SCORE INFORMED TONIC IDENTIFICATION FOR MAKAM MUSIC OF TURKEY

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compmusic

Introduction - Tonic

- Tonic ~ tonal center of a melodic structure
- The concept of tonic is not unique
    - It changes with the music culture, historical context etc.
    - Identification requires knowledge-based methods
- The pitch of the tonic is needed for:
    - Tuning/intonation analysis
    - Melody analysis
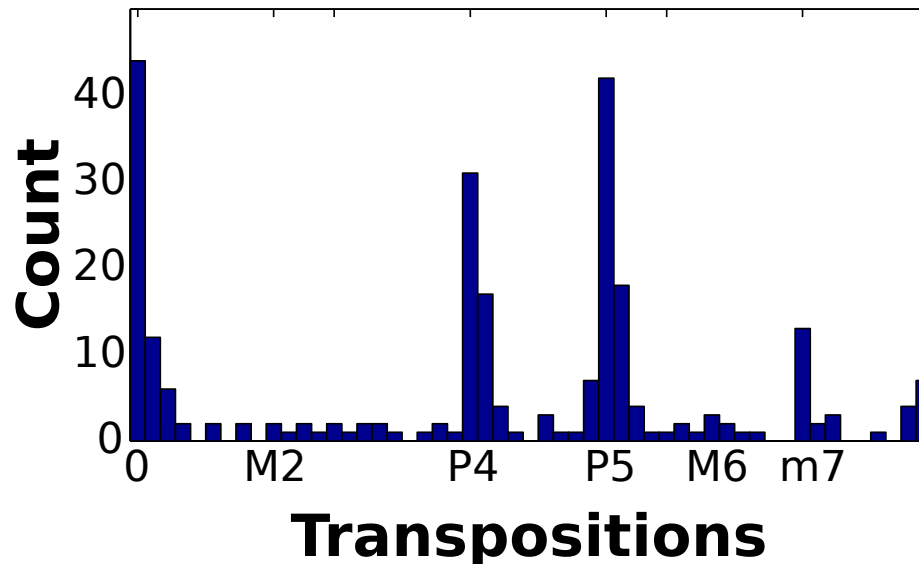   - Mode recognition
    - Music cognition
    - …

Outline

- Introduction
- Makam Music of Turkey (MMT)
- State of the Art
- Score Informed Tonic Identification for MMT
  - Distribution Matching
  - Section Linking
- Results & Discussion
- Future Work

Makam Music of Turkey

- More than 12 notes per octave

- Makams are modal structures

  - **Karar** (final) note: **Synonymous to tonic**

- There is no standard tuning ~~(A4 = 440Hz)~~

- Pitch transpositions are common

  - Due to vocal/instrumental range or personal preferences

Makam Music of Turkey

- Extended Western notation
- Scores notate the basic melody lines

- Performances and scores differ substantially
  - Heterophony
  - Embellishments are not notated
  - Tuning/intonation

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Tonic Identification Methods
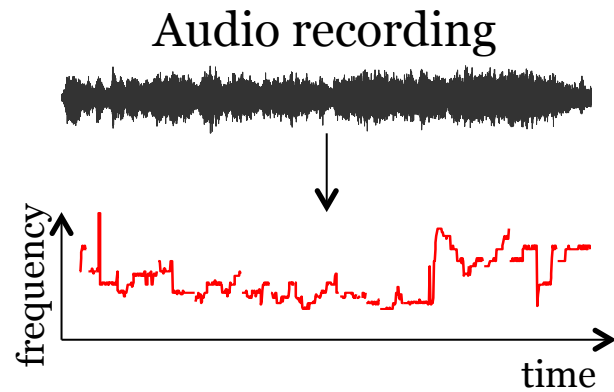
Audio recording
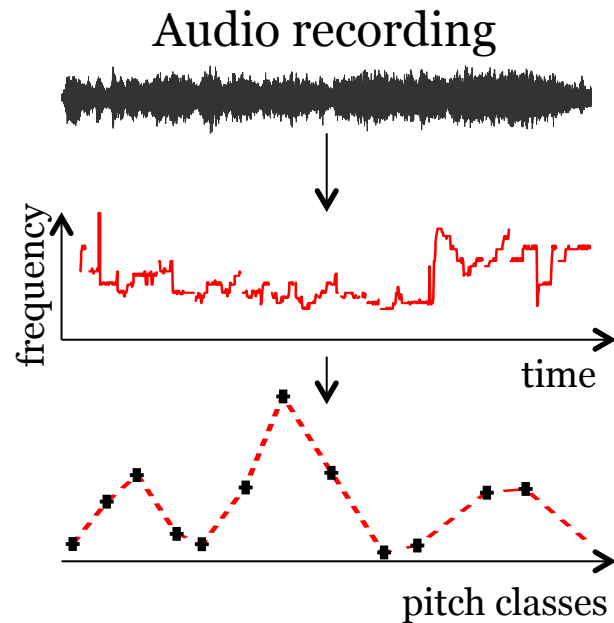
Tonic Identification Methods

Audio recording

The **makam** is known.

