FWF
Der Wissenschaftsfonds.

UNI GRAZ

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AN ACCENT-BASED APPROACH TO AUTOMATIC RENDERING OF PIANO PERFORMANCE

Erica Bisesi & Richard Parncutt

Expressive piano performance

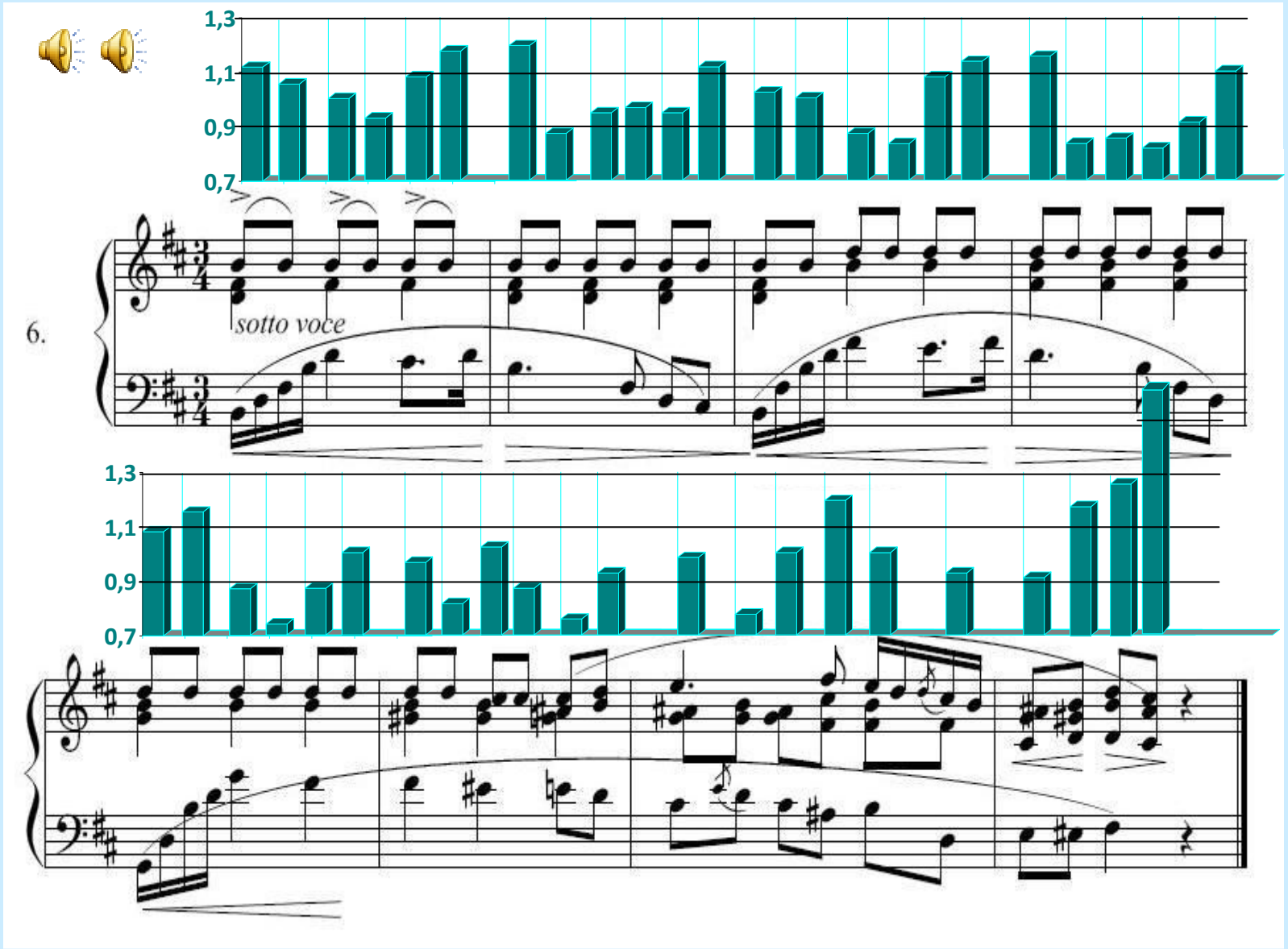
- Music performance research involves
  - music performance studies in humanities and education
  - music theory and analysis
  - systematic musicology: acoustics, information sciences, psychology

