

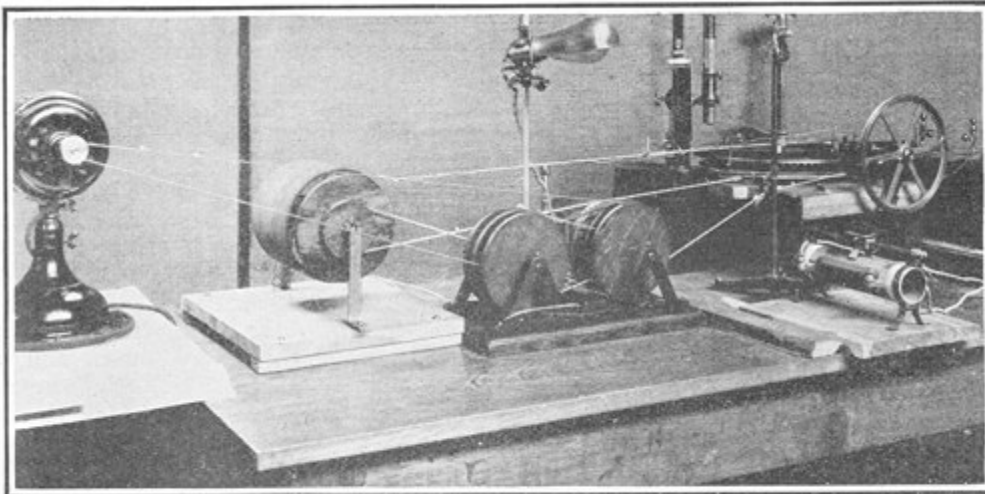
Pitch Analysis Workshop

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Historical Methods

University of Iowa

- ▶ **Carl Seashore (1938) and colleagues studied timing, dynamics, intonation, and vibrato in pianists, violinists, and singers**
 - Equipment: piano rolls, films of the movement of piano hammers during performance, phono-photographic apparatus



Wave recorder for use with disk phonograph; the lever, acting like a pantograph, traces the waves on a revolving smoked drum

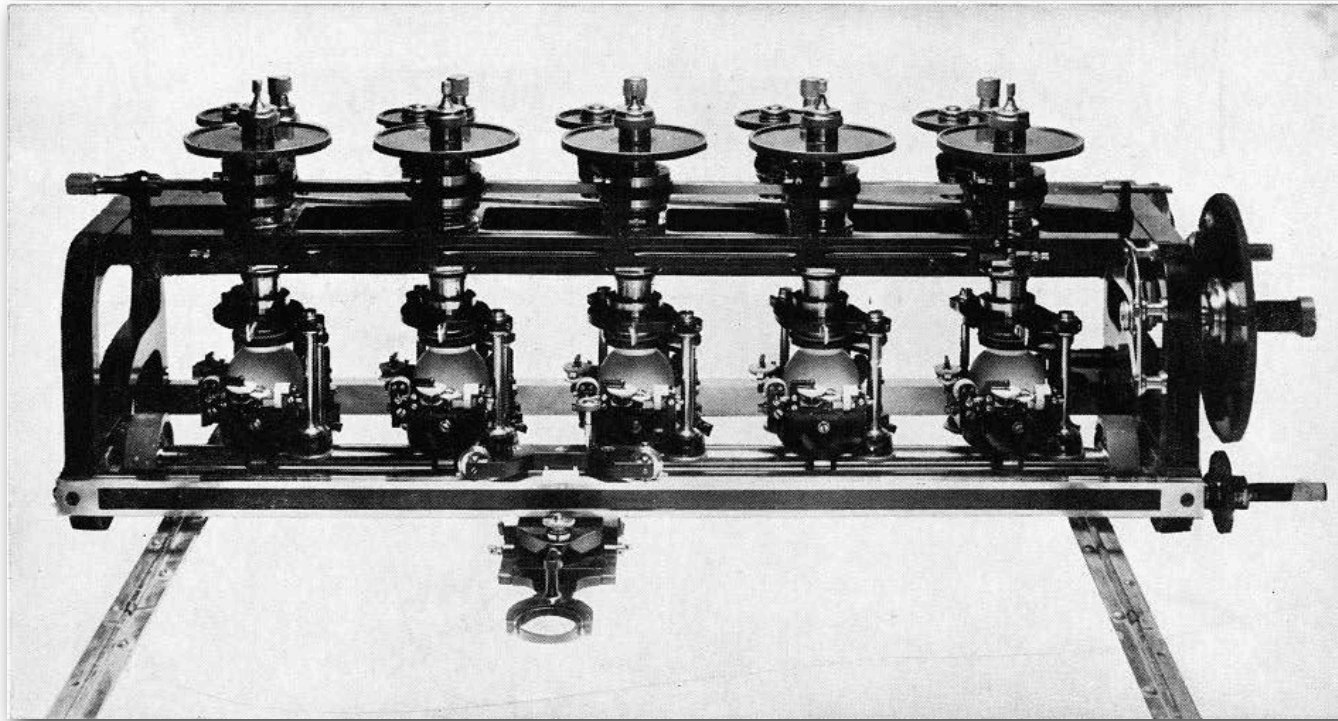


The tonoscope for analyzing the pitch of the tones on a disk phonograph record

Cary (1922)