Tonic Identification Methods

Audio recording

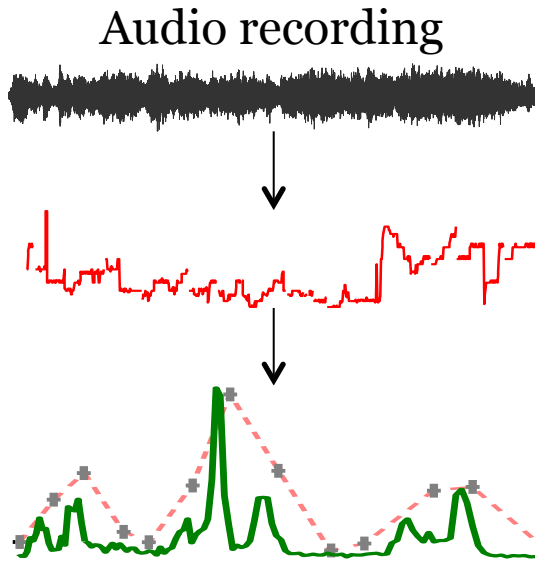

Prominent melody
(Better for
melody-dominant
musics)

Tonic Identification Methods

Audio recording

Pitch-class Distribution*
(octave-wrapped)

pitch classes

* D.Temperley and E.W.Marvin. Pitch-class distribution and the identification of key. Music Perception: An Interdisciplinary Journal, 25(3):193–212, 2008.
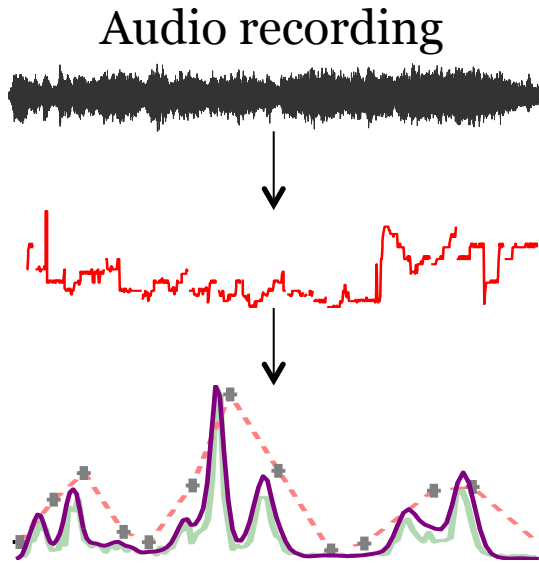
Tonic Identification Methods

Audio recording

Fine-grained distributions*
(better for musics where
intonation is crucial)

* Ali Cenk Gedik and Barış Bozkurt. Pitch-frequency histogram-based music information retrieval for Turkish music. Signal Processing, 90(4):1049–1063, 2010.
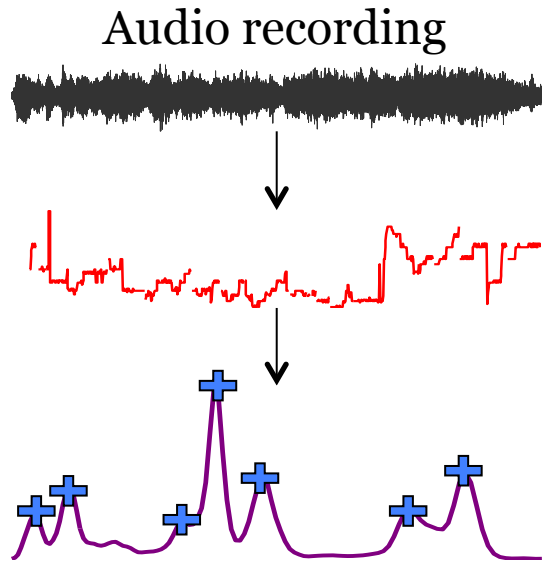
Tonic Identification Methods

Audio recording

Smoothed distributions*
(easier processing)

* P.Chordia and S.Şentürk. Joint recognition of raag and tonic in North Indian music. Computer Music Journal, 37(3):82–98, 2013.
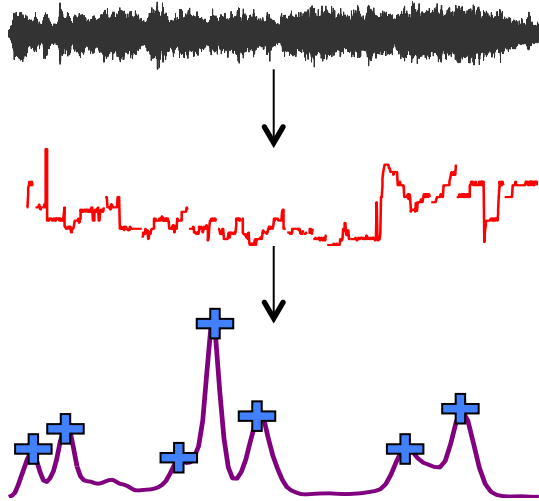
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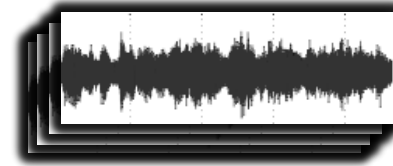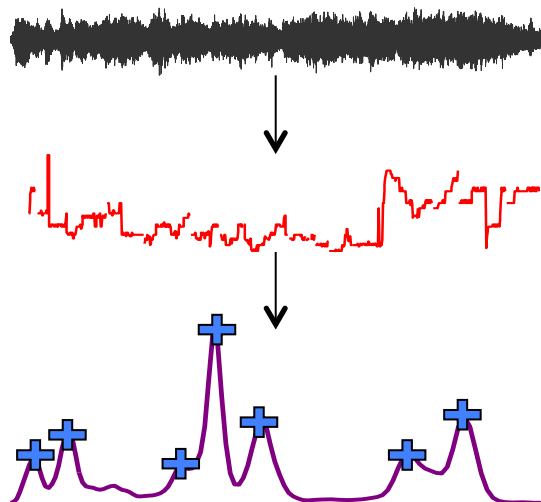
Tonic Identification Methods

