Universitat Pompeu Fabra Barcelona

MTG Music Technology Group

Evaluation of Set Class Similarity Measures for Tonal Analysis

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SMC Master Thesis Presentation

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Outline

- Introduction:

  Problem - Definitions - Objectives

- Methodology:

  Systematic Description - Set Class Theory - Segmentation - Representation

- Conclusions

- Future Work

Introduction

Problem

1. Existing approaches to tonal analysis lack depth

2. Use of “non-musical” similarity measures

Introduction

"**Evaluation of Set Class Similarity Measures for Tonal Analysis**"

- Tonal Analysis:
    1. Description
    2. Representation
- Set Class Theory: Tool for description stage
- Similarity Measures: Tool for representation stage

Introduction

Objectives

1. Adopt systematic approach to description
2. Use set class theory
3. Survey set class similarity measures
4. Represent set class data using similarity measures
5. Demonstrate with analysis examples

Methodology

Systematic Description

- What does it mean to be systematic?

  Mid-Level

Methodology

Set Class Theory - What?

Pitch Set: {A4, C#5, E5, A5}

Pitch Class Set: {C#, E, A} = {1,4,9}

Set Class: {0,4,7}

Forte Name: 3-11B

Methodology

Set Class Theory - Why?

- An appropriate mid-level descriptive tool

- What are the differences/benefits?

Methodology

Set Class Similarity Measures - What?

- Theoretical models of similarity
- Compare subset contents
- Musical measures

Methodology

Set Class Similarity Measures - Survey

SIMILARITY MEASURE	C1	C2	C3.1	C3.2	C3.3	C3.4	C4	C5	C6	
s.i.					X	X				
sf					X	X	X			
IcVSIM	X	X				X				
ISIM2	X	X				X				
K	X	X			X	X	X			
SIM	X	X			X	X	X			
MEMBn	X	X			X	X	X			
AMEMB2	X	X	X							
ASIM	X	X	X	X		X	X			
IcVD1	X	X	X	X		X	X			
IcVD2	X	X	X	X		X				
COS	X	X	X	X		X				
ANGLE	X	X	X	X		X				
AK	X	X	X	X		X	X			
SATSIM	X	X	X							
CSATSIM	X	X	X							
REL2	X	X				X				
%RELn	X	X	X	X	X	X	X			
TMEMB	X	X			X		X	X		
ATMEMB	X	X	X	X		X	X	X		(Rahn, 1979)
TSATSIM	X	X	X	X		X		X		(Buchler, 1997)
AvgSATSIM	X	X	X	X		X		X		(Buchler, 1997)
REL	X	X	X	X		X	X	X		(Lewin, 1979)
T%REL	X	X	X	X	X	X	X	X		(Castrén, 1994)
RECREL	X	X	X	X	X	X	X	X	X	(Castrén,1994)

Methodology

Segmentation

- Two segmentation policies:

