

Exploring Expressive Performance Trajectories: Six
Famous Pianists Play Six Chopin Pieces
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(2004)

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Introduction

- Exploratory approach for analyzing large amount of expressive performance data
- CD recordings of professional pianist playing Chopin
- Statistical analysis of tempo and loudness information
- What are the individual expressive strategies?
- What are the common performance principles?

Source Materials

- Commercially available recordings
- 6 famous pianist
 - Claudio Arrau
 - Vladimir Ashkenazy
 - Adam Harasiewicz
 - Maria Joao Pires
 - Maurizio Pollini
 - Artur Rubinstein
- Each playing 6 Chopin Pieces
 - Op. 15, No. 1: Nocturne in F major
 - Op. 27, No. 1: Nocturne in C# minor
 - Op. 27, No. 2: Nocturne in D b major
 - Op. 28, No. 4: Prelude in E minor "Suffocation"
 - Op. 28, No. 8: Prelude in F# minor "Desperation"
 - Op. 28, No. 17: Prelude in A b major "A scene on the place do Nortre-Dame de Paris"

Data Acquisition

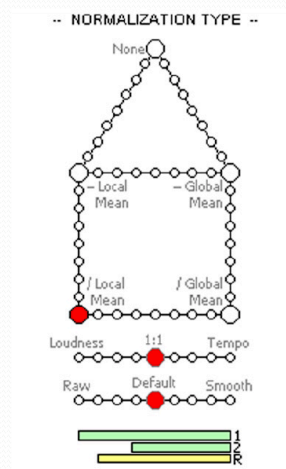
- Each of the 36 recordings was "beat-tracked"
 - Onset times extracted semi-automatically
- Overall loudness at each onset measured (in Sones)
- Result: data points at each note (tempo, loudness)
- Tracks segmented into "musically relevant phrases"
 - 1-2 bars in length

Pruning and Interpolation

- 1600 phrase segments ranging from 3-25 data points (0.5 – 25.7 sec)
- Only phrases with 5-15 data pairs (and 2 – 10 sec) analyzed for fair comparison
- Final set containing 1216 phrases
 - Each interpolated to contain 25 data pairs

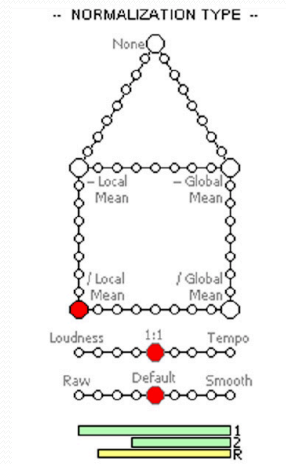
Phrase Normalization

- 5 types of normalization
 - None
 - Subtract mean (absolute change)
 - Local (phrase)
 - Global
 - Divide by mean (relative change)
 - Local (phrase)
 - Global



Smoothing and Weighting

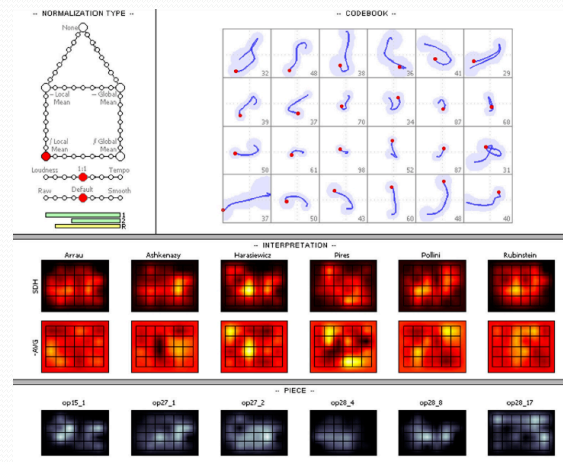
- Weight between tempo and loudness
 - Changes emphasis
- Degree of Smoothing
 - Windowed (0, 0.5, 0.75, 1 or 2 beats to either side)
 - Unsmooth (raw) data reveals every accent or delay
 - Smoothed data indicates larger-scale performance developments (bar level)



Clustering

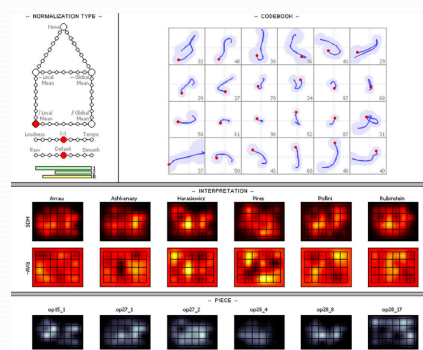
- Cluster phrases to explore potentially interesting sets of input parameters (normalization, weighting and smoothness)
- Use of novel computational technique
- Aligned self-organizing maps (SOM)
 - Groups similar phrase segments into cluster of similarity
 - Distance metric calculated between phrases
 - Generally, phrases “near” each other or clustered

Interactive Visual Interface



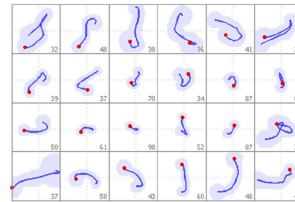
Visualization of Expressive Data

- User sets parameters
- Settings applied and phrases clustered
- Windows
 - Cluster codebook
 - Smoothed data histograms
 - By performer
 - By piece



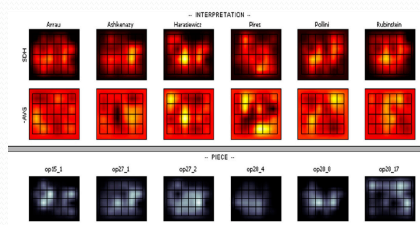
Codebook

- 2 dimensional trajectory of each cluster
 - x-axis: Tempo
 - y-axis: Loudness
- Dark blue curve indicates mean performance trajectory of the phrases in cluster
- Light outline shows variance of the phrases in cluster
- Each cluster referred to by 6x4 grid coordinate: (row, column)