Audio recording

Collection of audio recordings
of the **same makam**
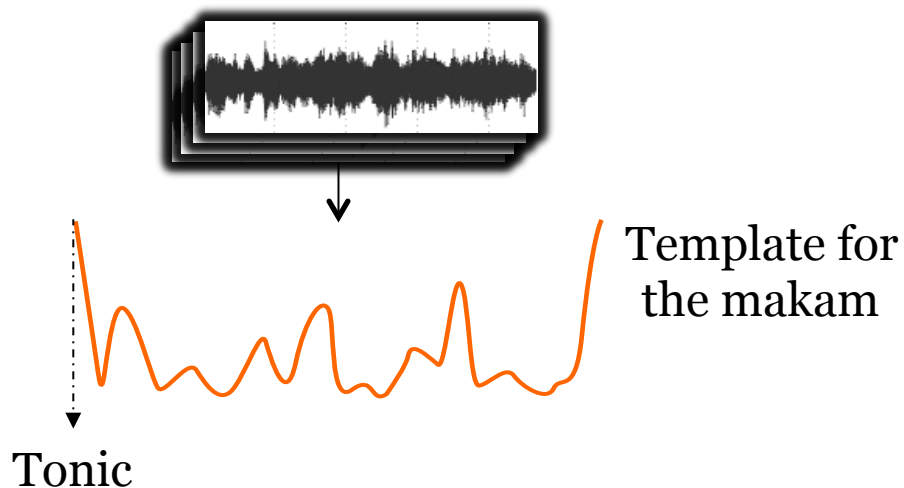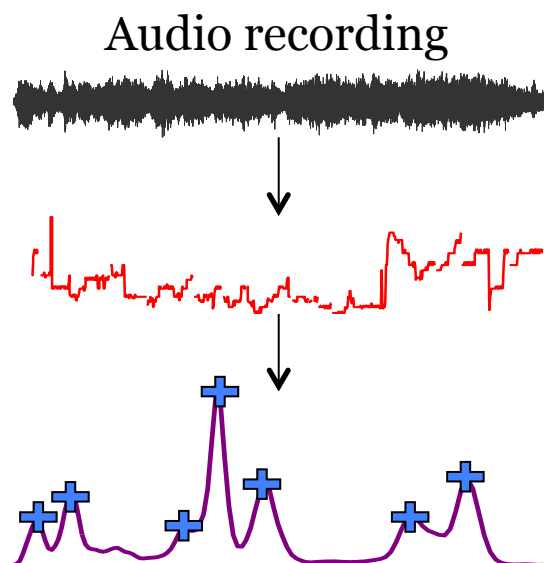and with **annotated tonics**
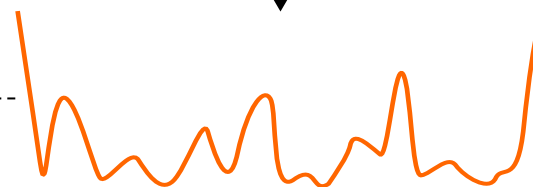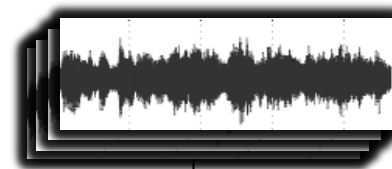
Tonic Identification Methods

