AMPACT: Automated Music performance Analysis and Comparison Toolkit

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Carl Seashore

Source: www.acsu.buffalo.edu/~duchan/

- Seashore and colleagues at the University of Iowa (1936, 1938)
  - Parameters: timing, dynamics, intonation, vibrato
  - Subjects: pianists, violinists, singers
  - Expressivity in performances conveyed through deviations from a norm
- Timing deviations measured in relation to a metronome
- Dynamics measured in terms of relative loudness
- Intonation and vibrato measured in cycles per second

Timing and Dynamics

Bosendorfer SE piano, BRAMS, Montreal

- Piano performance is widely studied due in part to the
  - large amount of solo repertoire
  - existence of specially equipped pianos to measure performances
- Bengtsson and Gabrielsson (1980, 1983) undertook a number of experiments on musical rhythm in performance
- Todd (1985, 1989) studied both rubato and dynamics
- Clarke (1989) related rhythmic tendencies to the structural hierarchy of the piece and note-level expressive gestures
- Repp (1992, 1997) examined timing in piano performance and related it to phrase hierarchy
- Surveys available in Palmer (1997) & Gabrielsson (1999, 2003)

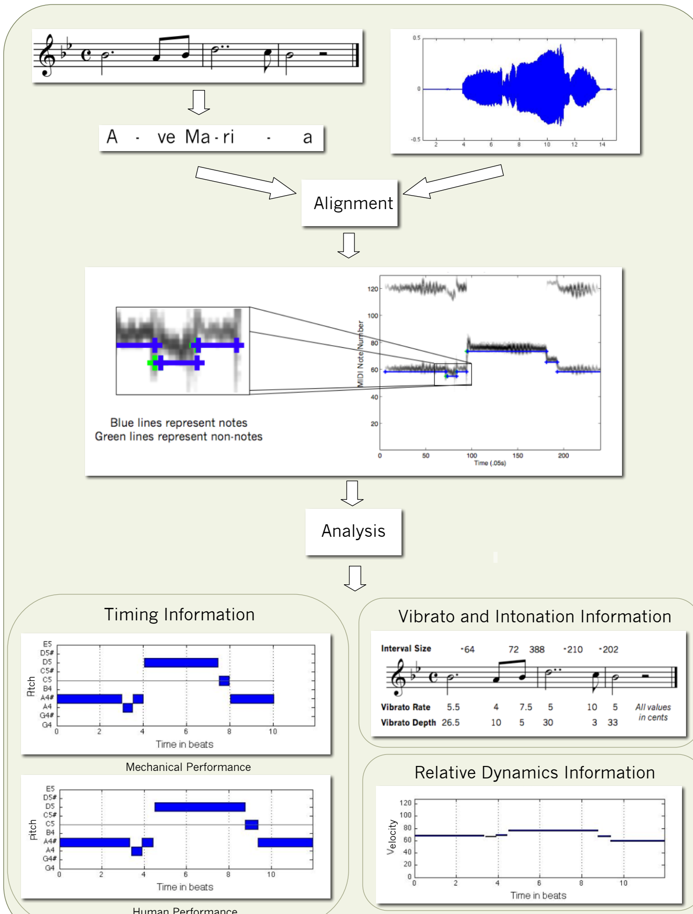
Intonation and Vibrato

- Fyk (1995) studied intonation in solo violin and explored the relationship between intonation tendencies and gravitational attractions at work within the tonal system
- Jers and Ternstrom (2005) studied intonation and vibrato a 16-part choir in attempt to define "chorus-effect"
- Howard (2007a, 2007b) examined pitch drift and adherence to Equal Temperament or Just Intonation in an SATB quartet
- Timmers (2007) studied intonation in several Schubert songs and related the results to musical structure
- Ambrazevičius and Wiśniewska (2008) studied chromaticism and pitch inflection in traditional Lithuanian singing and derived rules to explain chromatic inflections for leading tones, and ascending and descending sequences
- Marinescu and Ramirez (2008) analyzed timing, dynamics, and intonation in excerpts from several arias performed by Jose Carreras and related the collected data to Narmour's implication-realization model (1990)

AMPACT

- The Automated Music Performance Analysis and Comparison Toolkit for the MATLAB programming environment automatically analzyes performance data from recordings where a score is available
- By using the information available in the score about what notes are expected in the performance and the order in which they occur (Devaney et al. 2009)
- The analysis portion of toolkit is able to produce estimates of note onsets and offsets for tones with non-percussive onsets (e.g., vocalists) that are more robust than blind onset detection algorithms
- Once the AMPACT has identified the note onsets and offsets, information about the performance can be extracted
  - Inter-onset intervals between notes and tempo information
  - Relative dynamic level between notes
  - Mean frequency for each note and interval sizes in cents
  - Vibrato rate and depth
- AMPACT also has tools for comparing different performances of the same musical material or piece

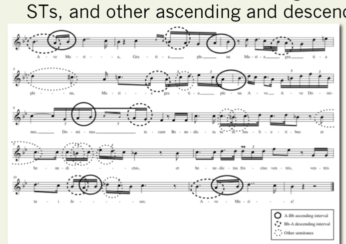
AMPACT - Analysis



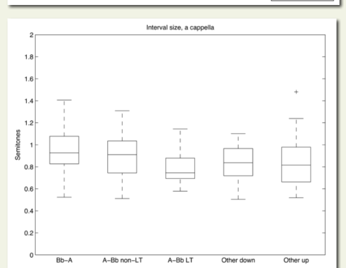
Timing and Dynamic plots made with the MIDI Toolbox (Eerola and Toiviainen 2004)

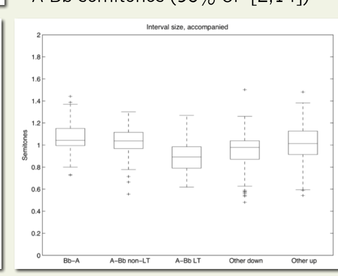
AMPACT - Comparison

- The following plots show the variability across 6 singers for semitones in 4 different contexts in *a cappella* and accompanied performances of Schubert's Ave Maria: ascending A-Bb semitones (STs), descending Bb-A STs, and other ascending and descending STs (Devaney et al. 2010).



- STs in the a cappella context were on average 5 cents smaller than in the accompanied context (95% confidence interval (CI)=[2,8])
- A-Bb and Bb-A STs were on average 7 cents larger than the other semitones (95% CI =[4,10])
- Leading tone A-Bb STs were on average 8 cents smaller than non-LT A-Bb semitones (95% CI=[2,14])





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