Analyzing Performances of Chopin’s Mazurka

Neta Spiro, Nicolas Gold, John Rink
University of London &
King’s College London

Presented by Chandra Rajagopal
University of Southern California
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Aims and Motivation

• Timing patterns
  – How tempo (beat ‘timing’) fluctuates in performance
• Dynamic patterns
  – How performers manipulate the ‘loudness’ of notes
• What are the patterns?
• Why use them?
• How do different performers use these patterns?
• Correlation between the two domains?
Existing Research vs. New Approach

• Previous work
  – Simplistic relationship assumed between timing and dynamics (Palmer): arc shape of phrases (coinciding with melody)
  – True in some cases, contradicted by real examples (Langner, 75)
  – Focused on similarities, rather than differences

• Spiro et al:
  – Higher-level analysis proposed by Spiro et al., involves the ‘motive’ - usually refers to musical motives understood directly from scores
  – Here, not necessarily a musical motif, rather any repeated structure in musical performance

Preparation for Analysis

• Frederic Chopin’s Mazurka
  Op.24 No. 2 in C Major
• The mazurka – Polish folk dance in triple meter, heavy accent on second beat
• Why?
  – Clear structure
  – Contrasting sections
  – Relatively simple accompaniment structure (easy to annotate, analyze)
• 29 Performances
• Listen to performance
Method
Collecting Data

- Beat annotation by human tapping
  - Possible error with human anticipation? (Patel, 100)
- Loudness data obtained (and subsequent smoothing performed) through Sonic Visualizer
- Pre-processing
  - Beat timing data converted to relative proportion of containing bar
Method
Bar/Beat Structure

• Neural network technique used for clustering
• Apriori nature – ideal for this experiment
• Best results from treating timing, dynamics as two separate spaces (more on this later)
• Result – average shape for the bars represented by cluster
Analysis
Structure

• Form:
  [Intro] A B A [Codetta] C D A
• Clear separation into four-bar phrases
• Clear melodic pitch ‘arc’ shape for each phrase (in right hand):

Analysis
‘Mazurka Patterns’ and the Hemiola

• The typical ‘Mazurka Pattern’ involves a stressed second or third beat (in a 3-beat bar)
• May have consequence in timing as well
• Hemiola – ambiguity (in listener’s perception) of grouping in either two or three notes.
• See first few bars

Grouping by ‘two’
Grouping by ‘three’
Results

Clustering with SOM

- Above: Timing clusters
  - Observe T2: longer second beat typical of the mazurka
- Below: Dynamic clusters
  - Observe D4: stressed second beat as in mazurka

Timing, dynamic patterns not used in globally uniform manner
Patterns are used consistently over individual sections
  - Intro: Dominated by T1 (not mazurka pattern), possibly due to hemiola effect
However...
  - Great differences between performances
  - Seemingly 'identical' regions (e.g. bars 20, 52) have different profiles
  - Dynamics, Timing patterns do not necessarily match
If direct coupling existed between the two quantities, we would expect one dominant dynamic pattern for every timing pattern and vice versa. Many patterns dominate in each, therefore direct coupling is not present.

- **Mazurka** has a very consistent 4-bar phrase structure and arc.
Analysis Structure

- Form:
  [Intro] A B A [Codetta] C D A
- **Clear separation into four-bar phrases**
- Clear *melodic* pitch ‘arc’ shape for each phrase (in right hand):

![Mazurka form and melodic arc](image1.png)

Results Phrasing

- **Mazurka has a very consistent 4-bar phrase structure and arc**
- Expect start with T3, end with T4 (or T2)
- This pattern would follow the ‘arc’ of the 4-bar phrase

![Mazurka phrasing diagram](image2.png)
• Timing results relatively consistent with hypothesis
  – T3 dominant at start, T2 dominant at end – exhibition of ‘phrase-lengthening’ (Palmer)
  – Flatter patterns in timing and dynamics in middle bars
  – T2 (mazurka pattern) very prominent in bars 2-4 of every phrase

• Conclusion: Timing, dynamics linked to phrase structure
• Observe section-ending bars (4, 20, 52, 104), with otherwise similar appearance — our ‘motives’
  – Similar structural arrival
  – Similar structural context
• Again, no consistent choice of timing or dynamic patterns
• Tempo varies between sections (see graph on right)
• However
  – Pattern of tempo is not consistent for different performers
  – Different performers vary tempi differently between sections

Results
Motives and Tempo

Results
Individual Performances

• General trend in use of timing:
  – T1 (32%) T2 (30%) T3 (24%) T4 (14%)
• Despite trend, use of timing patterns varies greatly between performers (notably in T2 and T4 use)
Results

The Curious Case of Rubenstein

- Several Performances spanning 27 years (1939, 1952, 1966)
- SOM method shows decreasing number of clusters over time
  - Less varied performance style?
  - More rigid playing? Firmer understanding of the piece?

Discussion

Timing and Dynamics

- Relationship between timing, dynamics is complex, dependent on
  - Structural context
  - Thematic significance
  - Idiomatic style of musical work – here, the mazurka
- Gain a sense of when/why certain timing profiles used
  - T2 and T4 used for similar structural positions (T4 for ends of sections/phrases)
  - Performances with more ‘sectionalization’ use T4 more frequently
- Tempo changes between sections are well pronounced
Further Discussion
New Directions

• Synthesis – incorporating timing patterns into MIDI performances
• With more exhaustive study
  – Apriori method to identifying performance style
  – Obtain a new higher-level method of identifying pieces

References