Audio recording

Collection of audio recordings
of the same makam
and with annotated tonics

Template for
the makam

Tonic

Tonic Identification Methods

Audio recording

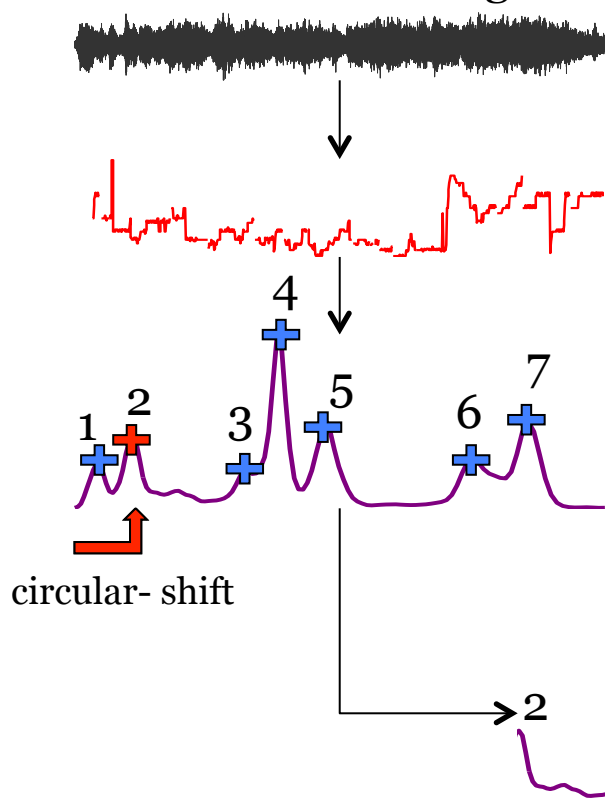Collection of audio recordings
of the same makam
and with annotated tonics

Template for
the makam

The same makam
The distributions should be similar

Tonic Identification Methods

Tonic Identification Methods

Audio recording

Collection of audio recordings
of the same makam
and with annotated tonics

4

2
1
3
5
6
7

circular- shift

and compare!
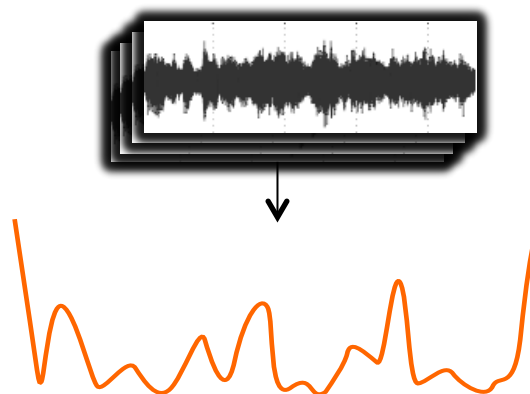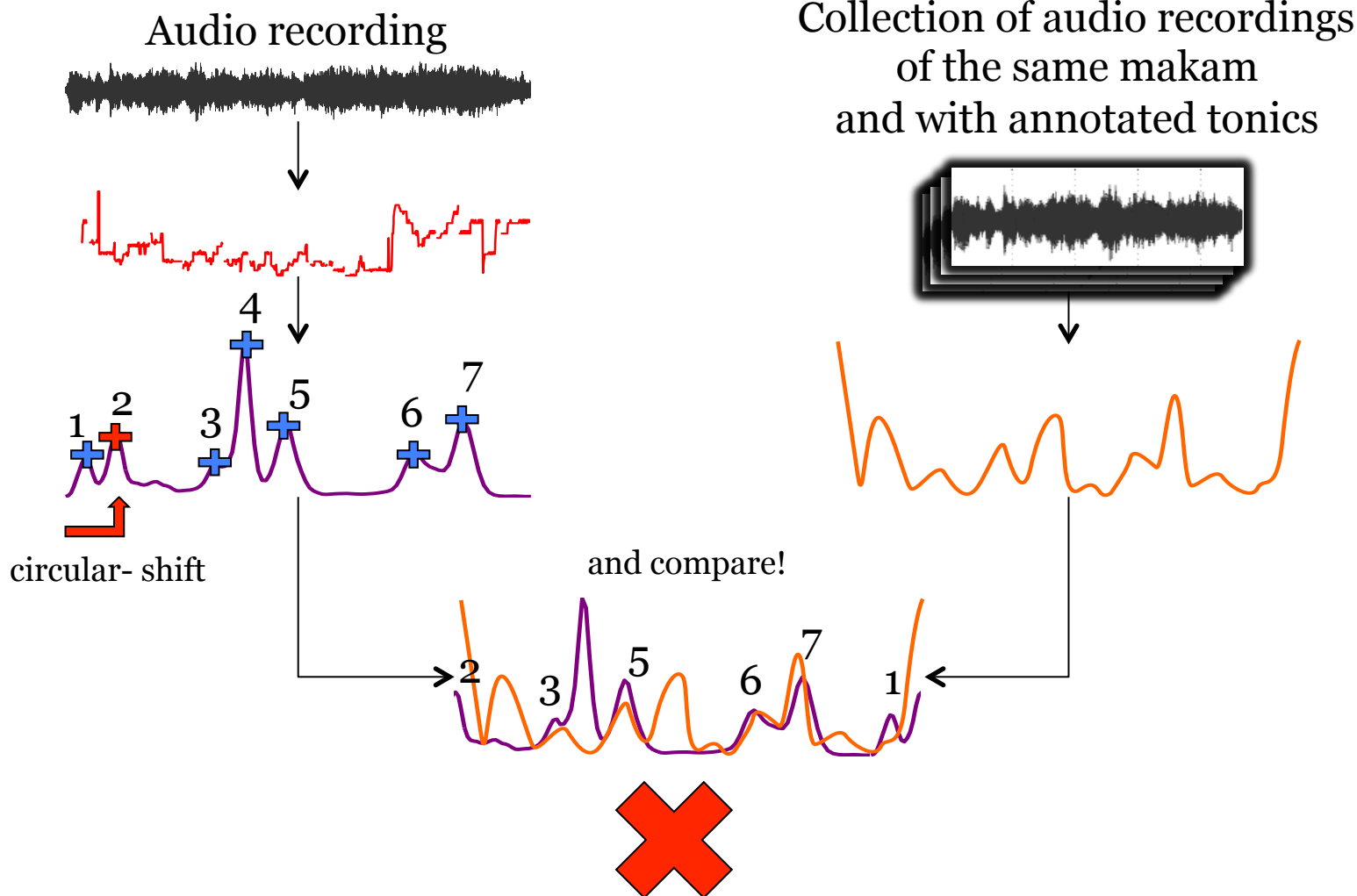
2
3
5
6
7
1