1. Fully Systematic (A. Martorell, 2014)

   For capturing the complete SC contents

2. Sliding Window

   For tuning in to a *sets of interest*

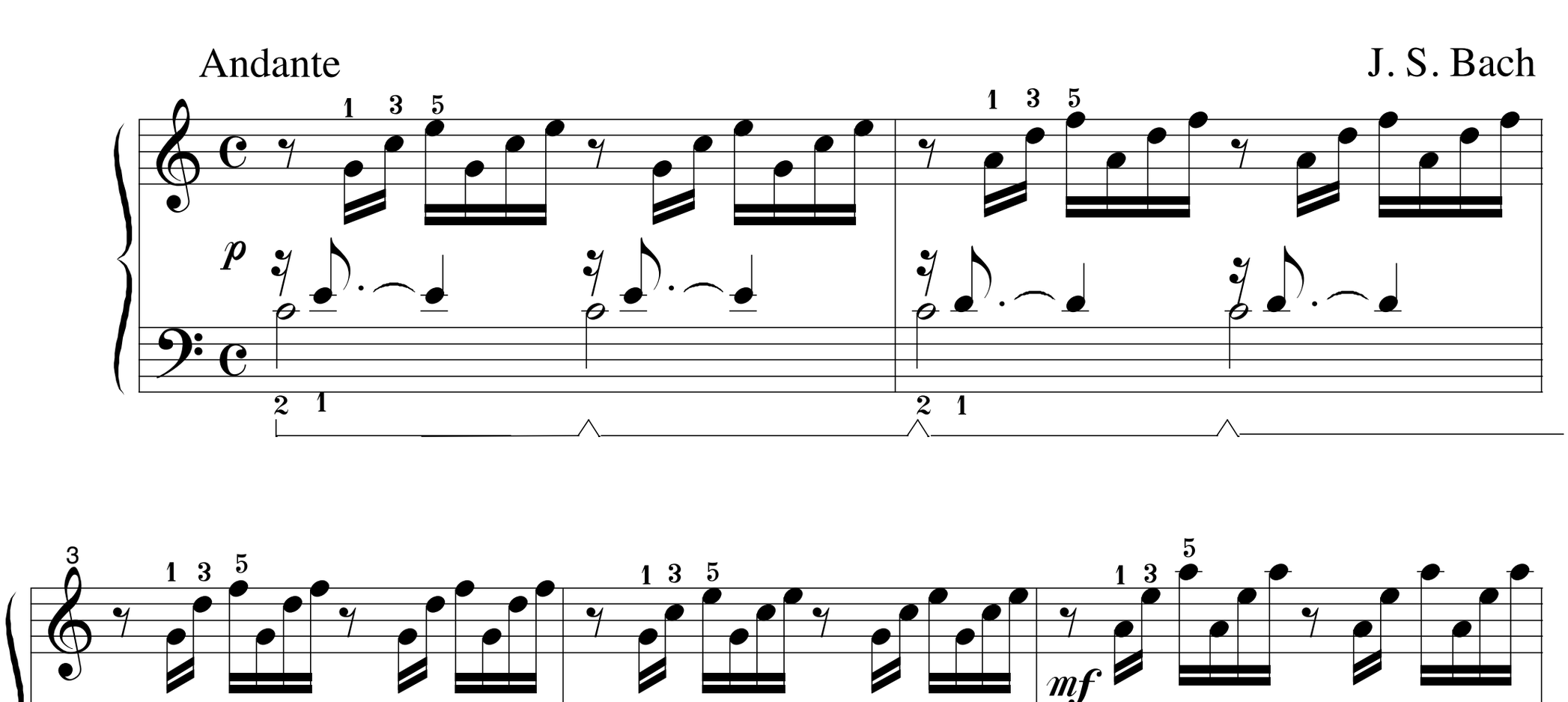
Methodology

Segmentation - Fully Systematic

Example:

Prelude in C

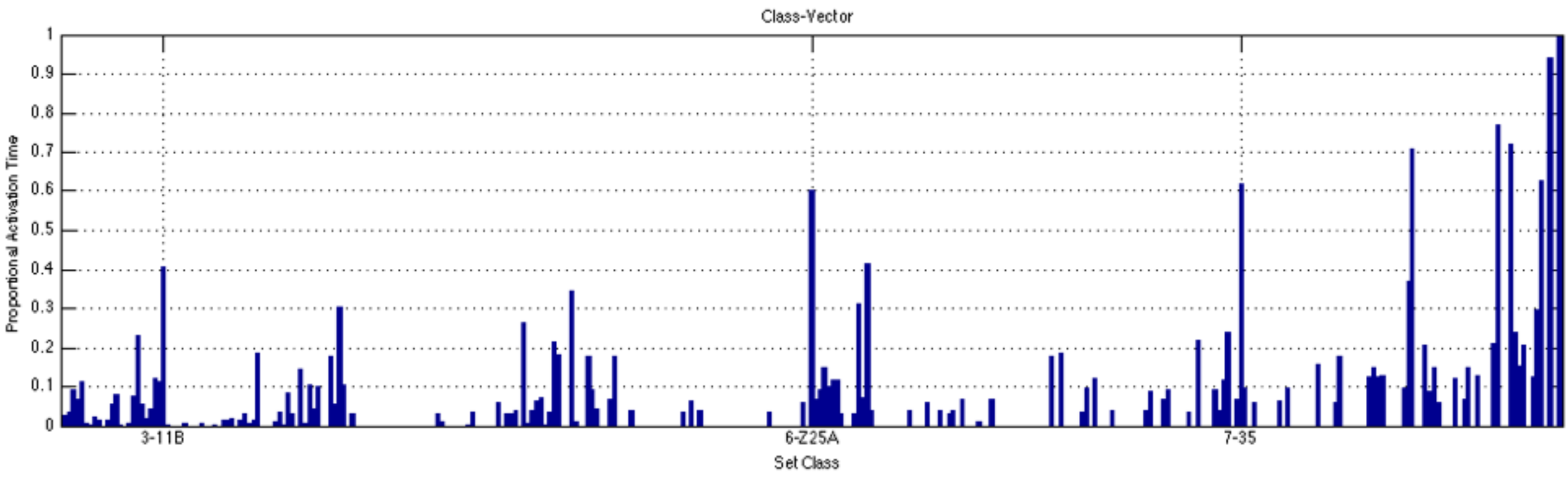
from *The Well Tempered Clavier*, Book One