Historical Methods

Phonophotography technique



Henrici Harmonic Analyzer


Seashore (1937)

- ▶ Frequency graphed in 10 cent units
- ▶ Intensity graphed in decibels
- ▶ Timing information as a function of linear space

Manual Annotation by Tapping

Tap Snap

mazurka.org.uk/cgi-bin/tapsnap



Mazurka Project

AHRC Research
Centre for the History and Analysis of Recorded Music

This webpage will auto correct reverse conducting taps so that they align with the nearest onset in the audio. The input tapping data can contain taps for all of the events, or just a selection of the events, such as the beats.

Input data is a text file with the event times in seconds on the first column of each line as output from [Sonic Visualiser](#) annotation layers. The tapping data is usually generated manually by tapping to a audio recording in Sonic Visualiser. The onset data is usually generated automatically from a plug-in for Sonic Visualiser, such as [Spectral Reflux](#).

**Input
Tapping
Data**

First, specify the location of the beat tapping data to be processed in one of the fields below.

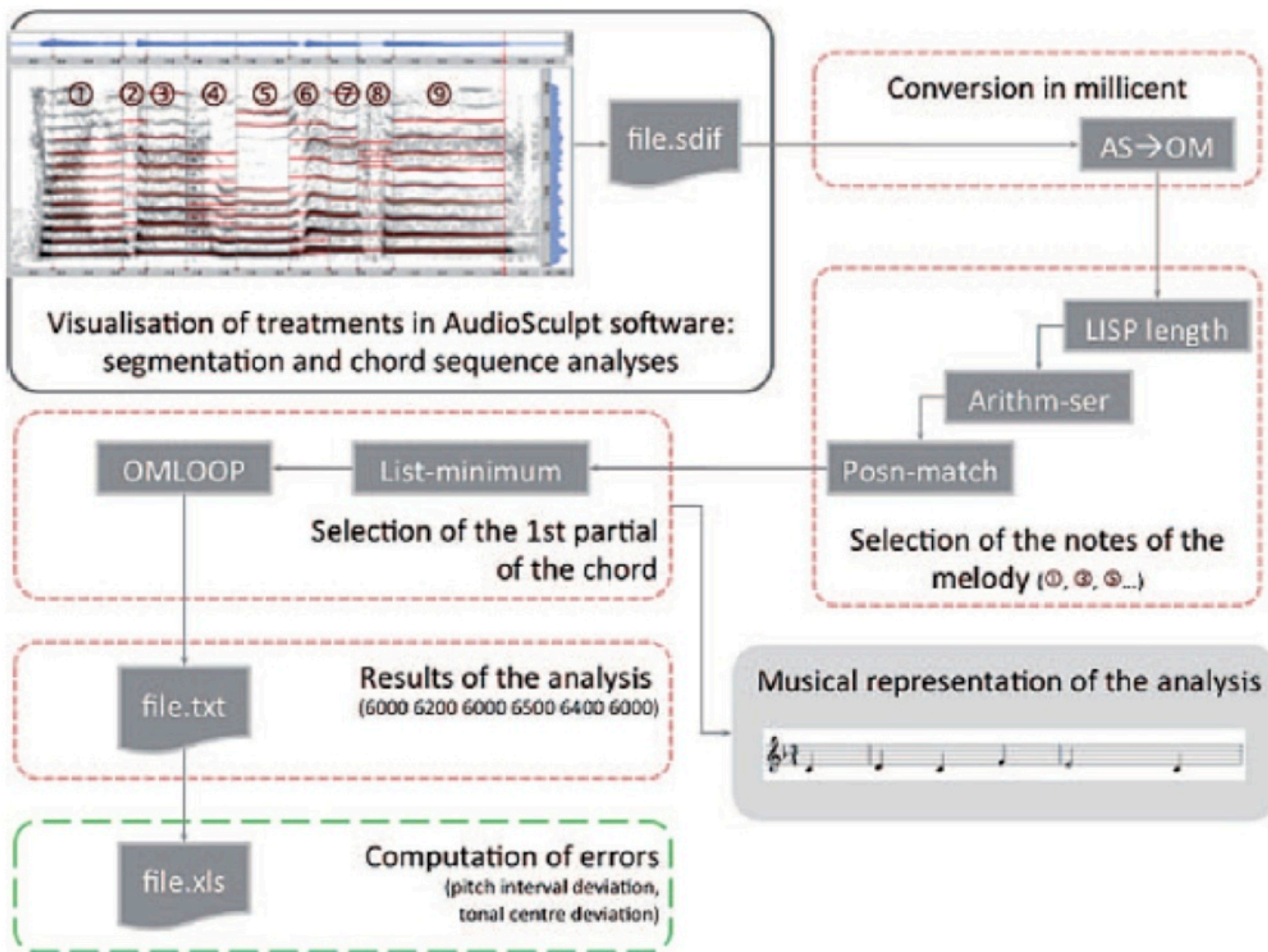
Upload a file from your computer: No file chosen