Tonic Identification Methods

Audio recording

Collection of audio recordings
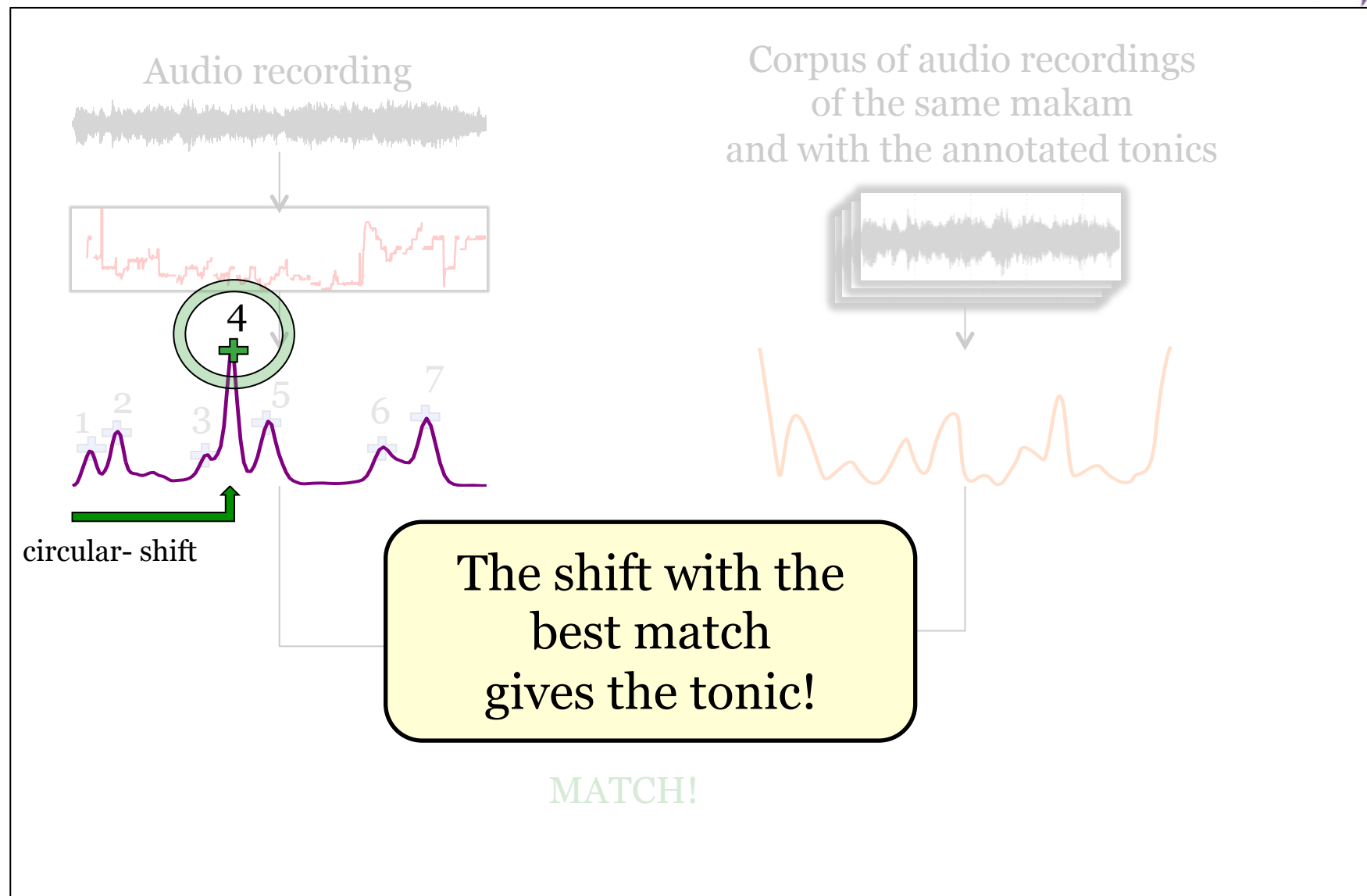of the same makam
and with annotated tonics

4

1 2 3 5 6 7

circular- shift

and compare!

4 5 6 7 1 2 3

MATCH!

Tonic Identification Methods

Audio recording

Corpus of audio recordings
of the same makam
and with the annotated tonics

circular- shift

4

1 2 3 5 6 7

The shift with the
best match
gives the tonic!

MATCH!

