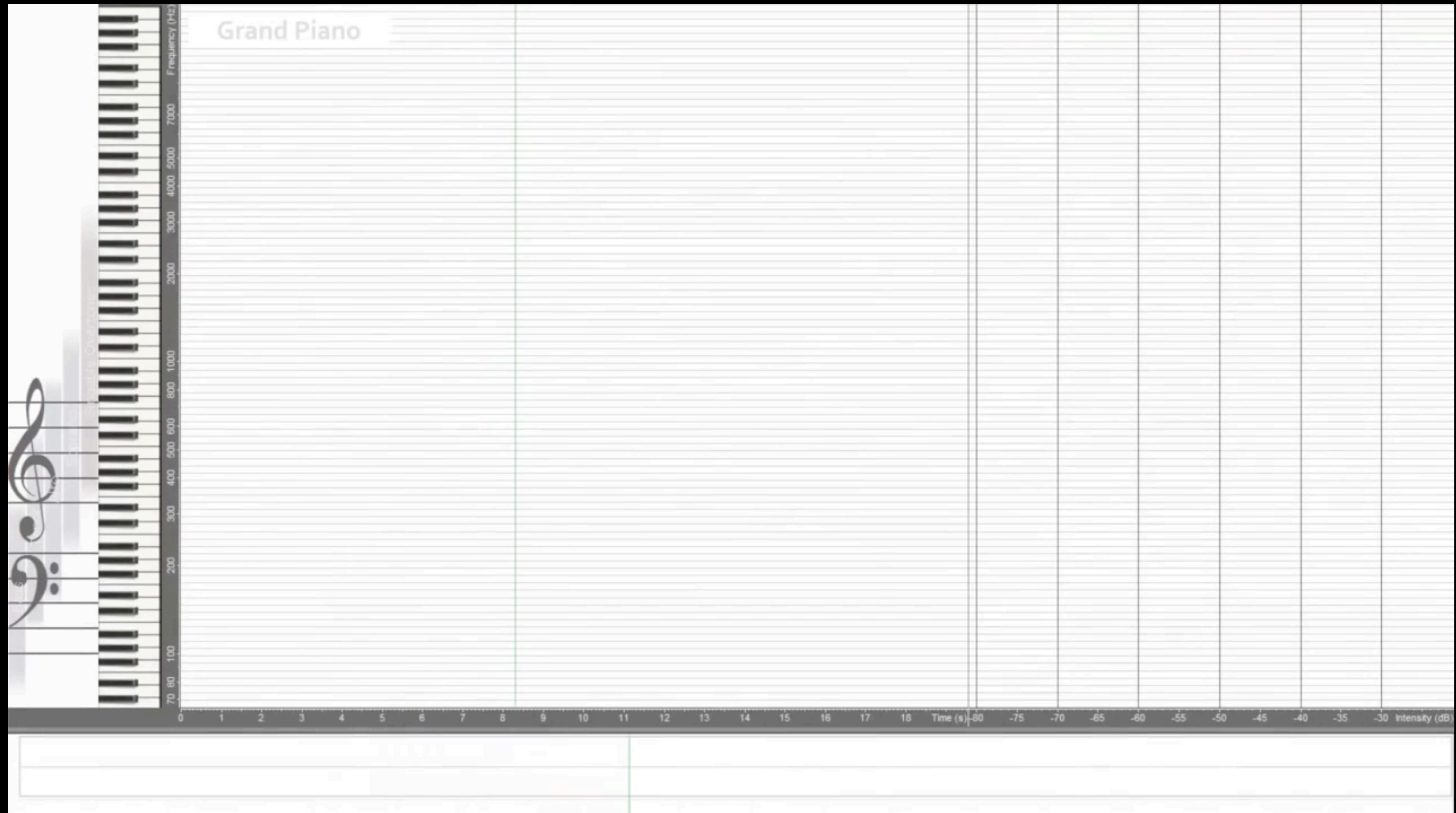
Spectrogram (snapshot)



audio sonogram of 2 bird trills



Identifying Different Instruments





Spear (software)

audio surgery?

isolate partials
within a complex
sound