Methodology

Segmentation - Fully Systematic

- Class Vector



3/4 note chords Cadences Scales

Methodology

Segmentation - Sliding Window

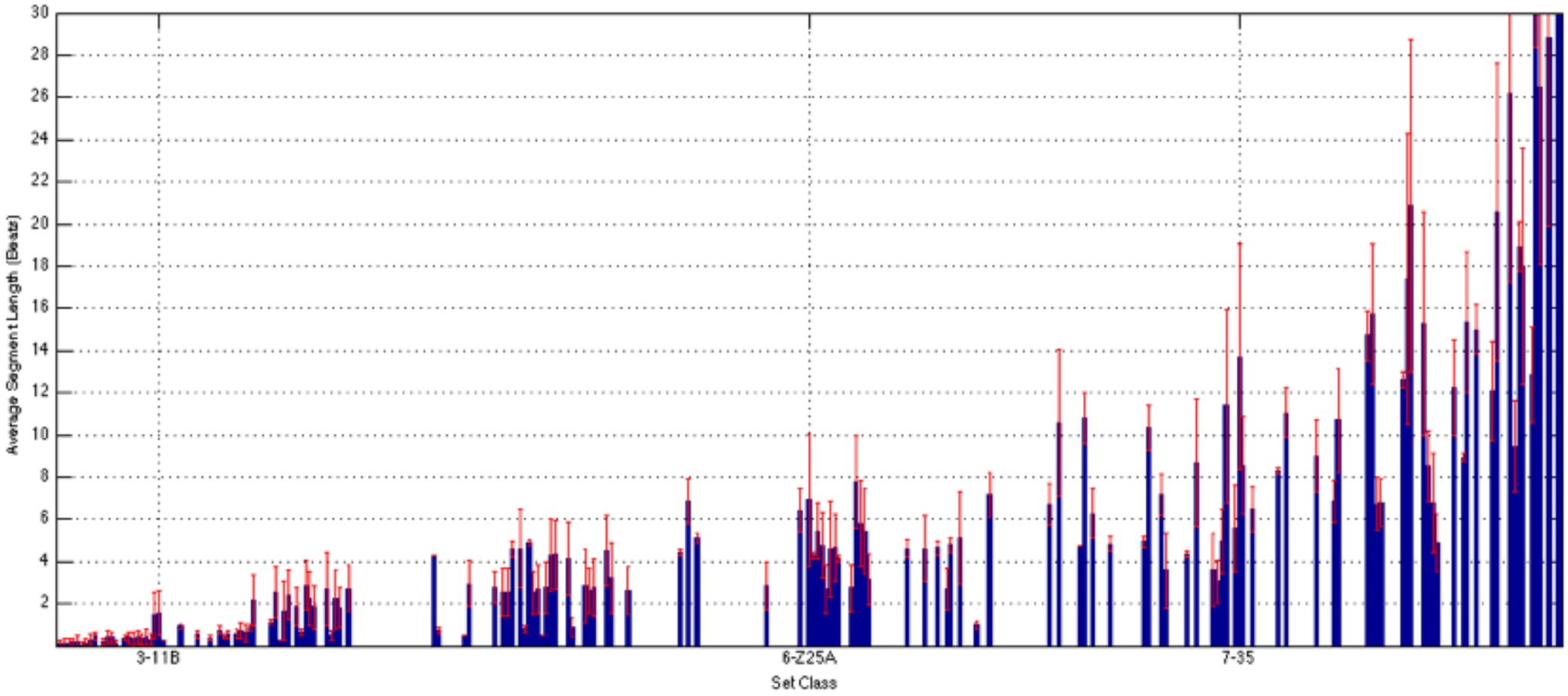
- Window and hop size selection
- What are the *sets of interest?*

	Chord	Set Class	Name
3 note chords	maj	{0,4,7}	3-11B
	min	{0,3,7}	3-11A
	dim	{0,3,6}	3-10
	aug	{0,4,8}	3-12
	sus4	{0,2,7}	3-9
	sus2	{0,2,7}	3-9
4 note chords	maj7	{0,1,5,8}	4-20
	min7	{0,3,5,8}	4-26
	hdim7	{0,2,5,8}	4-27A
	7	{0,3,6,8}	4-27B
	dim7	{0,3,6,9}	4-28
	min(7)	{0,1,4,8}	4-19A
	aug(7)	{0,3,4,8}	4-19B
	maj(9)	{0,2,4,7}	4-22A
	min(9)	{0,2,3,7}	4-14A
	maj6	{0,3,5,8}	4-26
	min6	{0,1,5,8}	4-20
	sus4(7)	{0,2,6,7}	4-16B
	sus4(b7)	{0,2,5,7}	4-23
5 note chords	9	{0,2,4,6,9}	5-34
	maj9	{0,1,3,5,8}	5-27A
	min9	{0,3,5,7,8}	5-27B
Cadences	V-I/IV-I	{0,1,3,5,8}	5-27A
	V7-I	{0,1,3,5,6,8}	6-Z25A
	V-IV	{0,2,4,6,7,9}	6-33B
Scales	Pentatonic	{0,2,4,7,9}	5-35
	Wholetone	{0,2,4,6,8,10}	6-35
	Diatonic	{0,1,3,5,6,8,10}	7-35
	Octatonic	{0,1,3,4,6,7,9,10}	8-28