Problems

- Quality/representativeness of the template
  - What if we don't have enough recordings for training?
  - What if the training recordings modulate to different makams?
- Confusion occurs when the occurrence of tonic pitch class and some other pitch classes are comparable
  - e.g. two or more shifts produce close results?
- Tonic identification in unsegmented audio recordings

improvisation   target piece   piece in a different makam
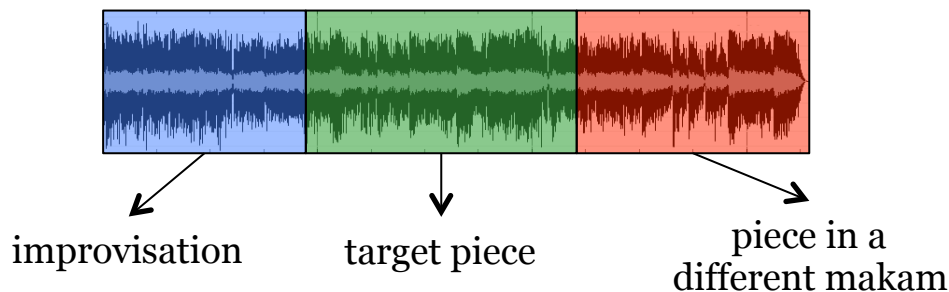
The resulting distribution could be substantially different from the template!

Score Informed Tonic Identification

- Can we compare with a better reference?
- Similarity in the **composition level**
  - We can gather audio recordings of the same composition
  - OR a **score** of the composition, which is easier to process

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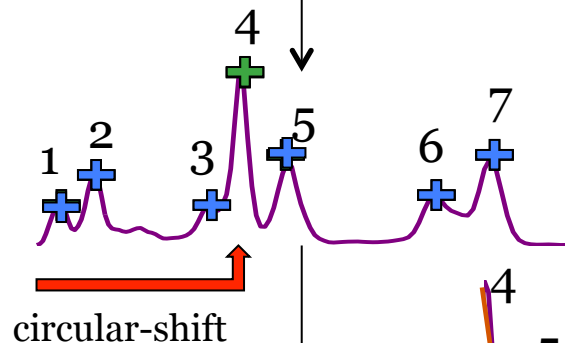- Results & Discussion
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Distribution Matching

Audio recording of a composition
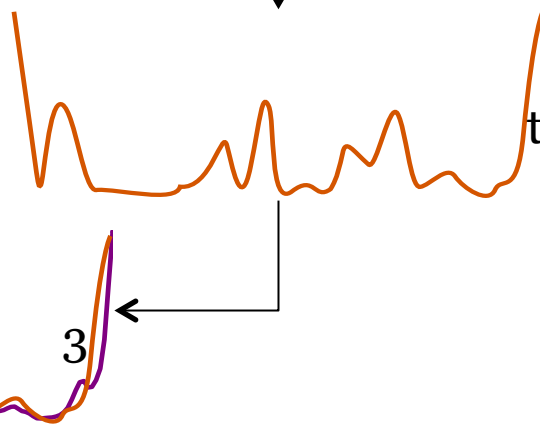

Score of the same composition

Synthetic prominent pitch

4

2

1   3   5   7
         6

circular-shift

and compare!

Template for the composition

4
5   7
6   1 2   3

MATCH!

Better, but complex makams and unsegmented audio might still be a problem.
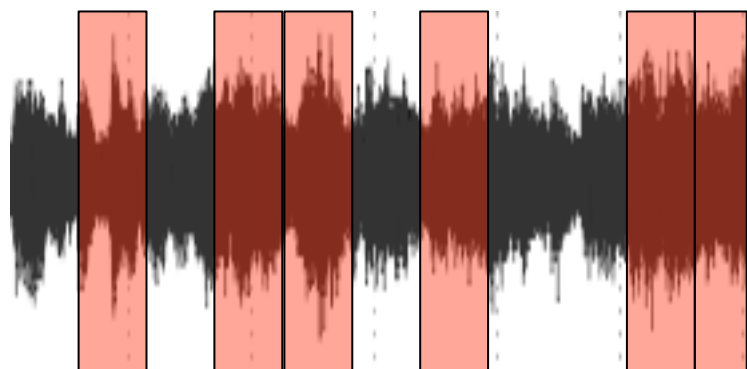
We can use temporal information given in the score!

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Repetitive Section Linking

The repetitive section is annotated

Fragment Linking

Tonic symbol = 0

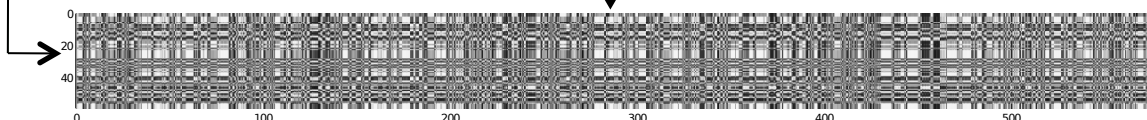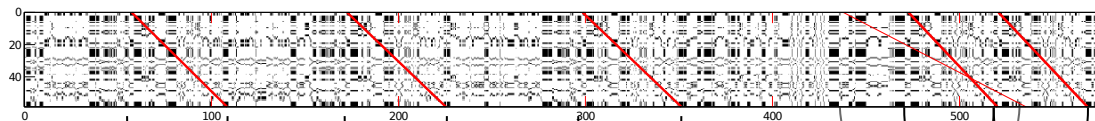Tonic pitch = 0