Or, **paste** the contents of the data file here:

Or, specify a data file **URL**:

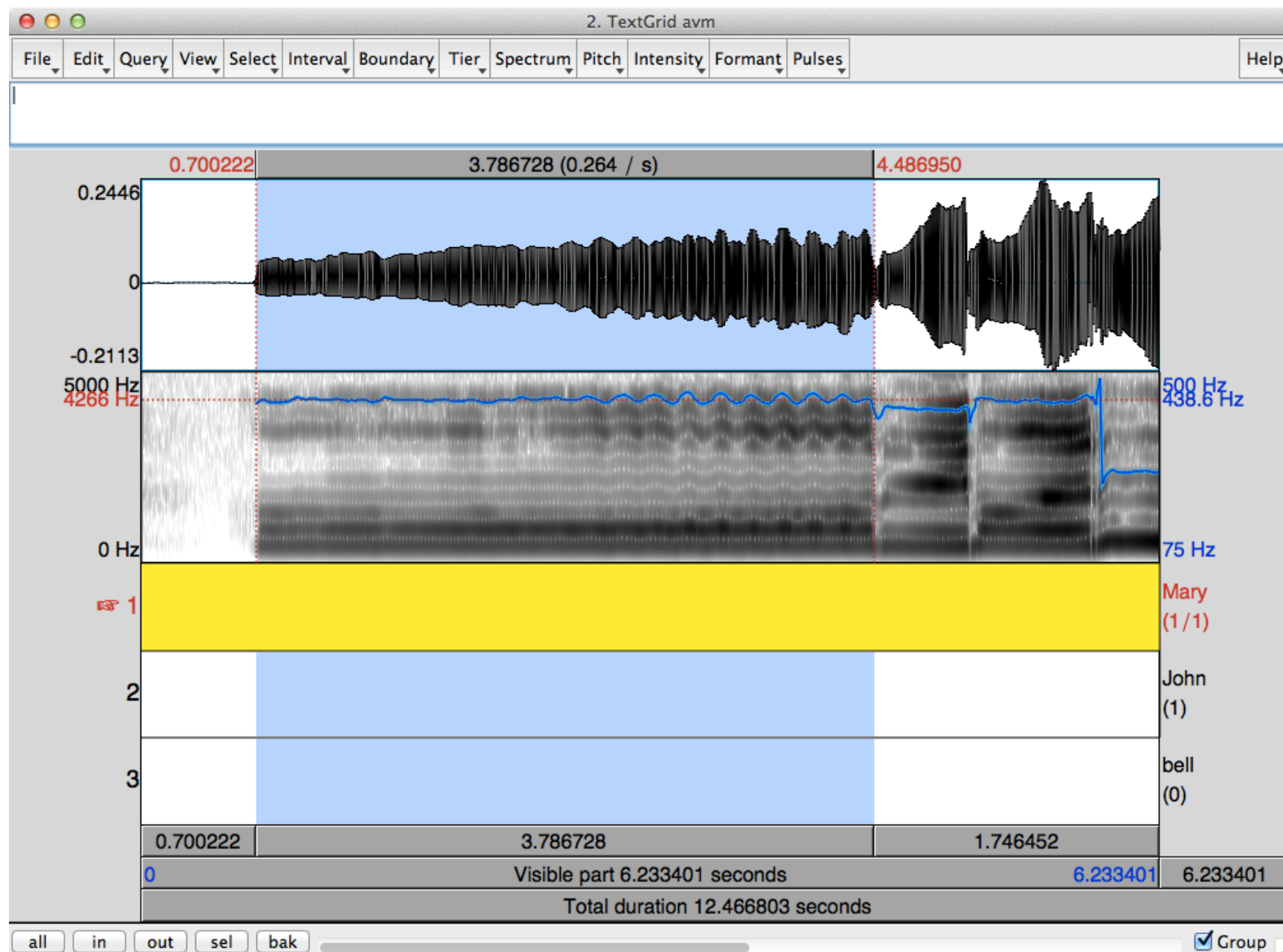
Manual Annotation with Software