Methodology

Segmentation - Sliding Window

- Average segment length vs set class

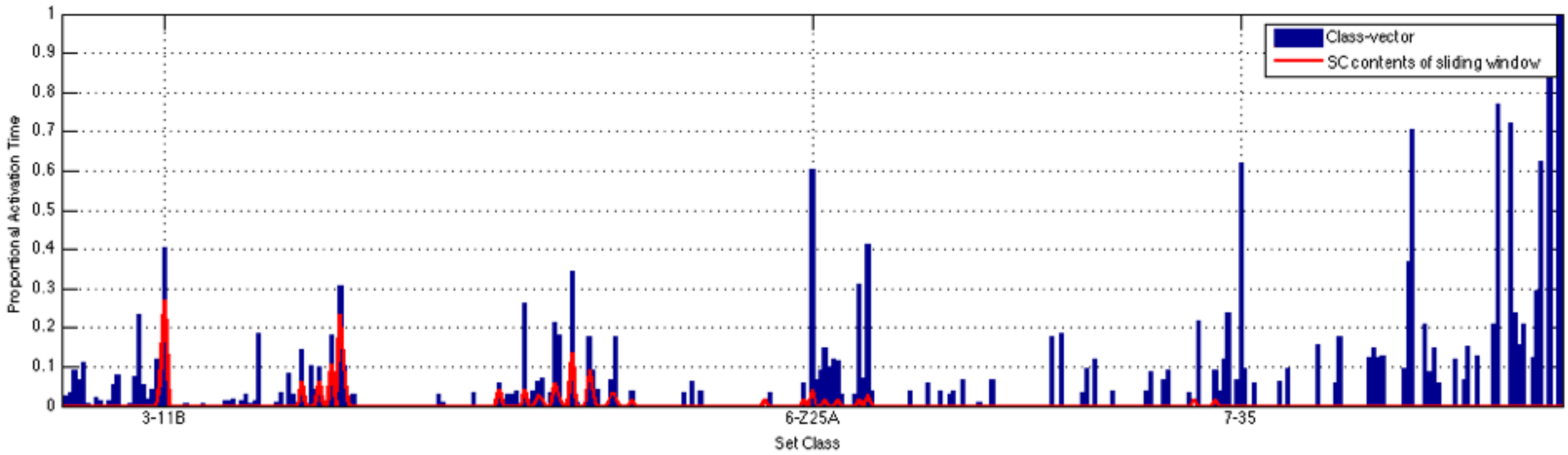


Methodology

Segmentation - Sliding Window

- Class vector + sliding window contents

(Window = 2 beats, hop = 1 beat)



Methodology

Representation

3 representation techniques:

1. Distance plot
2. Autocorrelation
3. Self-similarity matrix

Methodology

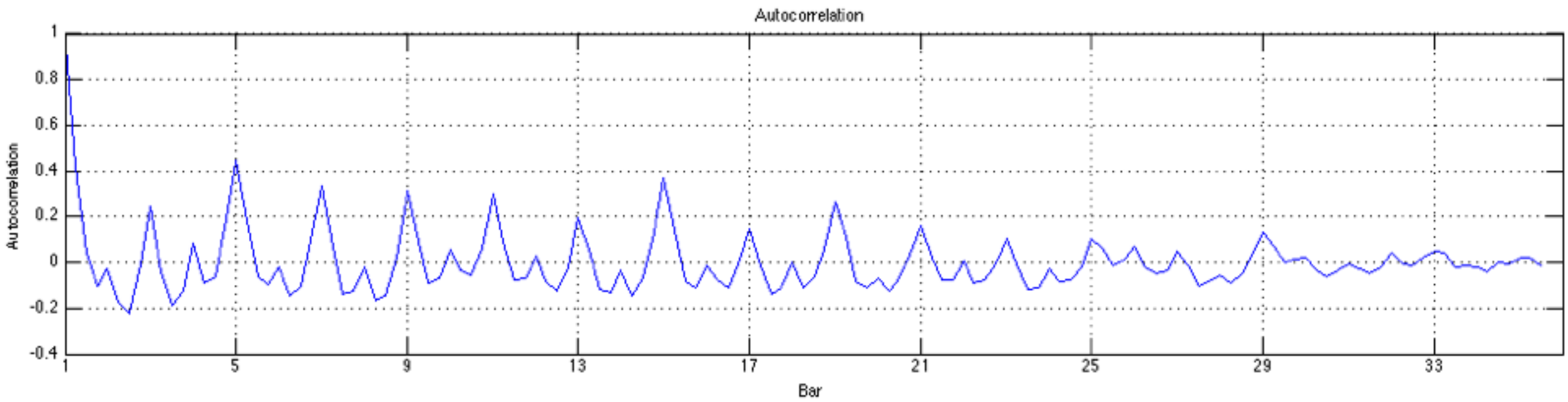
Representation - Distance Plot

- Represents tonal change in time with respect to comparison set
- Comparison set selection (3-11B)

