Johan Sundberg
Rules for Simulating Human Performance
http://www.speech.kth.se/music/performance/Texts/

1. Differentiation Rules

Name	Accommodation
Duration contrast …/duration_contrast.htm	Fast notes go faster, slow notes go slower.
Melodic charge …/melodic_charge.htm	Notes distant in the overtone series from the tonal center tend to emphasized by duration, loudness, and vibrato.
Treatment of sharp notes …./high-sharp.htm	High tones are played sharper, low tones are played flatter.

2. Grouping Rules

| Name	Accommodation
Punctuation	Segment phrase boundaries with micro-pauses.
Double duration	In passages with two note durations in the ratio 2:1, short notes are lengthened.
Tuning	Make small intervals smaller.
Phrase arch	Accelerate phrase beginnings and decelerate phrase endings.
Notes inégales	In dotted quarter-sixteenth passages, lengthen the dotted note and shorten the sixteenth note.
Ensemble swing	The ratio of beat lag between soloist and drummer in "classical jazz" can be increased to make it swing more
Final retard	Slow down at the end of the piece.
Harmonic charge	Same as melodic charge but polyphonic context

Visualization of Expression via Tempo and Loudness

See http://www.ofai.at/~simon.dixon/pub/2002.icmc.pdf

Simon Dixon, Werner Goebl, and Gerhard Widmer

Detecting beat rate from inter-onset intervals (IOI).