Audio Sculpt + Open Music



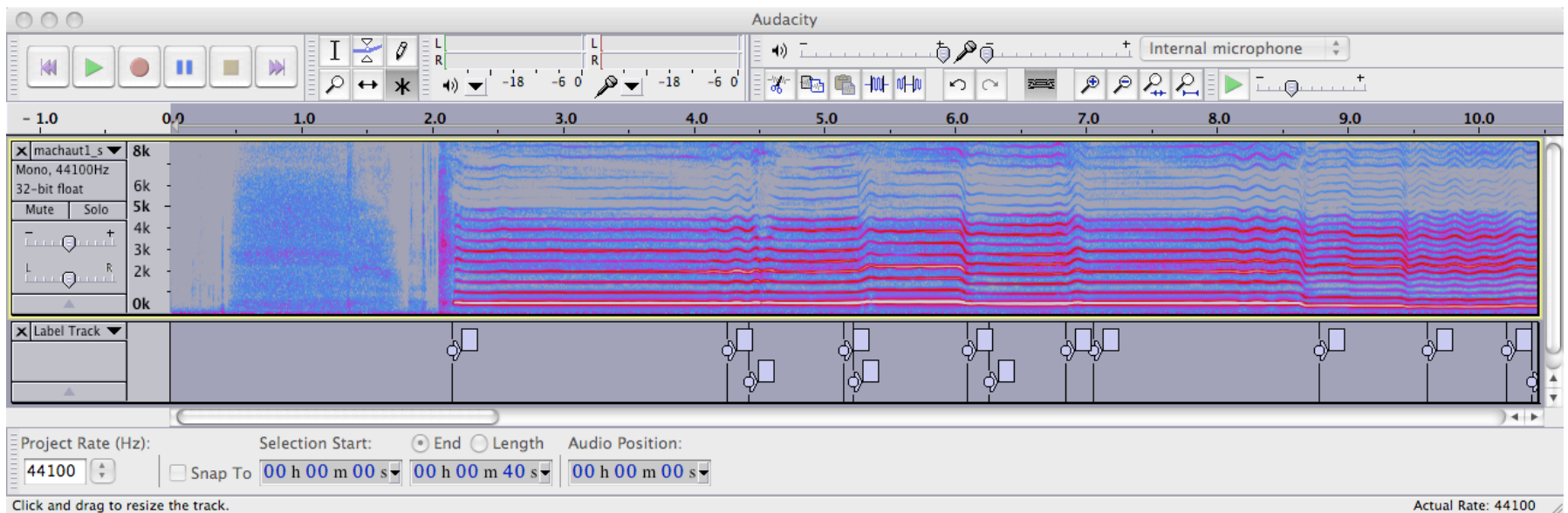
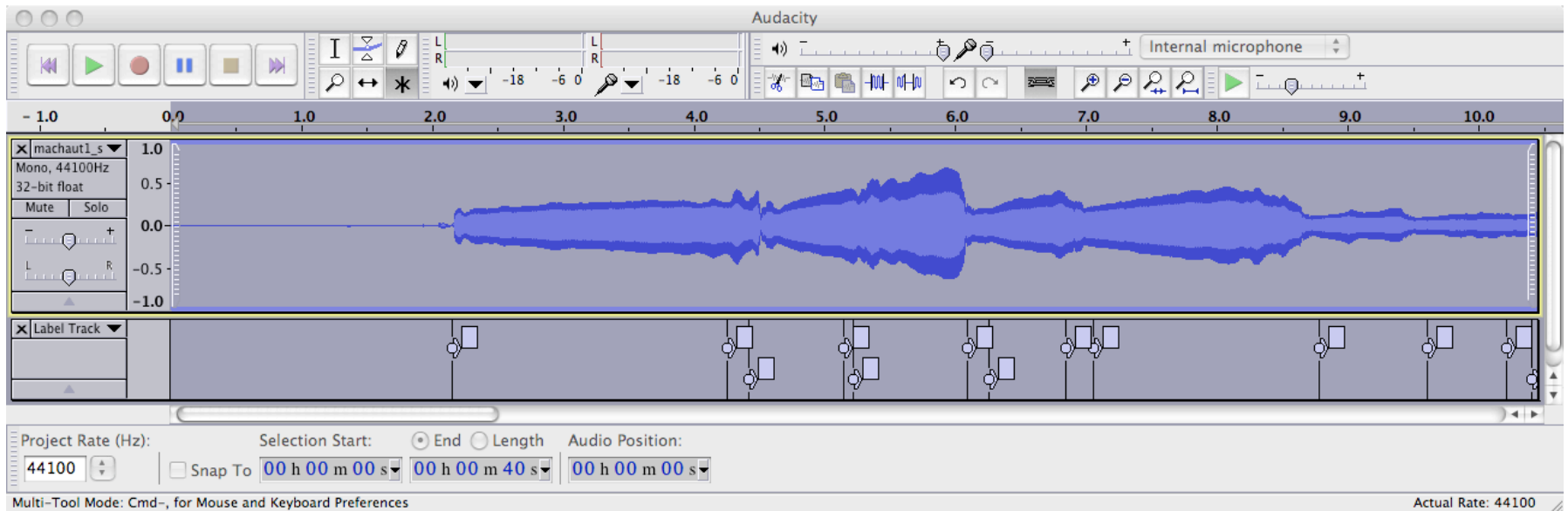
Manual Annotation with Software