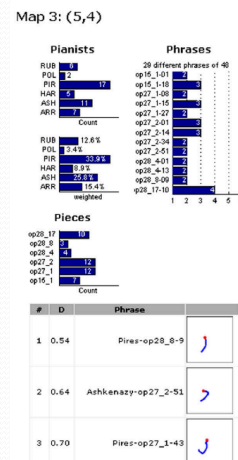
Smoothed Data Histograms (SDH)

- Frequency distribution of phrase by cluster
 - By performer
 - By Piece
- Brightness in each grid-cell indicates frequency of phrases from the corresponding codebook cell
- “Avg”: distribution after subtracting average SDH



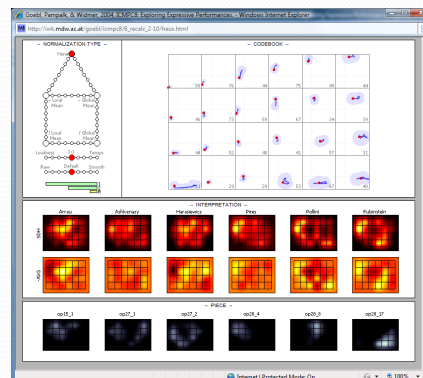
Cluster Inspector

- A closer look at an individual cluster from codebook
- Indicates the kind of phrase segments represented in a cluster
 - By pianist
 - By piece
 - By phrase
- Playback of represented phrases



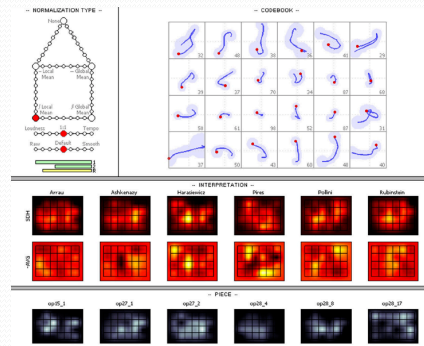
Unnormalized Data

- Both Op. 15, No. 1 and Op. 27, No.1 have alternating tempo and loudness
 - [soft/slow...loud/fast...soft/slow]
- Most clusters are along piece boundaries
- Some expressive strategies are characteristic of the performer
 - Pollini playing Op. 28, No. 17
 - Dominates 45% of cluster (6,4)
 - Acceleration/deacceleration with narrow loudness range



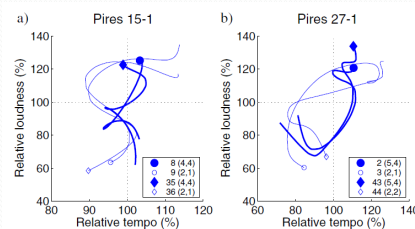
Normalized Data

- Normalization: division by local mean
- Pires and Pollini employ antagonistic strategies
 - Pires: peaks at (4-5,4) and (2,1-2)
 - Typical phrase:
 - Initial acceleration and crescendo
 - Final deceleration and decrescendo



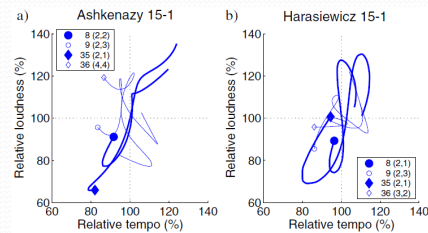
Arching Phrase Structure of Pires

- Pairs of consecutive phrase segments played by Pires
- Each first segment shows upward, opening tendency
- Each second segment has downward, closing trend
- Each pair upwards/downwards curves is the theme and its recurrence



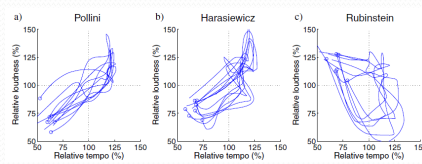
Other Performer-specific Strategies

- Ashkenazy plays first 2 bars in gradual diminuendo and ritardando
 - Builds loudness in next 2 bars
- Harasiewicz, Pollini and Rubinstein (on right)
 - Apex of first 2 bars at 3rd beat of 1st bar
 - First phrase closed with decrescendo and diminuendo



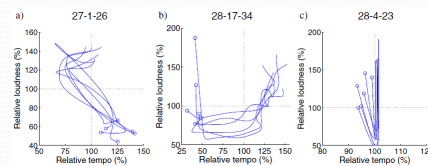
More Performer Strategies

- Coda section from Op. 28, No. 17 (bars 65-81)
- Main theme is played very soft against strongly accented bass at start of each 2 bar phrase
- Each pianist plays section consistently, but differently
 - Pollini (6,1)
 - Harasiewicz (1,1)
 - Rubinstein (5,1)



Performer Commonalities

- Phrases played the same for all performers
 - Op. 27, No. 1 (phrase 26)
 - Op. 28, No. 17 (phrase 34)
 - Op. 28, No. 4 (phrase 23)
 - Cluster (3,1)
 - Contains two chords with long rest in between
 - Extreme case where score dominates trajectory



Problems with Methods

- Loudness measured from audio file
 - Ignores individual voices
- Performances were tracked at one particular level
 - Ex. Ignoring eighth notes
- Temporal accuracy approximately ± 10 ms
- Interpolation may disassociate trajectory from performance
 - Single delayed event (i.e. lengthening of a note) may be misinterpreted as retardando
 - Smoothing can help
- Articulation and pedaling are not analyzed