- Our aim:

  understand expressive timing and dynamics by
  - measuring timing and dynamics in excellent performances
  - developing theories about timing and dynamics
  - implementing these theories in a computer algorithm
  - generating and evaluating automatic performances

Expressive piano performance

An example: musical timing



Our project

FWF LISE MEITNER (M1186–N23)

- Our research will focus on the relationship between immanent (notated) accents and performed accents, and specific parameters associated with performed accents in piano music.
- Our project is to explore the complex relationship between musical expression (as perceived by listeners and performers) and corresponding physical parameters (such as timing and dynamics).
- Our approach is highly interdisciplinary, in the sense that we regard the relevant sciences as equally important.

What is an "accent"?

What accents do:

- attract attention of listener
- give a feel for what is important
- clarify structure
- facilitate musical communication

A broad definition (Parncutt, 2003):

- immanent (in the score):
  - metrical, grouping, melodic, harmonic
- performed (in the sound):
  - dynamic, durational, articulatory, timbral

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A broad d

- imman
  - met
- perfor
  - dyn

ACCENTS	*IMMANENT*	*PERFORMED*
time	grouping metrical	agogic (onset time) articulatory (duration)
pitch	melodic harmonic	intonation
loudness	dynamic	stress
timbre	instrument orchestration	coloration

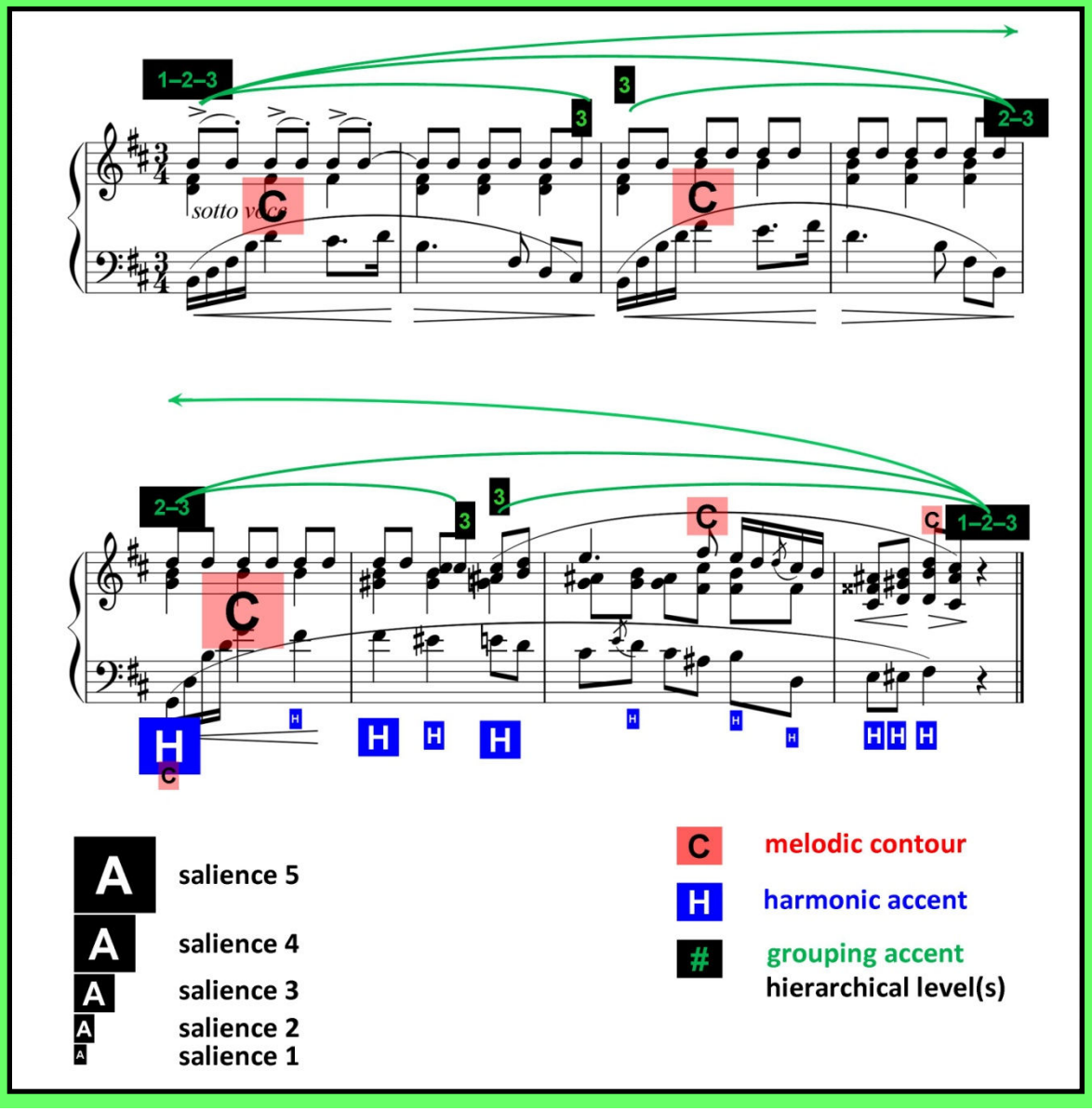
Table 1: Parncutt's (2003) taxonomy of musical accents.

