**Neo-Riemannian cycle detection with weighted finite-state transducers**

**Research goal**
Automatically identify and label neo-Riemannian cycles in a score of music.

**Motivations**
- Why automate what music theorists already do?
- Formalize the task with a rigorous definition of what constitutes a cycle.
- Understand musical judgments made during an analysis.
- Facilitate a comprehensive study.
- Facilitate a critique of neo-Riemannian theory.

**Neo-Riemannian theory**
- Harmonies are related by transformations, rather than common tonic.
- Basic transformations $P$ (parallel), $L$ (leading tone), $R$ (relative).
- Repeated patterns of transformations generate cycles of harmonies.

**Experiment**
- Data are analyses of four chamber pieces by Franz Schubert.
- Training parameters set from system of linear inequalities (empirical):
  - $B + D + D + X$ (privilege labeling over deletion of an observed cycle of $n$ triads with $i$ insertions and $m$ deletions).
  - $D = X$ (prevent arbitrary cycle extension).
- Evaluation scores from global string alignment on each region (calculate edit distance between the strings of triads labeled with transformations in ground truth and prediction).

**Results**
- Precision $= 0.18$, Recall $= 1.0$, where successful cycle retrieval is prediction of cycle in same aligned region as ground truth.
- Average cycle length 6.4 and alignment score 3.2.
- Handled cycles with many insertions better than many deletions.

**Conclusion**
- Natural language processing
- Neo-Riemannian music theory

**Noisy channel model**
- Hypothetical score $C / G$ (input is a harmonic analysis).
- Composition of weighted finite-state transducers.

**Cycles**
- Transduces chords to transformations (only portion corresponding to LR$^P$ transducer shown).

**Related work**
- For more details, please visit [http://www.jonathanbragg.com/ismir2011](http://www.jonathanbragg.com/ismir2011)

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