Performance Style Analysis

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2,732 recordings of 49 mazurkas by Frédéric Chopin (1810-1849) = Average of 56 performances/mazurka

- 157 performers
- on 209 CDs/records
- 123 hours of music
- Earliest performance from 1902 by Alfred Grünfeld: mazurka 67/4
Basic Problem

• How to numerically compare different performances?

89 performances of mazurka 17/4

(measure 31)

Afanassiev 2001
Andsnes 1990
Ashkenazy 1981
Bacha 1998
Barbosa 1983
Beliavsky 2004
Ben-Or 1989
Biret 1990
Blet 2003
Block 1995
Brailowsky 1960
Brunhoff 1963
Casadesus 1930
Chiu 1999
Clidat 1994
Cohen 1997
Coop 1987
Cortot 1951
Csalog 1996
Czerny-Stefanska 1949 live
Czerny-Stefanska 1949 studio
Czerny-Stefanska 1989
Ezaki 2006
Falvay 1989
Ferenczy 1958
Fiorentino 1990
Flière 1977
Fou 1978
François 1956
Gieseking 1938
Ginzburg 1957
Goldmann 1997
Guller 1956
Hatto 1993
Hatto 2006
Horowitz 1971
Horowitz 1985
Indjic 1988
Kapell 1951
Kiepura 1999
Kilenyi 1937
Kissin 1993
Kitain 1937
Kushner 1990
Lévy 1951
Lear 1994
Lefébure 1950
Lilamand 2001
Luisada 1990
Lushtak 2004
Lympany 1968
Lympany 1990
Magaloff 1977
Magaloff 1977b
Magin 1975
Milkina 1970
Mohovich 1999
Nadelmann 1956
Ohlsson 1999
Olejniczak 1990
Olejniczak 1991
Osinska 1989
Pöntinen 2003
Paderewski 1912
Paderewski 1923
Paderewski 1924
Perahia 1994
Perlemuter 1986
Poblocka 1999
Rangell 2001
Risler 1920
Rosen 1989
Rubinstein 1939
Rubinstein 1952
Rubinstein 1966
Rummel 1943
Shebanova 2002
Simon 1991
Smith 1975
Szpilman 1948
Sztompka 1959
Tanyel 1992
Uninsky 1971
Vardi 1988
Wasowski 1980
Weissenberg 1971
Zecchi 1942
Zecchi 1942b
Performance Extraction

Sonic Visualiser
Audio Editor
http://www.sonicvisualiser.org
(Queen Mary, University of London)

Plugins:
- Mz SpectralReflux
- Mz HarmonicSpectrogram

http://sv.mazurka.org.uk
(Royal Holloway, University of London)
# Beat Tempo Data

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Correlation Comparisons

(ISMIR 2007)

Pearson correlation:
output range: -1.0 to +1.0

\[
\sum_i (x_i - \bar{x}) (y_i - \bar{y}) \over \sqrt{\sum_i (x_i - \bar{x})^2 \sum_i (y_i - \bar{y})^2}
\]

Uninsky 71  0.72
Biret 90   0.64
Jonas 47   0.56
Luisada 90 0.46
Magaloff 77 0.37
Rubinstein 66 0.22
Brailowsky 60 0.09

Yaroshinsky 05 tempo in measures 32-48:
Sometimes Clear Meaning
Sometimes Unclear Meaning

- Plots have to show some match at all points
  -- not necessarily a good one

- indicates who the nearest neighbor is

- doesn’t indicate how close the nearest neighbor is.

- does not mean he plays 23.6% like Lushtak, 15.5% like Falvay, etc.
Purely Random Matches