PRAAT



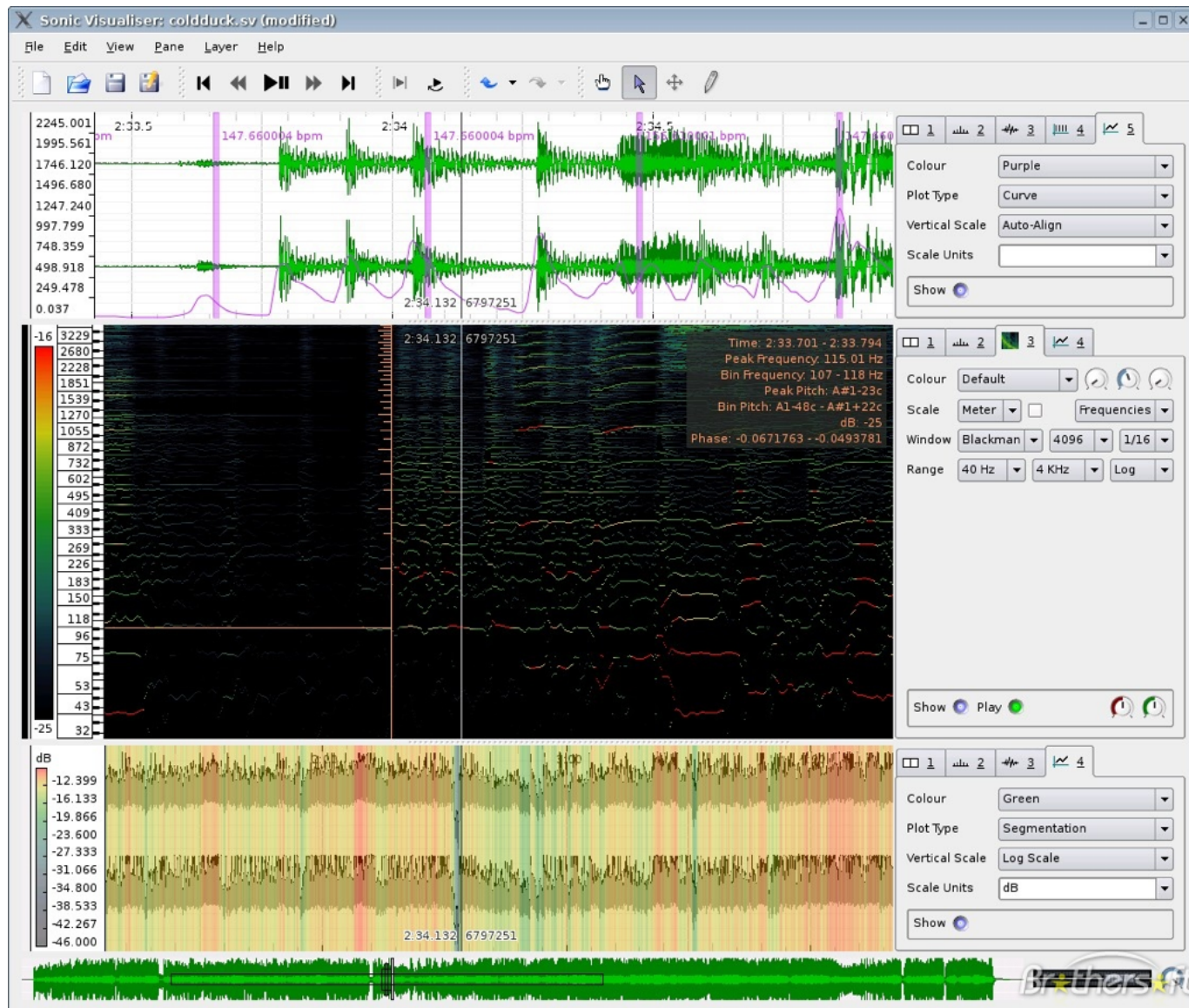
Manual Annotation with Software

Audacity



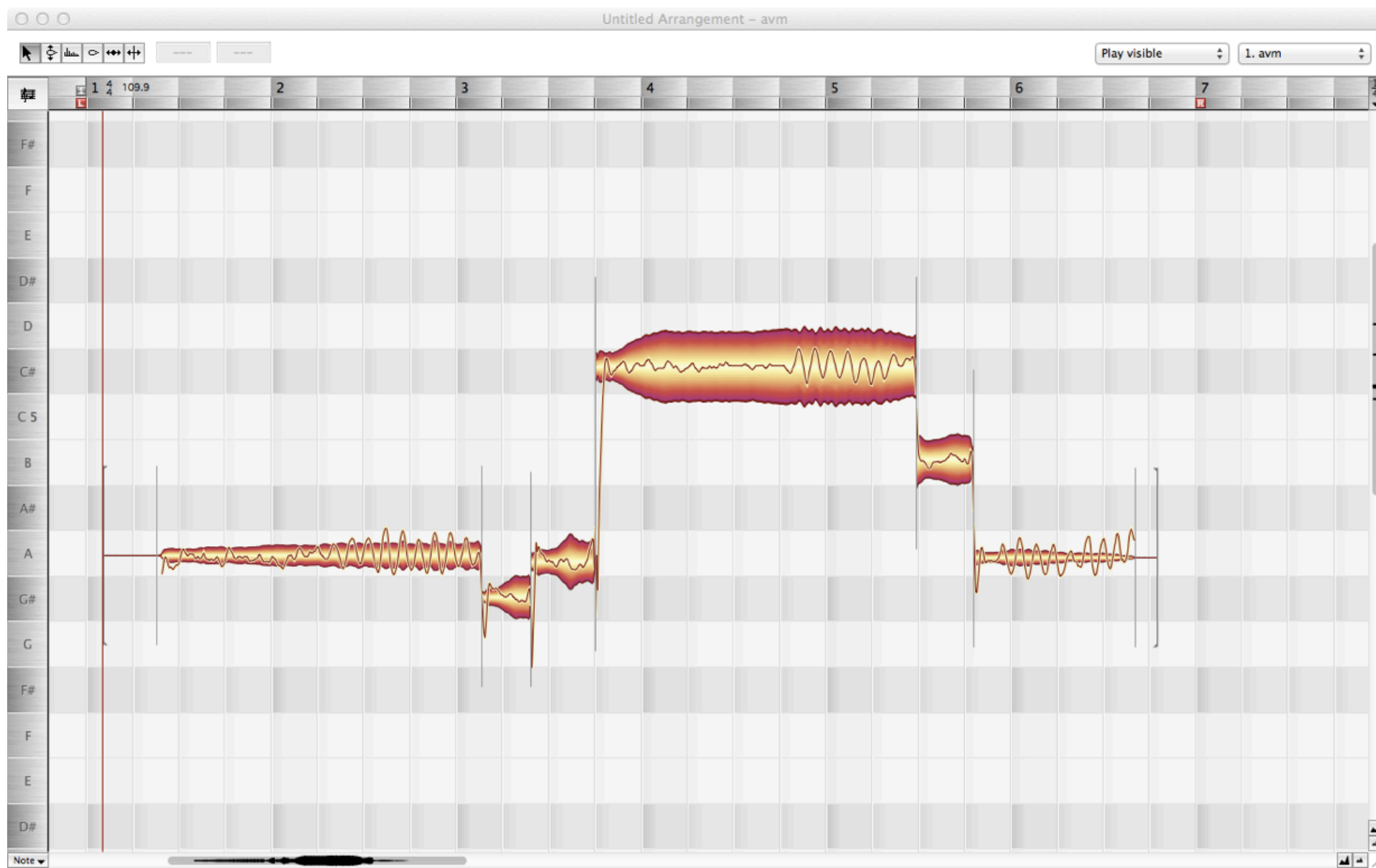
Automatic Annotation

Sonic Visualiser

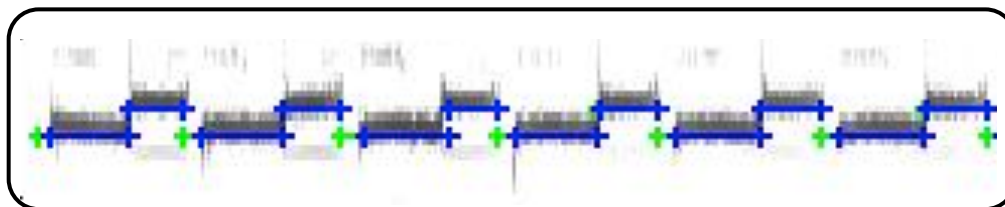


Automatic Annotation

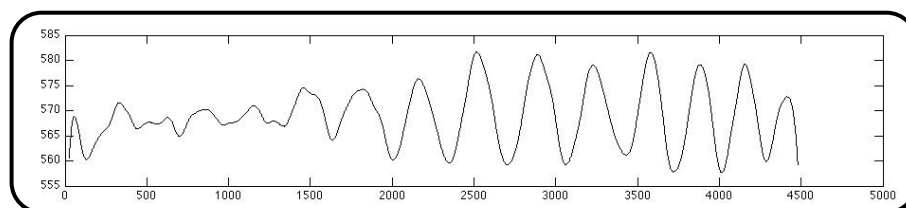
Melodyne



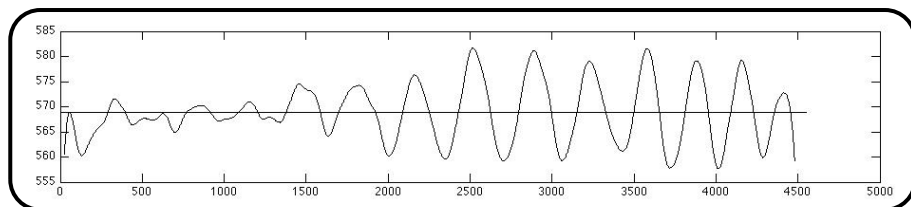
Identify Note Onsets and Offsets



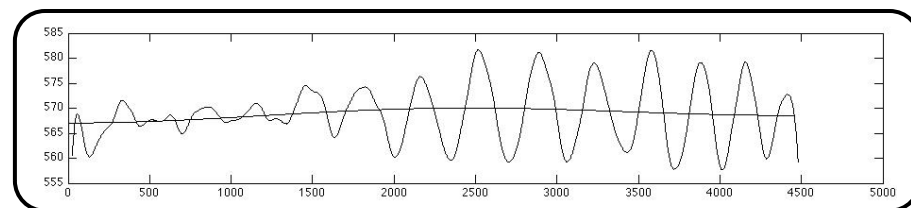
Fundamental Frequency (F₀) Estimation



Perceived Pitch



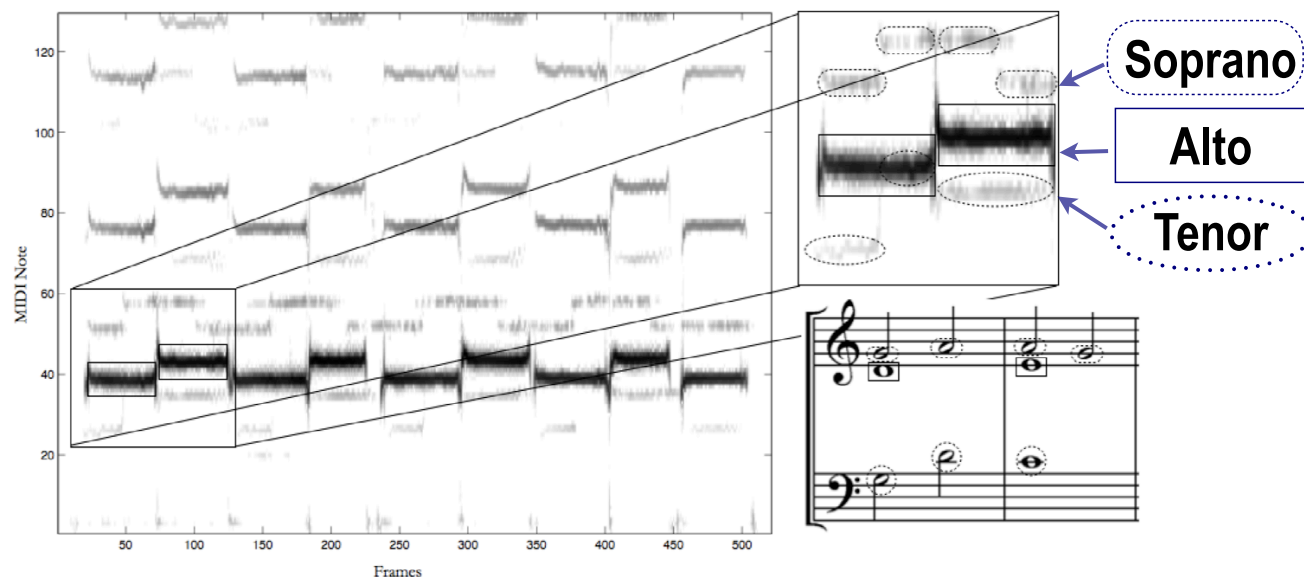
Evolution of F₀



Score-guided performance data extraction

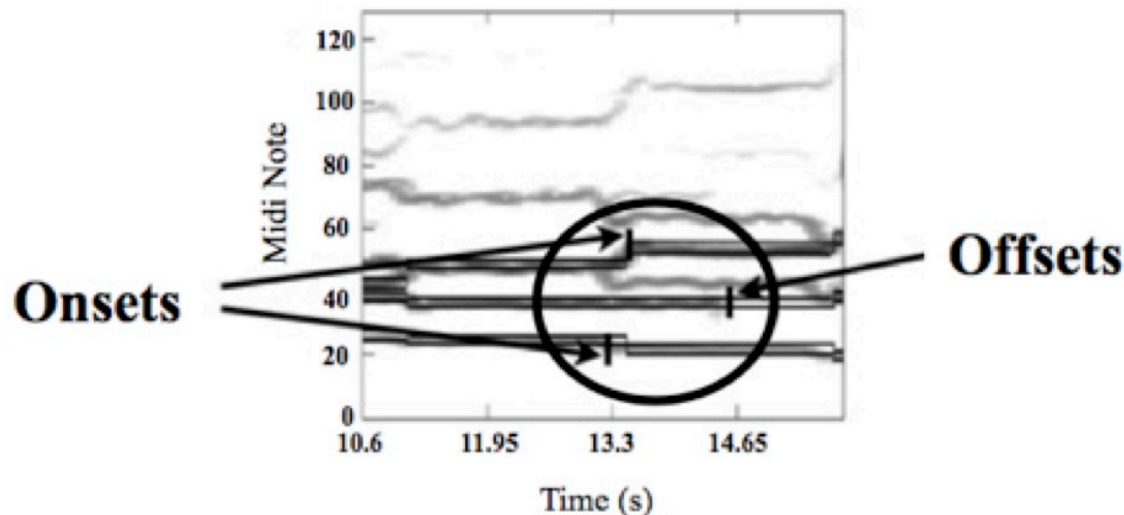