Methodology

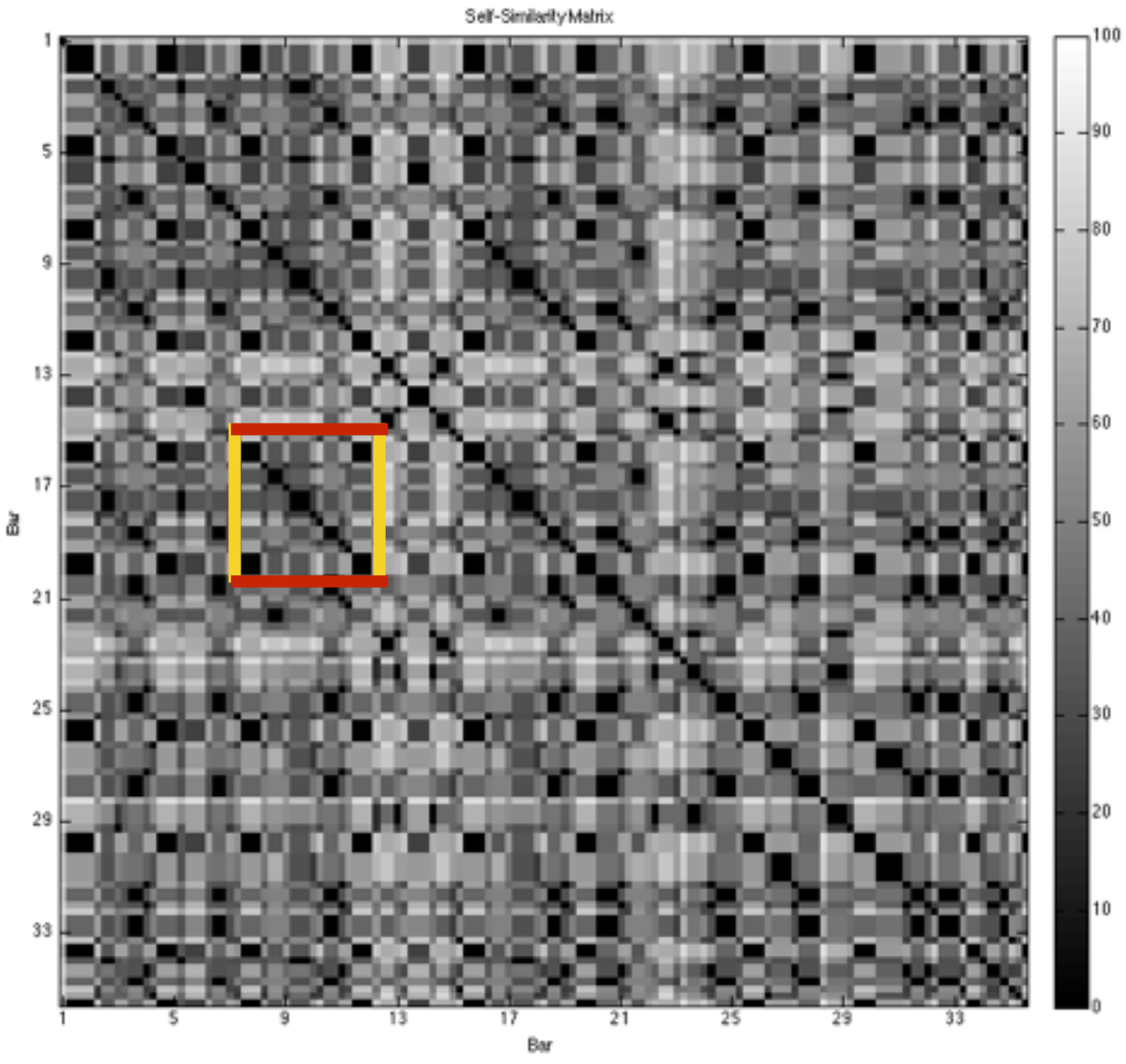
Representation - Autocorrelation

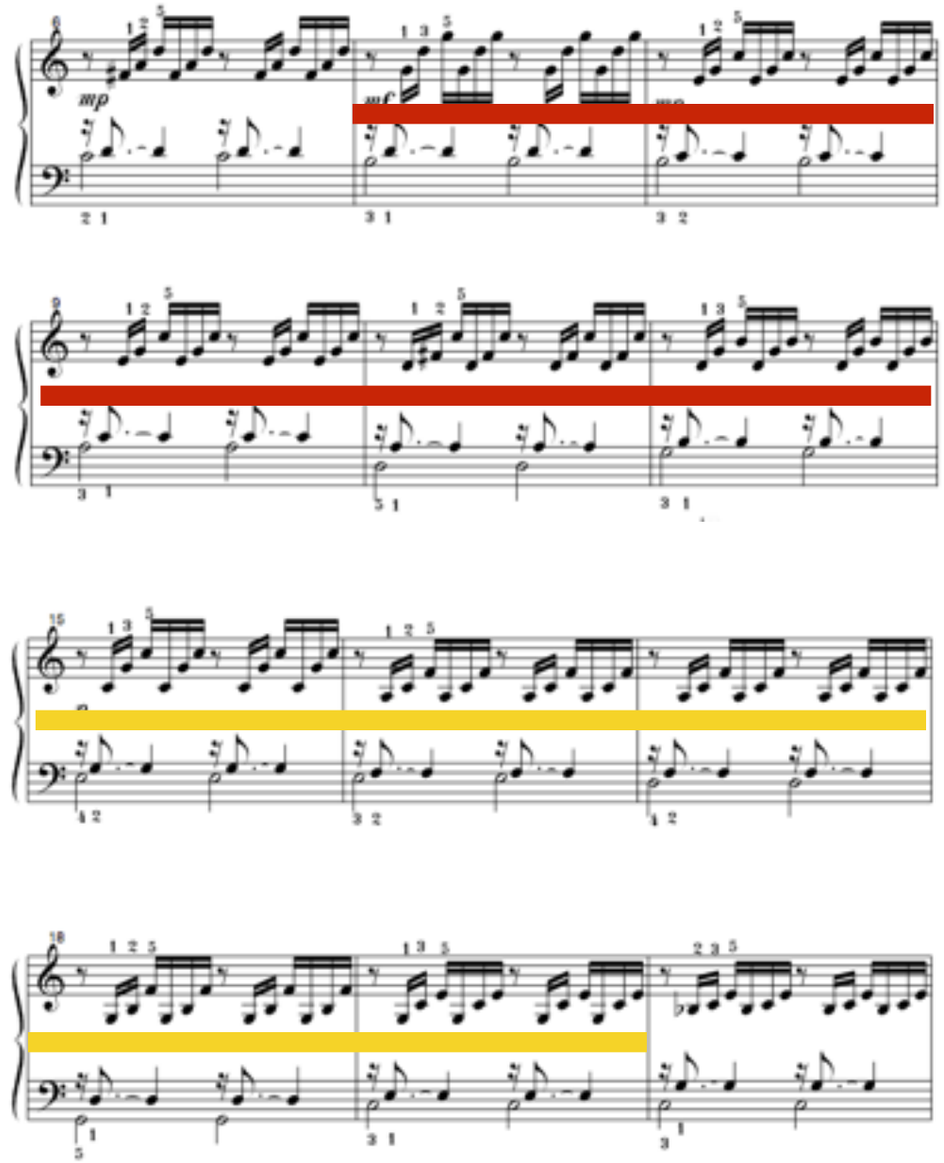
- Autocorrelation of distance plot
- Peaks represent recurring patterns