- Small color regions, inverted triangles & broken borders = poor matches

```
Random1
22.7% Jonas 1947
14.1% Shebanova 2002
8.3% Blet 2003
8.0% Chiu 1999
7.3% Random2
6.0% Tsong 2005
4.3% Mohovich 1999
4.4% Fiorentino 1962
3.3% Cortot 1951
2.5% Fliere 1977
2.4% Lushtak 2004
2.1% Michelangeli 1971
2.1% Smith 1975
2.1% Sofronitsky 1960
1.7% Tsong 1993
1.6% Ferenczy 1956
1.4% Ashkenazy 1981
```

```
Random2
17.7% Brainzewsky 1960
13.8% Fiorentino 1962
10.1% Random1
7.6% Blet 2003
7.1% Uninsky 1971
6.9% Yaroshinsky 2005
4.8% Rangell 2001
3.8% Sofronitsky 1960
3.7% Clidat 1994
3.1% Francois 1956
3.0% Jonas 1947
2.8% Tsong 2005
2.2% Mageloff 1977
1.9% Ferenczy 1956
1.8% Ashkenazy 1982
1.6% Lusada 1990
1.5% Indjic 2001
1.2% Shebanova 2002
```
Peeling Back the Layers

- Eventually
- noise-like display
Noise Floor Definition
(ISMIR 2008)

- Peel off first half of performances
- Other half defined as “noise floor”

Horowitz 1949 dynamics
Noise Floor Definition (2)

Remove better matches:

Horowitz 1949 dynamics

Horowitz’s noise-floor
Reintroduce Better Matches

Rachmaninoff’s correlations exceed noise-floor in 74% of sub-sequences.
Overlay Other Performers with “Noise”

Rachmaninoff | Horowitz

Zak | Horowitz
Non-Overlapped Similarity

Horowitz 1949 dynamics

34%

28%

74%

64%

Rachmaninoff | Horowitz

S₃

Zak | Horowitz
Asymmetric Matches

- Luisada often a nearest neighbor of Brailowsky
- but Brailowsky never a nearest neighbor of Luisada...

\[ S_3 = 0.82 \]

\[ S_3 = 0.17 \]
Rough Performance Map Schematic

Luisada

Brailowsky

Biret

Average

(other performers)
Distant Neighbor Suppression

\[ S_3 = A \Rightarrow B \text{ measurement} \]
\[ S_{3r} = A \Leftarrow B \text{ measurement} \]
\[ S_4 = \sqrt{S_3 \cdot S_{3r}} \]

Forward = 74\%  (Rachmaninoff|Horowitz)
Reverse = 77\%  (Horowitz|Rachmaninoff)
Mean = 75\%

Forward = 64\%  
Reverse = 57\%
Mean = 60\%
Evaluation

• Arthur Rubinstein – 3 performances for each mazurka:

1939 1952 1966

→ also, more variable between performances than other pianists

• How well can 2 of his performances be identified with the third?

Query: Rubinstein 1952 (smoothed tempo)

1: Rubinstein 1939
2: Rubinstein 1966
0.59 Tomsic 1995
0.56 Falvay 1989

Average rank: 1.5

Query: Rubinstein 1952 (full dynamics)

1: Rubinstein 1966
0.62 Milkina 1970
0.60 Csalog 1996
0.60 Kissin 1993
0.56 Fou 1978
0.56 Cohen 1997
0.56 Rubinstein 1939

Average rank: 4.0
Results by Composition
(using Rubinstein performances)

Average Rankings for Different Similarity Metrics

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Results by Feature
(using Rubinstein performances)

Average Rankings by Musical Feature

- **tempo by beat**
- **smoothed tempo**
- **tempo residue**
- **dynamics**
- **composite of tempo & dynamics**

- **Avg.**

---

**tempo**

**smoothed tempo**

**residual tempo**
Performance Map (using $S_4$)
Performance Map Interpretation
1. Hatto Hoax
### Background

#### Best overview:

**Sept. 17, 2007 issue of the *New Yorker***


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#### 2003-2006: ~100 CDs covering a wide range of classical piano repertoire.

#### TOP CDs OF 2005

Richard Dyer, Boston Globe:

10. Brahms: Piano Music. Joyce Hatto, piano *Concert Artist/Fidelio Recordings*. **Hatto, a British pianist now in her mid-70s, was my great discovery of 2005**. Although illness has kept her off the concert platform for decades, she has made well over 100 CDs surveying virtually the major piano repertory. None of the 50 or so I have heard is disappointing, and the best join the company of the best piano record ever made. A particular favorite is this Brahms volume that includes the "Paganini" Variations.

