Learning Violinist’s Expressive Trends

Miguel Molina-Solana
Josep Lluis Arcos
Emilia Gomez

MML08, July 9th 2008
1 Introduction

2 Trend-based Modeling

3 Experimentation

4 Conclusions
1 Introduction

2 Trend-based Modeling

3 Experimentation

4 Conclusions
Introduction

What?
Identify violinists from their playing style using descriptors automatically extracted from commercial audio recordings by means of state-of-the-art-feature extraction tools.

Problems
- High heterogeneity in the recording conditions.
- Partial accuracy in audio feature extraction.

How?
1. Using a high-level abstraction of the transcription
2. Tagging melodic segment according to Narmour’s IR model.
3. Characterizing performance patterns as probabilistic distributions.
Introduction

What?
Identify violinists from their playing style using descriptors automatically extracted from commercial audio recordings by means of state-of-the-art-feature extraction tools.

Problems
- High heterogeneity in the recording conditions.
- Partial accuracy in audio feature extraction.

How?
1. Using a high-level abstraction of the transcription
2. Tagging melodic segment according to Narmour’s IR model.
3. Characterizing performance patterns as probabilistic distributions.
Introduction

What?
Identify violinists from their playing style using descriptors automatically extracted from commercial audio recordings by means of state-of-the-art-feature extraction tools.

Problems
- High heterogeneity in the recording conditions.
- Partial accuracy in audio feature extraction.

How?
1. Using a high-level abstraction of the transcription
2. Tagging melodic segment according to Narmour’s IR model.
3. Characterizing performance patterns as probabilistic distributions.
Outline

1. Introduction
2. Trend-based Modeling
3. Experimentation
4. Conclusions
2 Trend-based Modeling

- Feature extraction and segmentation
- Modeling trends
- Classifying new performances
Title Outline Introduction Trend-based Modeling Experimentation Conclusions

Audio file

Segmentation and music features extraction

- feature extraction
- segments
- IR tagging

music feature values

- tagged segments

Modeling trends

- Trend generation

Performer identification

- performers' learned trends

Classifier

- sorted list of most similar performers
## Feature extraction and segmentation

### Features
- Not focused on developing new methods. So, existing algorithms are employed.
- Currently, we collect pitch, duration and energy of each note.
- Scores are not used, just wave files.

### Problem:
Automatic transcription not very accurate

### Solution:
- More abstract representation than notes.
- IR model by E. Narmour to perform melodic segmentation.

Each segment of three notes is tagged with an IR pattern.
Feature extraction and segmentation

### Features
- Not focused on developing new methods. So, existing algorithms are employed.
- Currently, we collect pitch, duration and energy of each note.
- Scores are not used, just wave files.

### Problem:
Automatic transcription not very accurate

### Solution:
- More abstract representation than notes.
- IR model by E. Narmour to perform melodic segmentation.

Each segment of three notes is tagged with an IR pattern.
Feature extraction and segmentation

Features

- Not focused on developing new methods. So, existing algorithms are employed.
- Currently, we collect pitch, duration and energy of each note.
- Scores are not used, just wave files.

Problem:

Automatic transcription not very accurate

Solution:

- More abstract representation than notes.
- IR model by E. Narmour to perform melodic segmentation.

Each segment of three notes is tagged with an IR pattern.
2 Trend-based Modeling

- Feature extraction and segmentation
- Modeling trends
- Classifying new performances
Modeling trends

- Audio file
  - Segmentation and music features extraction
    - Feature extraction
    - Segments
    - IR tagging
    - Music feature values
    - Tagged segments

- Trend generation

- Modeling trends

- Performer identification
  - Performers’ learned trends
  - Classifier
  - Sorted list of most similar performers
A trend model is a set of discrete probability distributions for a given audio descriptor.

### Features
A note value is compared with the mean value of the fragment.

- If higher: +
- Else: -

With segments of 3 notes and 2 qualitative values: 8 possibilities.

—, –+, -+-, -++, +–, +-+, ++-, +++
Modeling trends

A histogram per IR structure and performer is constructed.
2 Trend-based Modeling

- Feature extraction and segmentation
- Modeling trends
- Classifying new performances
Classifying new performances

Features

- A Nearest Neighbor (NN) classifier is employed.
- Trend models learnt in training stage are used as class patterns.
- Classifier outputs a ranked list of performer candidates.

Steps

1. Process new input recording.
2. Create its trend models.
3. Compare these trend models with previously learnt ones.
Outline

1. Introduction
2. Trend-based Modeling
3. Experimentation
4. Conclusions
Musical data

What?
Sonatas and Partitas for solo violin from J.S. Bach.

Why?
- Well-known collection
- Recorded many times by several violinists
- Commercial recordings available
- Monophonic music
Musical data

What?
Sonatas and Partitas for solo violin from J.S. Bach.

Why?
- Well-known collection
- Recorded many times by several violinists
- Commercial recordings available
- Monophonic music
Each set contains 23 instances from different violinists.

<table>
<thead>
<tr>
<th>Exp</th>
<th>Learning Set</th>
<th>Testing Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp-1</td>
<td>Second Movement of Partita No. 1</td>
<td>Sixth Movement of Partita No. 1</td>
</tr>
<tr>
<td>Exp-2</td>
<td>Sixth Movement of Partita No. 1</td>
<td>Second Movement of Partita No. 1</td>
</tr>
<tr>
<td>Exp-3</td>
<td>Sixth Movement of Partita No. 1</td>
<td>Fifth Movement of Partita No. 3</td>
</tr>
</tbody>
</table>
Results

How we measure?

For each input recording, the classifier outputs a ranked list of performer candidates where 1 is the most likely performer.
Results

![Graph showing the accumulated success rate over the correct performer position for different conditions.

- Blue line: duration + energy Mov.2 vs Mov.6
- Black line: duration + energy Mov.6 vs Mov.2
- Red line: duration + energy Mov.6 vs Mov.5
- Cyan line: random classifier

The graph demonstrates the performance of different models in distinguishing between the expressive trends of different movements in violin playing.](image-url)
1. Introduction

2. Trend-based Modeling

3. Experimentation

4. Conclusions
Conclusions

Summary

- Identify violinist from their playing style.
- Performers are characterized by a set of probability distributions.
- Good results with not very accurate data.
- Random classifier is clearly outperformed.

Future work

- Extend the model with the use of fuzzy sets.
- Work with many more descriptors.
- Study relations between descriptors.
- Employ hierarchical classifiers.
## Conclusions

### Summary
- Identify violinist from their playing style.
- Performers are characterized by a set of probability distributions.
- Good results with not very accurate data.
- Random classifier is clearly outperformed.

### Future work
- Extend the model with the use of fuzzy sets.
- Work with many more descriptors.
- Study relations between descriptors.
- Employ hierarchical classifiers.
Questions ?

Miguel Molina-Solana
miguelmolina@ugr.es