Tonic Identification

Essentia* implementation of **Melodia+**
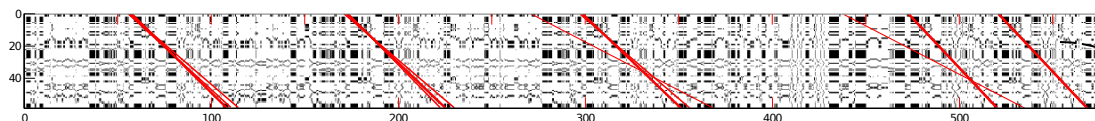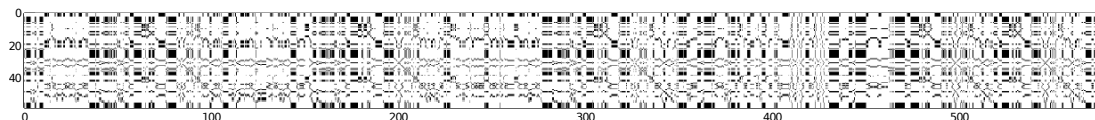
Hough Transform*

w=.67   w=.66   w=.67   w=.71 w=.71

w=.21

Score Informed Tonic Identification
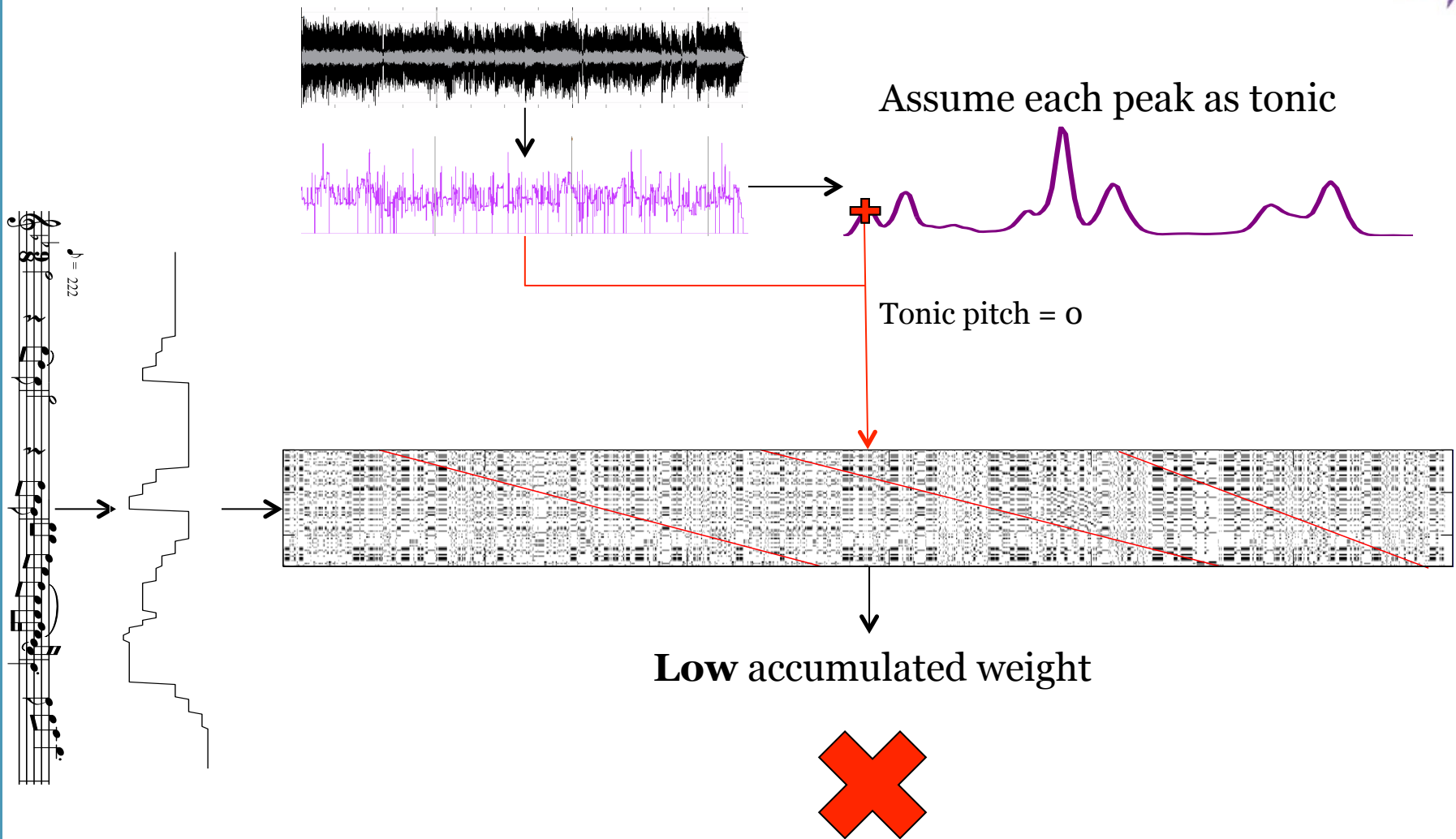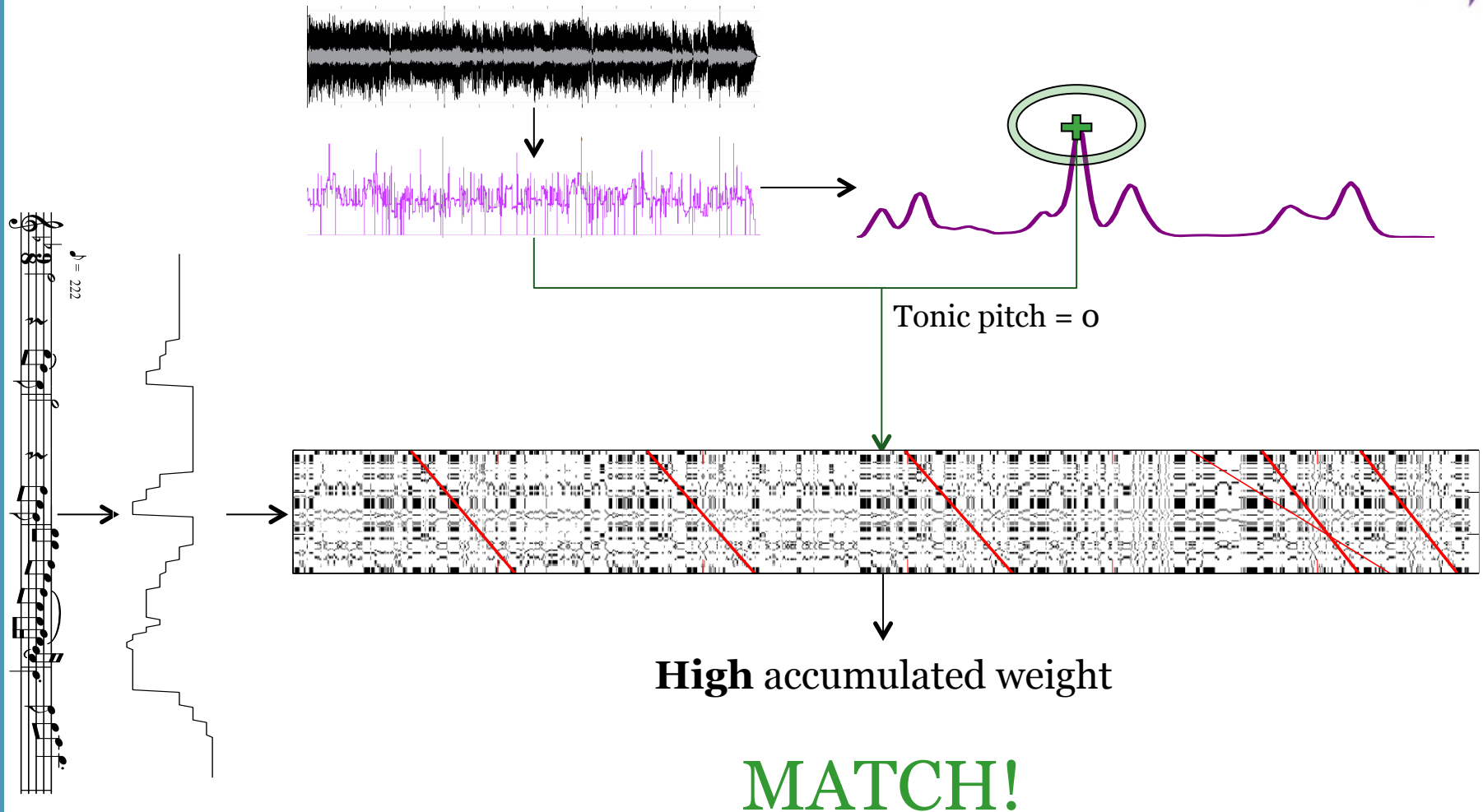
Assume each peak as tonic

Tonic pitch = 0

Low accumulated weight

Score Informed Tonic Identification

Tonic pitch = 0

High accumulated weight

MATCH!

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Results and Discussions

- 257 recordings associated with 57 compositions.

	Makam Toolbox (Makam Template from Audio)	Distribution Matching (Composition Template from the Score)	Repetitive Section Linking (Repetitive Score Fragment)
#Fails	62 / 257	13 / 257	1 / 257

- Adding score information improves tonic identification

- Composition templates are more effective than makam templates

- Distribution matching still makes mistakes
  - Complex makams, non-segmented recordings

- Repetitive section linking effectively solves the tonic identification problem!

* Ali Cenk Gedik and Barış Bozkurt. Pitch-frequency histogram-based music information retrieval for Turkish music. Signal Processing, 90(4):1049–1063, 2010.

Future Work

- Test on non-annotated scores
  - Initial tests show arbitrary fragments shorter than 8 seconds can be linked successfully

- Version Detection
  - Tonic identification followed by section linking

- Audio-Score Alignment

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