Monophonic and quasi-polyphonic

- ▶ **Timing information is available via MIDI/audio alignment**
- ▶ **Fundamental frequency (F_0), and amplitude can be reliably extracted**



Score-guided performance data extraction

Polyphonic



- ▶ **Timing information (including asynchronies between lines) is available in the alignment**
- ▶ **F_0 and amplitude are harder to extract**
- ▶ **Currently exploring the using High Resolution methods with Roland Badeau for the task of score-guided extracting of frequency and loudness information in polyphonic audio**

Devaney and Ellis (2009)

Devaney (2014)₁₂

Perceived Pitch

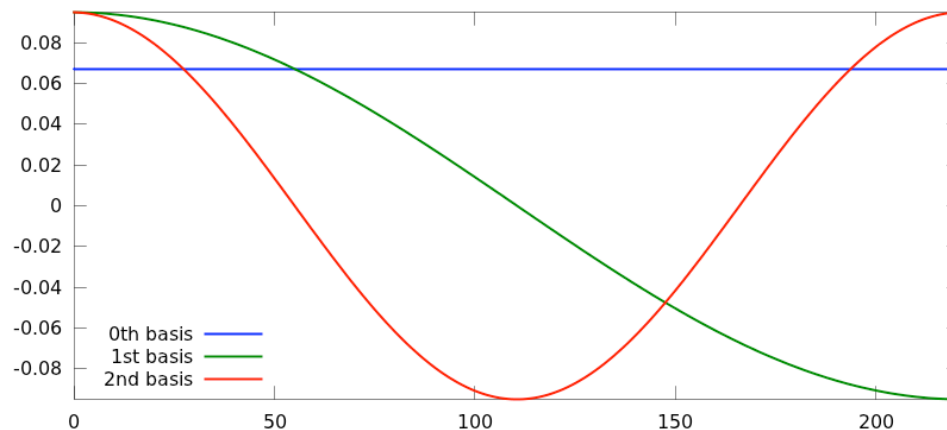
Possible calculation methods

Shonle and Horan (1980)	<ul style="list-style-type: none">•Geometric mean over the duration of the note
Iwamiya, Kosugi, and Kitamura (1983)	<ul style="list-style-type: none">•Center frequency between peaks and troughs in vibratos and symmetrical trills•In asymmetrical trills pitch shifts according to the direction of the asymmetry
D'Alessandro and Castellengo (1994, 1995)	<ul style="list-style-type: none">•F_0 at the end of the note was more significant for the pitch perception than the beginning of the note.•Mean of the steady-state portion of the note rather than the mid-point between the maximum and minimum frequencies
Gockel, Moore, and Carlyon (2001)	<ul style="list-style-type: none">•Weighted mean based on the fundamental frequencies' rate of change, with higher weightings for frames that had a smaller rate of change

Evolution of F_0

Modeling note trajectories

- ▶ **Characterizing F_0 trajectories is under-studied**
- ▶ **One option is to decompose of F_0 trace with the Discrete Cosine Transform to estimate slope and curvature**



Devaney, Mandel and Fujinaga (2011)
Devaney and Wessel (2013)

AMPACT

Automatic Music Performance and Comparison Toolkit



www.ampact.org