Production of "expression trajectory" with tempo expressed in beats per munute (x axis) and dynamics in decibels (y axis). The darkest area is the present instant. Color intensity decays as older events are followed by new ones.
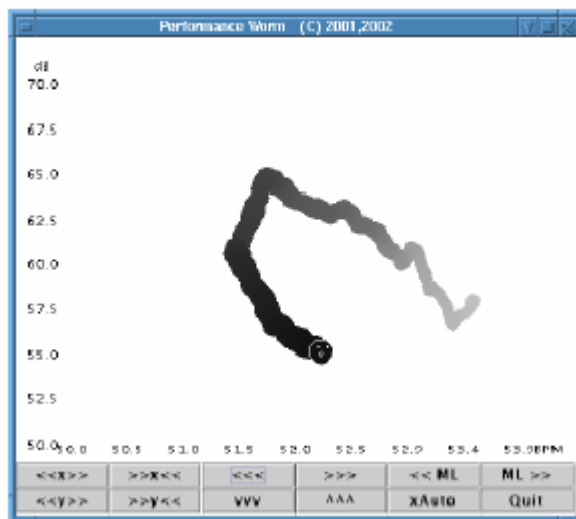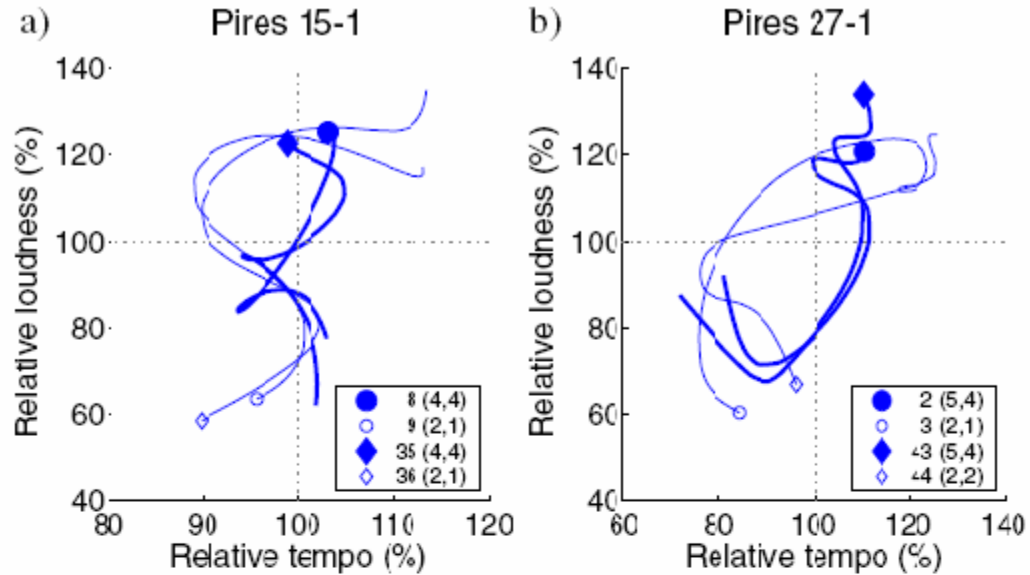
Figure 3: Pairs of consecutive phrase segments played by Pires, where each first segment depicts an upward, opening tendency (bold texture) and each second a downward, closing shape (light). (a) op. 15 No. 1, phrase 8–9 and 35–36 (b) op. 27 No. 1, phrase 2–3 and 43–44 (theme and its recurrence). The legends indicate the cluster (column,row) where each phrase segment can be found (see Fig. 1). The second segments do not continue exactly where the first ended, because each one is scaled to its local mean.
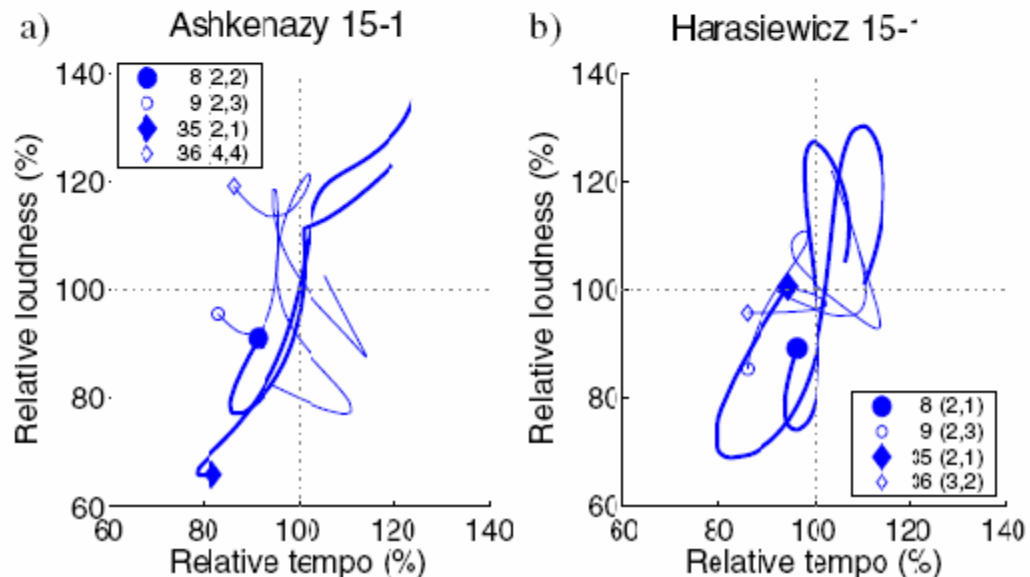
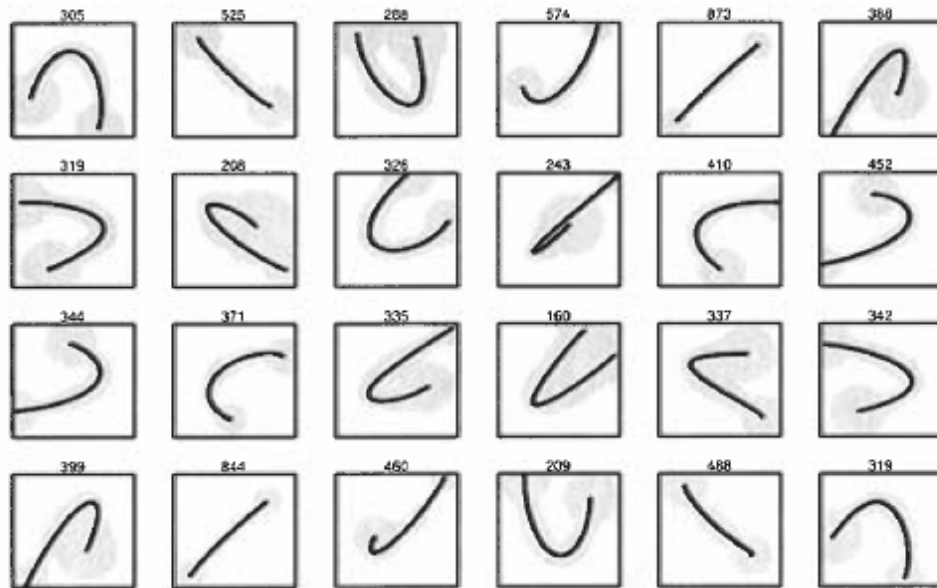A gesture alphabet derived from six pianists playing a Mozart sonata:

Fig. 2. A "Mozart performance alphabet" (cluster prototypes) computed by segmentation, mean and variance normalization, and clustering, from performances of Mozart piano sonatas by six pianists (Daniel Barenboim, Roland Batik, Vladimir Horowitz, Maria João Pires, András Schiff, Mitsuko Uchida). To indicate directionality, dots mark the end points of segments. Shaded regions indicate the variance within a cluster.

Other important research on timing, expression, tempo, and beat:

Bruno Repp.	Deviant timing normative
Peter Desain	Beats and polyrhythms
Luke Windsor	Music and emotion
Anja Volk	Conflict accents between different hierarchical levels of rhythm
Daniel Levitin	Tempo memory may be absolute

For a good, recent review article including the KTH and Widmer models see Gerhard Widmer and Werner Goebl, "Computational Models of Expressive Music Performance: The State of the Art," Journal of New Music Research 33/3 (2004), 203-216.
http://www.cp.jku.at/research/papers/Widmer_Journal_of_New_Music_Research.pdf