Music theory and analysis

Musical theory and analysis

- Our analysis will produce
  - accent positions,
  - their range of action,
  - their salience

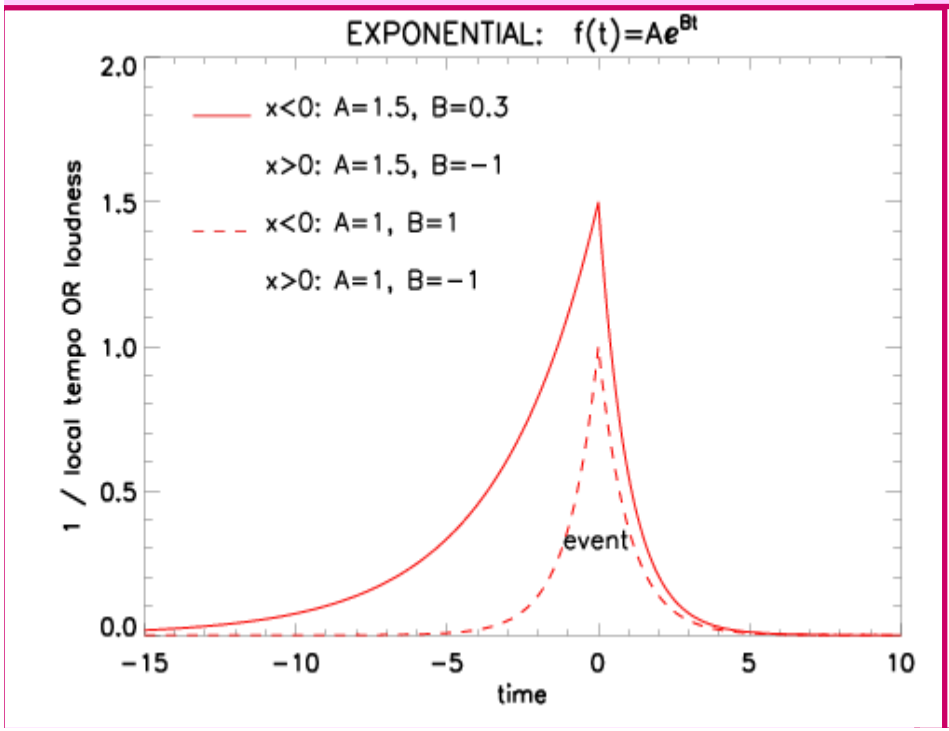
Musical theory and analysis

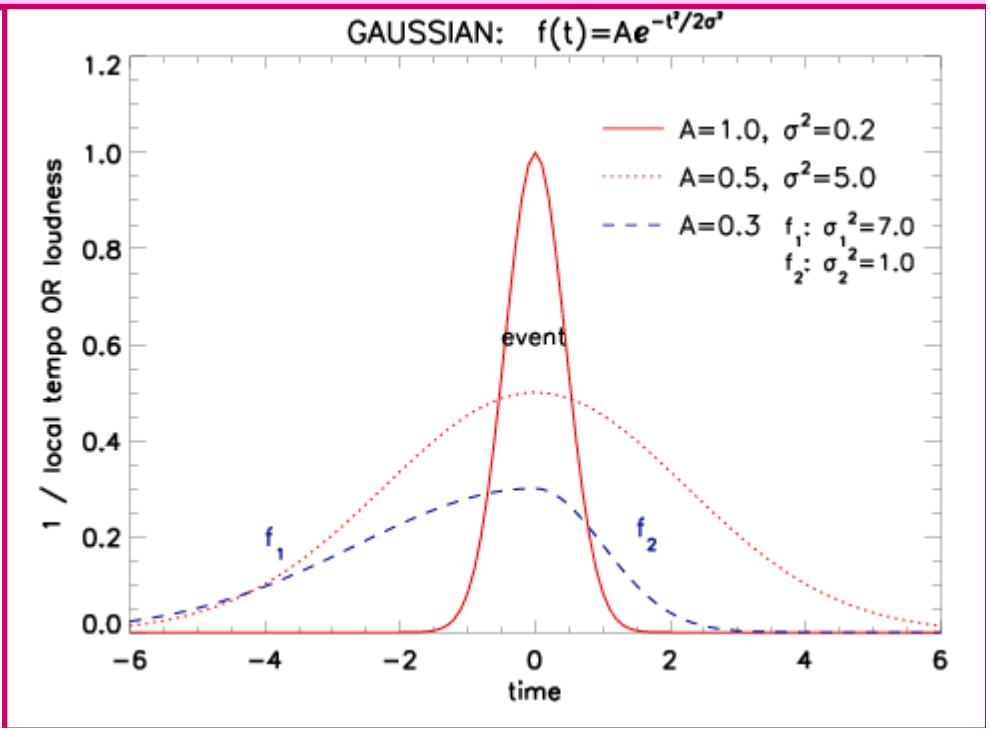


Mathematical modeling

Mathematical modeling

- tempo and dynamics fluctuate *gradually* or *suddenly*
- model gradual fluctuations (e.g. *ritardando*) by curve fitting
- curves can be added together





Computer implementation

Computer implementation

- **Director Musices** is a computer program that enables a musical score to be performed automatically. The result of a long-term research project at the KTH, Stockholm, it comprises performance rules that change specific note properties, including timing, duration, intensity, and frequency *(Friberg, Bresin & Sundberg, 2006).*

  Input: musical score → Output: "musical" performance

  Method: adjust timing, loudness, etc. by music-structural "rules"

- Our aim is to incorporate the accent theory of Parncutt (2003) into *Director Musices*

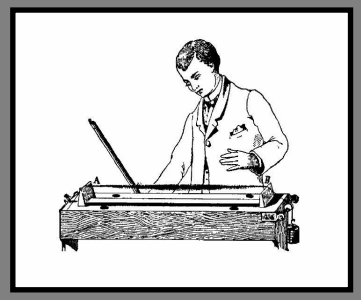
Director Musices 2.7.1 compiled: 20/9/2010 6:14

File Edit Rules Display Play Tools Help

PHRASING.mus

Type	Active	Name	Instrument type	Channel	Synth	BankMSB	BankLSB	Program	Volume	Pan	Reverb	Delay
Mono-Track	☑	piano	String	1	SBlive			1 Acou Grand Piano	0			0
Mono-Track	☑	piano	String	1	SBlive			1 Acou Grand Piano	0			0
Mono-Track	☑	piano	String	1	SBlive			1 Acou Grand Piano	0			0