(Matti Raekallio)

January 2006, *Gramophone*, Jeremy Nicholas:

“the world’s unrivaled authority on classical music since 1923”

#### 2007:

- 80 CDs identified in whole or part from other commercial CDs
- 90 pianists represented on Hatto CDs.

http://www.farhanmalik.com/hatto/main.html
William Barrington-Coupe

• Hatto’s Husband
• In recording industry since 1950’s (Saga/Lyrique/Delta/Triumph labels)
• Concert Artist/Fidelio Recordings
  http://concertartistrecordings.com

“Barry”

Sergio Fiorentino  Joyce Hatto
Edward Kilenyi  Ozan Marsh
Nicholas Zumbro  Dubravka Tomsic
Mazurka 17/4 Correlation

http://mazurka.org.uk/ana/pcor/mazurka17-4
Hatto / Indjic

Two different performances from two different performers on two different record labels from two different countries…

Calliope 3321

Concert Artist 20012

(0.7% slower)
Hatto Mazurka Cassette

• Hatto mazurka performances released on 3 Cassettes in 1993.
  (Fidelio FED4-TC-0116/8)

• Ernst Lumpe sent copy of cassettes to Christopher Howell (May 2007), and turns out they are also Indjic’s 1988 performances.

• Slight differences between the CD / cassette releases, such as:

  Mazurka 7/2 in A minor:
  • 1988 Indjic: bars 1-16 not repeated
  • 1993 Hatto: bars 1-16 repeated
  • 2005 Hatto: bars 1-16 not repeated

• Concert Artist mischief occurring since at least 1993, not 2002…
Beat-Event Timing Differences

Hatto beat location times: 0.853, 1.475, 2.049, 2.647, 3.278, etc.
Indjic beat location times: 0.588, 1.208, 1.788, 2.408, 3.018, etc.

Hatto / Indjic beat time deviations

Remove 0.7% timeshift
2. Fiorentino Fakes
Mazurka 17/4 Correlations
http://mazurka.org.uk/ana/pcor/mazurka17-4
Fiorentino / Olejniczak

Con. Artist CD 9200-2

Also mazurkas 7/1, 7/3, 7/4, 24/4, 30/4 match between two CDs…

"I faked my wife's recordings to please her"
AudioDB

• Developed by Michael Casey @ Goldsmiths College, University of London (now at Dartmouth College, Vermont).

• http://omras2.doc.gold.ac.uk/software/audiodb

QUERY=9065-12 WORK=24.4

------
9065-12  2759  Fiorentino  |  24.4 in B min
9100b-13  651  Olejniczak  |  24.4 in B min
9081-05  56   Nezu       |  24.4 in B min
9054-17  44   Smith      |  24.4 in B min
9070-25  41   François   |  24.4 in B min
3. Questionable Cortot
Performance Features

• Visualizations not intended to find exact matches
• Designed for finding similar performances

Such as different performances by same pianist:

See: http://mazurka.org.uk/ana/pcor-perf
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Fou 1978 30/2 tempo curve

Fou 2005 30/2 tempo curve

(live) (studio) (40 years)
“A most important happening during this period [c1990] was the discovery in succession of some extraordinary Chopin recordings Biret had not known about by three great pianists; performances which greatly inspired her. First came the complete 51 Mazurkas by Alfred Cortot on three cassettes bought privately in the UK. These were recorded by Cortot in the late 1950s and never released for unknown reasons.”

http://www.idilbiret.org/ENG/IBe13.htm
Cortot Mazurka Performances

Concert Artists CD 91802 (2005)
Complete (51) mazurka performances

Sony Classical S3K89698 (2005)
Partial performances of 5 mazurkas:
24/1, 24/2, 24/4, 30/1, 30/2
## Cortot Similarity Ranks

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(36 performances of mazurka 30/2 used in comparison)
Summary

Concert Artist Hatto recordings at least 80% fakes starting by 1993.

Concert Artist Fiorentino mazurka recordings -- All CA issues of Fiorentino after 1998 are now suspect.

Lots of smoke surrounding Concert Artist’s Cortot mazurka recordings – “real” performer not yet identified.