Methodology

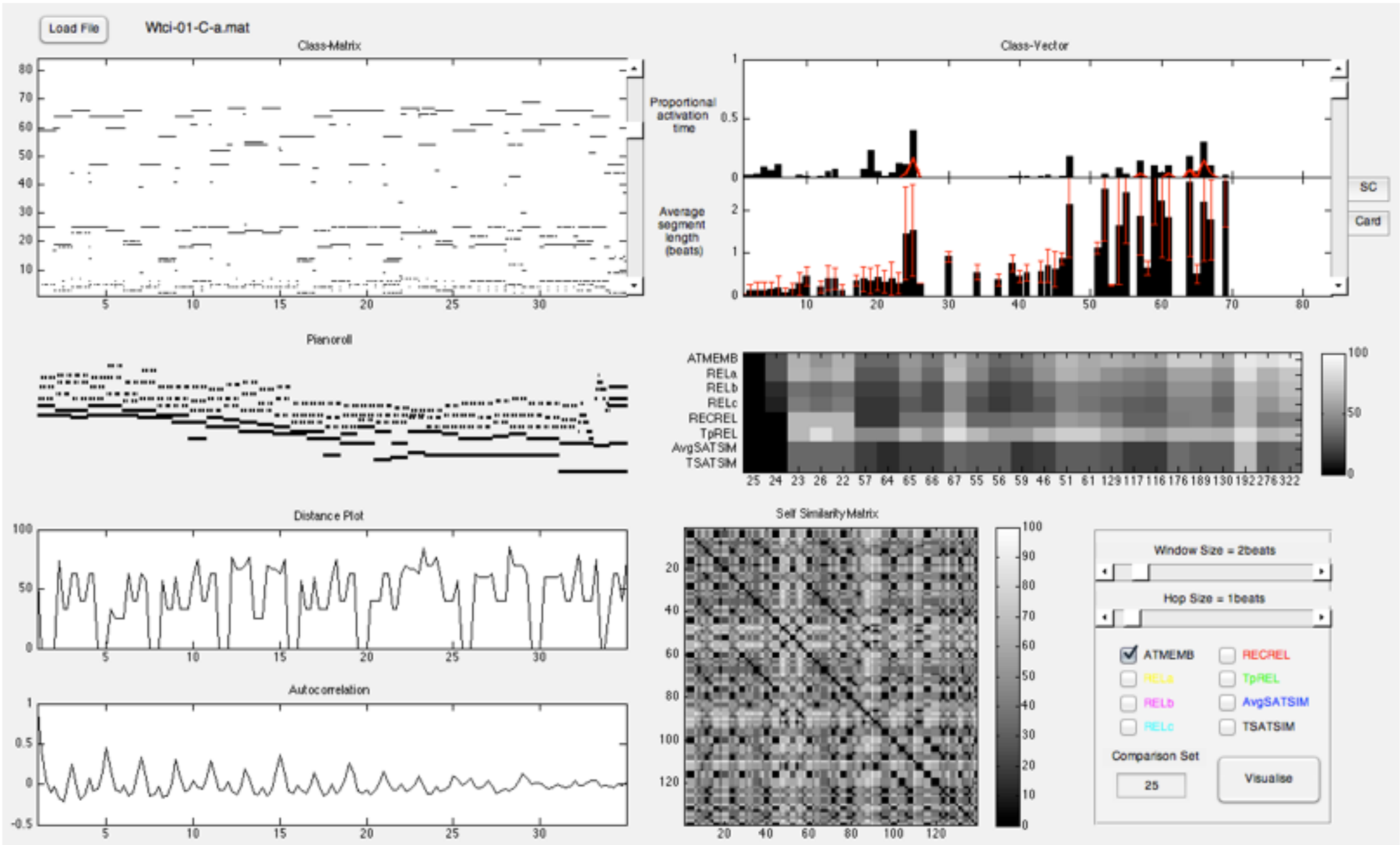
Representation - Self-Similarity Matrix





Methodology

Representation - Analysis Tool



Conclusions

Conclusions

- Set class tonal analysis
- Analysis Outcomes

Contribution