Nominal



Score

Start time (ms) 0

piano

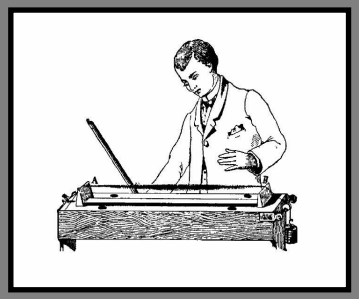
PHRASE-END
PHRASE-STAR(4 5 6)

Zoom y-axis + - x-axis + - Show Vars.. x-axis: ndr (dr) Redraw

Phrasing + Melodic and Harmonic Charge

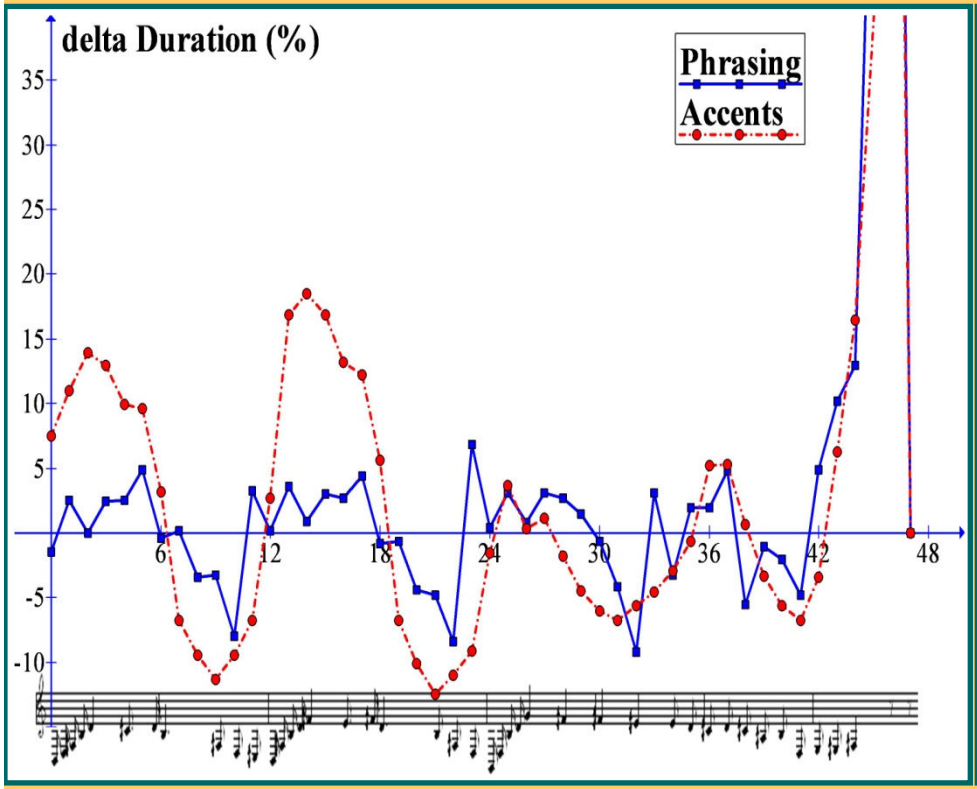
PHRASING.pal

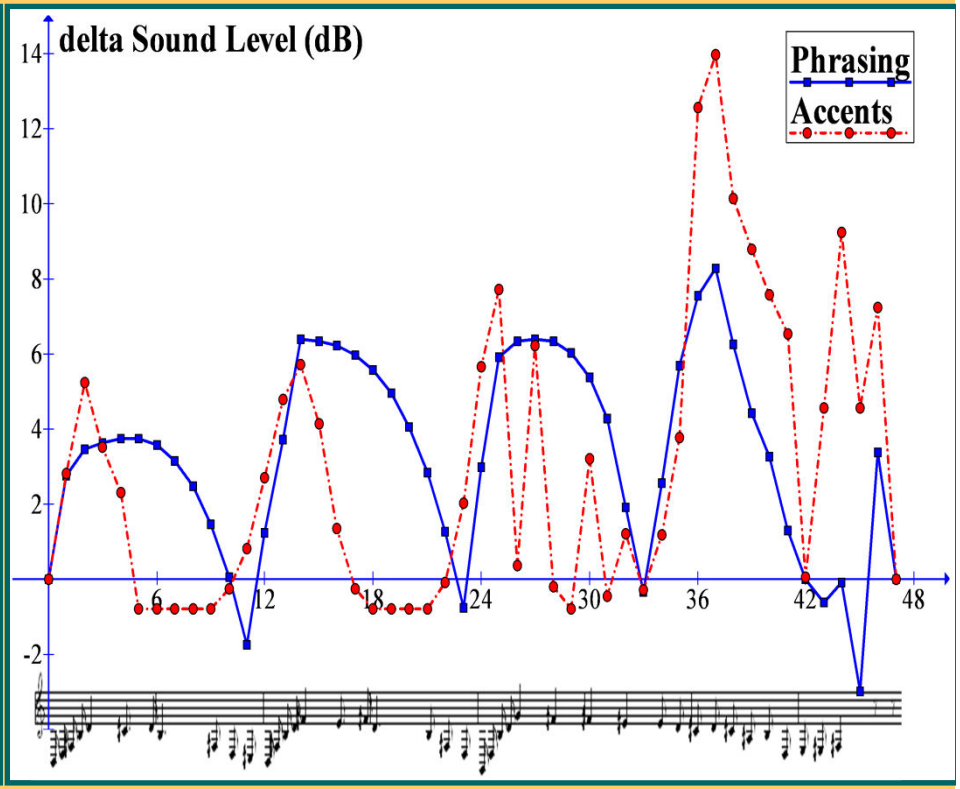
Play performed	3.0	High-Loud
Play nominal	3.0	Melodic-Charge :Amp 1 :Dur 1 :Vibamp 1
Init&Apply	3.0	Harmonic-Charge :Amp 1 :Dur 1 :Vibfreq 1
Apply	-1.0	Leap-Tone-Duration
	2.0	Score-Legato-Art
Scale: 1.5	0.3	Phrase-Articulation
Save as..	0.1	Phrase-Arch :Phlevel 4 :Turn 0.5 :Amp 15 :Dur 1
log to file	0.1	Phrase-Arch :Phlevel 5 :Turn 0.35 :Amp 15 :Dur 1
log to score	0.6	Phrase-Arch :Phlevel 6 :Turn 0.2 :Amp 10 :Dur 1 :Power 3
		☑ Normalize-Sl
		☑ Normalize-Dr
No-Sync	0.3	Final-Ritard
Melodic-Sync		
Simple-Mel-Syr		



Accents

Results


delta Duration (%)
Phrasing
Accents
35
30
25
20
15
10
5
-5
-10
6
12
18
24
30
36
42
48


delta Sound Level (dB)
Phrasing
Accents
14
12
10
8
6
4
2
-2
6
12
18
24
30
36
42
48

Conclusions

- The accent procedure can reproduce the patterns of timing and dynamics of the phrasing-based formulation
- Advantage of a bottom-up approach: different sub-phrases can be modeled independently from one another
- Higher variability in the profiles of timing and dynamics can produce a wider spectrum of performances

Implications

- For music research:

  link music analysis to music performance

  (more comprehensively than previous research)

- For music education:

  help music students develop interpretational skills

We acknowledge Dr. Anders Friberg (KTH, Stockholm)
for precious advice regards Director Musices

"Quelli che s'innamoran di pratica sanza scienzia
son come 'l nocchier ch'entra in navilio senza timone o bussola,
che mai ha certezza dove si vada"

Leonardo da Vinci

"Wir können überhaupt nicht denken,
ohne unsere fünf Sinne zu gebrauchen."

Albert Einstein