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A Multi-Version Approach for Transferring Measure Annotations Between Music Recordings

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Abstract

In this work, we address the task of transferring measure annotations between different recordings (versions) of a musical composition. Such annotations are useful for analyzing, linking, and navigating in multi-version scenarios of classical music. Given a version with manually annotated time positions, such as the beginning of musical measures, we transfer these annotations to musically corresponding positions in another version using synchronization techniques. As one contribution, we investigate the transfer process by exploiting additional versions. In a large-scale music scenario dealing with Richard Wagner's *Der Ring des Nibelungen*, we show that this multi-version analysis reveals musical passages that are problematic for synchronization. As another contribution, we introduce a late-fusion approach that improves the measure transfer when having several annotated versions.

Data Set

Richard Wagner's Cycle *Der Ring des Nibelungen*

Das Rheingold	*Die Walküre*	*Siegfried*	*Götterdämmerung*
WWV 86 A	WWV 86 B	WWV 86 C	WWV 86 D
3897 measures	5320 measures	6682 measures	6040 measures

- Four music dramas with 21952 measure boundary positions
- Six versions, 85 hours of music in total
- Three versions with manual measure annotations [3]

No.	Conductor	Recording year	hh:mm:ss
V_1	Barenboim	1991–92	14:54:55
V_2	Haitink	1988–91	14:27:10
V_3	Karajan	1967–70	14:58:08
V_4	Bodanzky/Leinsdorf	1936–41	12:32:20
V_5	Boulez	1980–81	13:44:38
V_6	Solti	1958–65	14:36:58

Detecting Synchronization Problems

Beginning of music

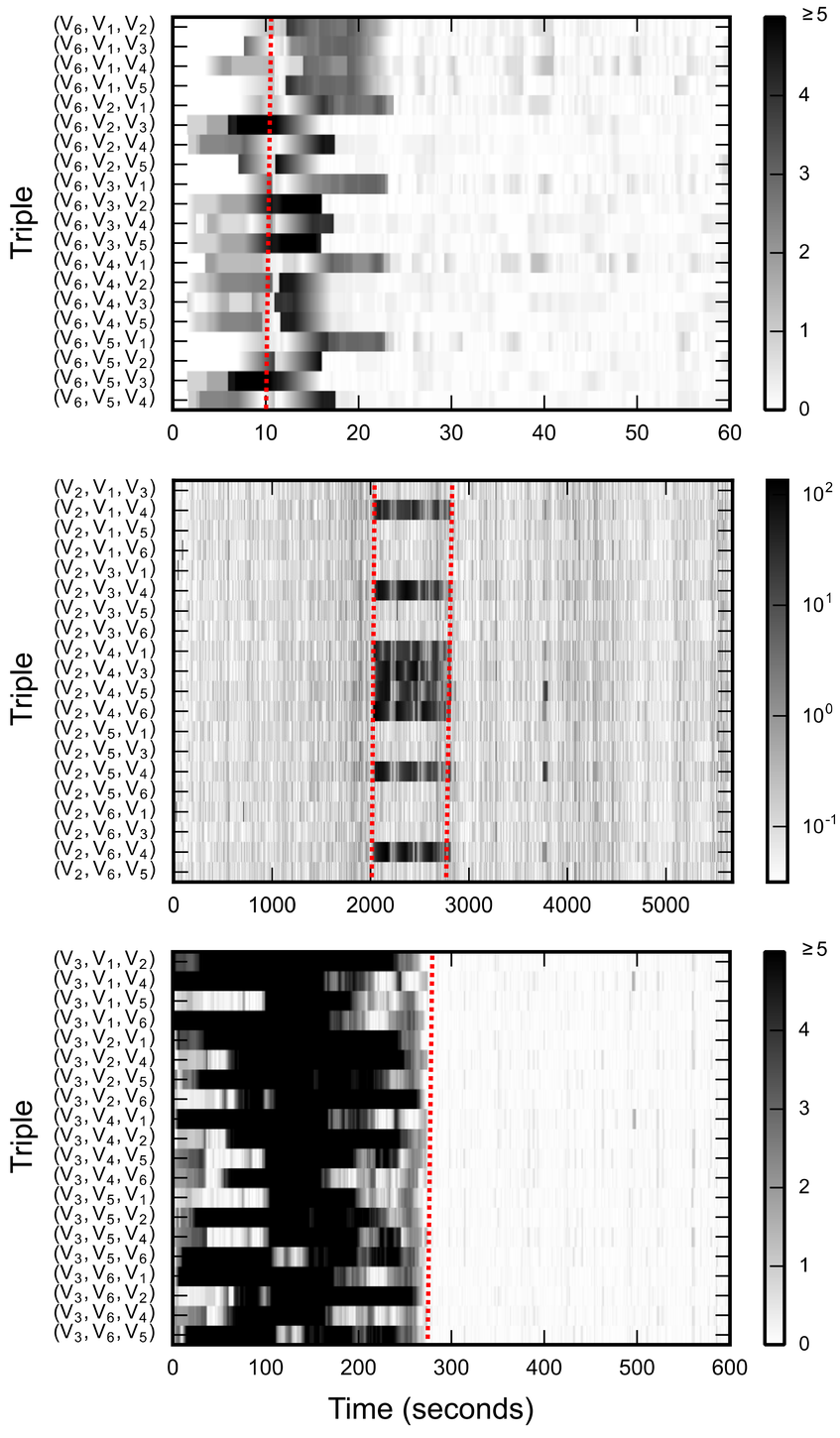
- Example: beginning of *Siegfried*, 2nd act
- Alignment unreliable for beginning of music (varying lengths of silence and very soft beginning in ***pp***)