- Similarity measure survey
- Analysis Tool

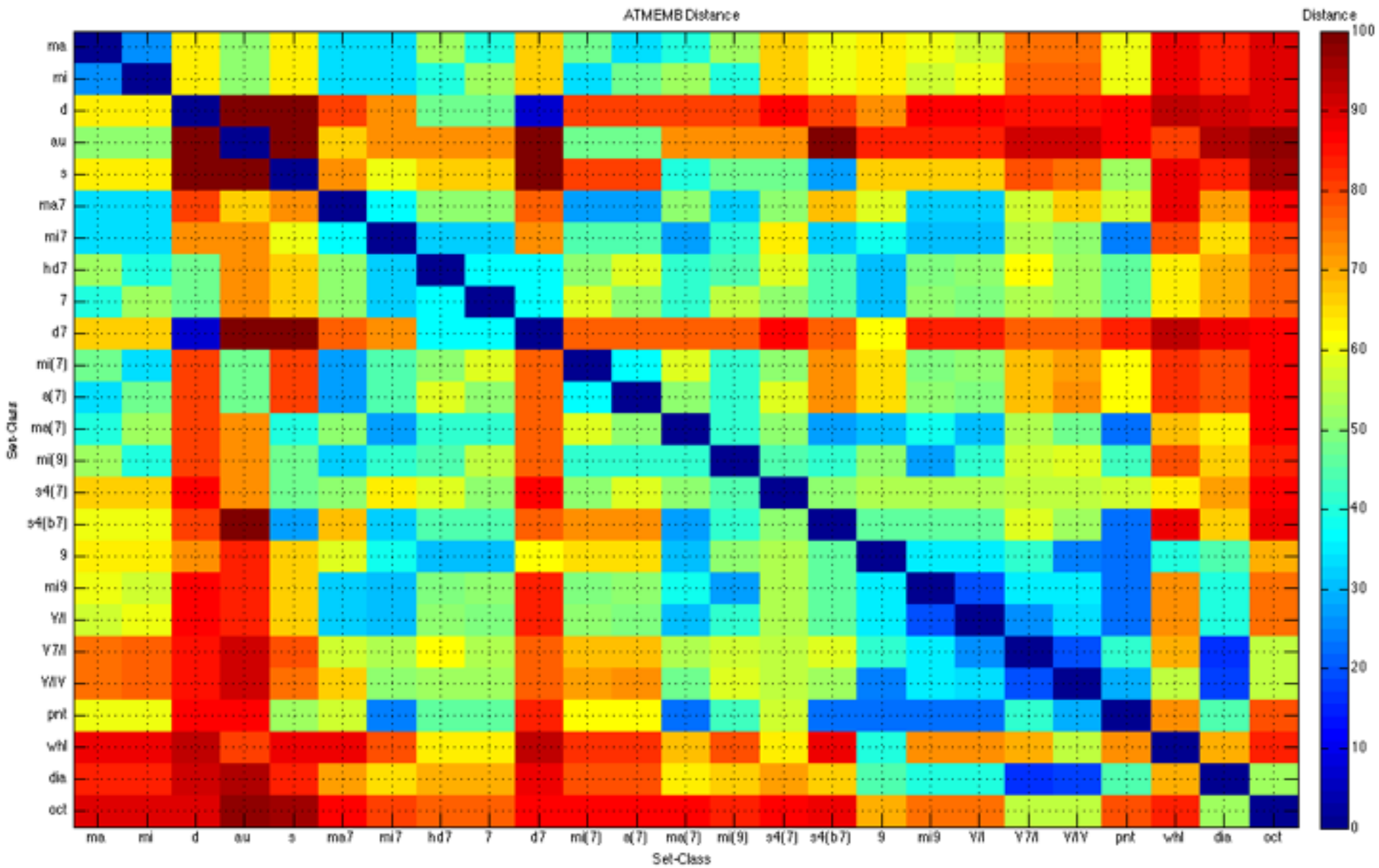
Future Work

- Pending Work
  - Comprehensive explanation of parameter selection
- Future Work
  - Set class based feature vectors

Questions?