Structural differences

- Example: complete 2nd act of *Die Walküre*
- Abridgement in V_4

Harmonic homogeneity

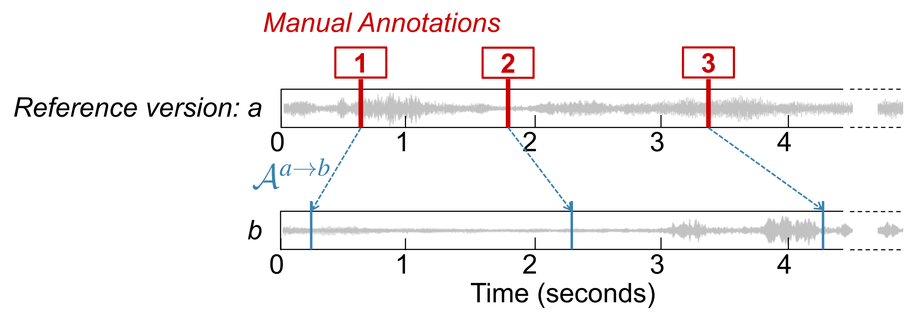
- Example: beginning of *Das Rheingold*
- Prelude: 136 measures with constant harmony, E♭ major triad



Measure Annotation Transfer

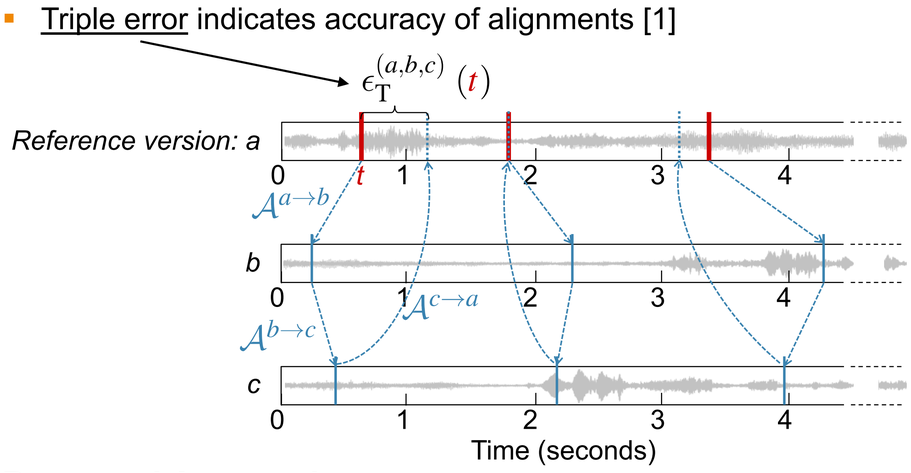
Transferring annotations with music alignments

- DTW-based synchronization with chroma and onset features
- Memory-efficient multi-scale procedure [2]
- Transfer of measure boundary positions using alignments



Triple error

- Triple error indicates accuracy of alignments [1]



Proposed Approach

- Scenario: more than one reference version available
- Compute triple errors from all reference versions
- Use alignment from reference version with smallest triple error for transfer

Evaluation of Measure Transfer

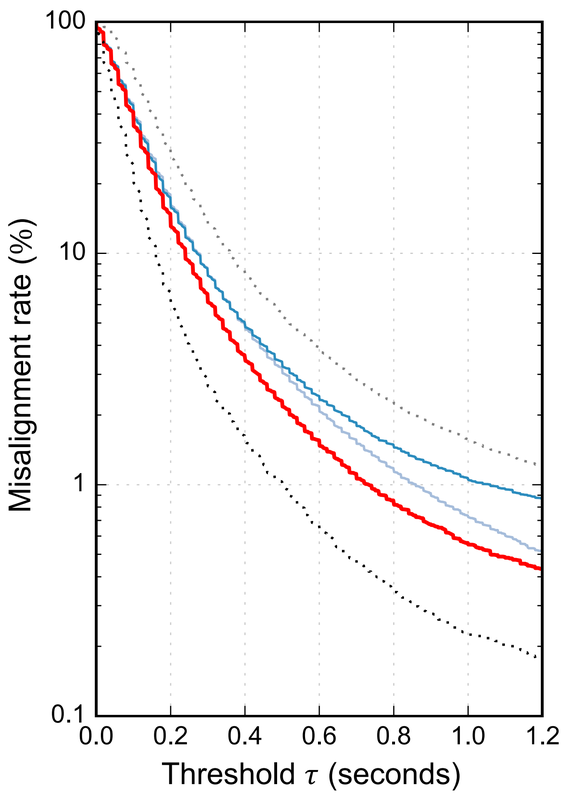
Proposed approach: using Triple-error-based voting strategy

Baseline 1: using alignment of version 1

Baseline 2: using alignment of version 2

Negative oracle: using alignment from version with highest ground truth error

Positive oracle: using alignment from version with smallest ground-truth error



Literature & Acknowledgments

[1] Prätzlich, T. and Müller, M., "Triple-Based Analysis of Music Alignments Without the Need of Ground-Truth Annotations," in Proc. of ICASSP, pp. 266–270, Shanghai, China, 2016.

[2] Prätzlich, T., Driedger, J., and Müller, M., "Memory-Restricted Multiscale Dynamic Time Warping," in Proc. of ICASSP, pp. 569–573, Shanghai, China, 2016.

[3] Weiß, C., Arifi-Müller, V., Prätzlich, T., Kleinertz, R., and Müller, M., "Analyzing Measure Annotations for Western Classical Music Recordings," in Proc. of ISMIR, pp. 517–523, New York, USA, 2016.

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