Methodology

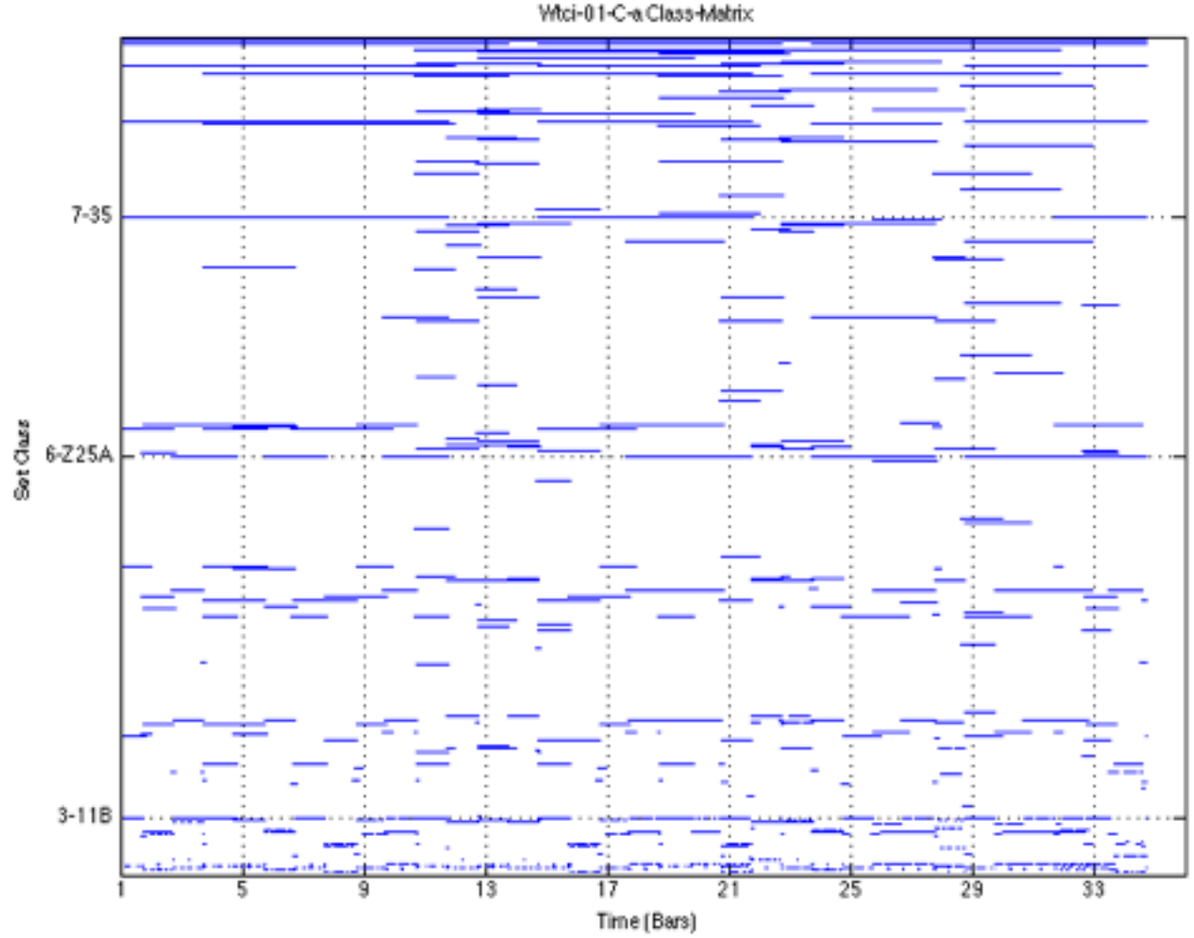
Set Class Similarity Measures - Survey



Methodology

Segmentation - Fully Systematic

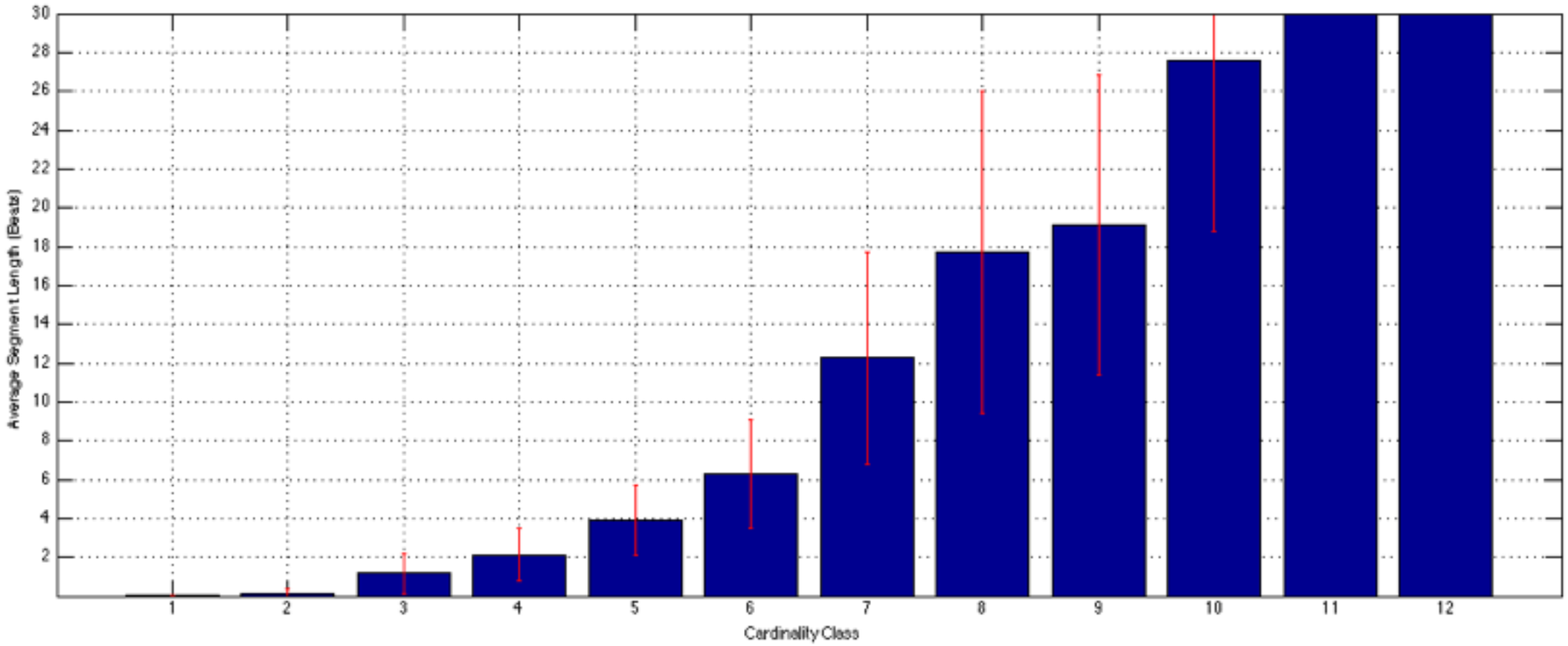
- Class Matrix



Methodology

Segmentation - Sliding Window

- Average segment length vs cardinality



Representation

Analysis Tool - Preliminary Findings

- Sets of interest
  - 6-Z25A / 5-27A
  - 7-35
  - 8-23
- Measures
  - ATMEMB/REL
  - TpREL
  - AvgSATSIM/TSATSIM