Counterpoint error-detection tools for optical music recognition of Renaissance polyphonic music

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Summary

- Part of a larger project to preserve and increase access to a set of Guatemalan colonial polyphonic choirbooks through digital images and symbolic scores
- Developed music information retrieval (MIR) pipeline to aid musicologists in making editions of mensural music sources by improving existing MIR tools and allowing for their interoperability
- Evaluated (for the first time) whether the use of counterpoint error-detection tools makes the correction process more efficient

Background

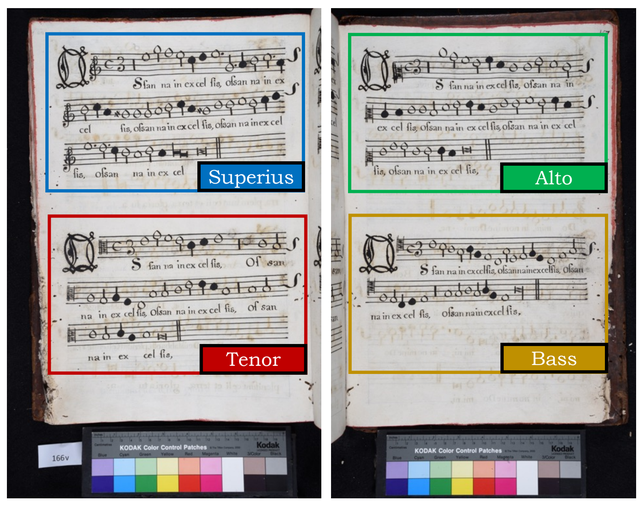
Renaissance polyphonic music is written in **mensural notation**

- Most mensural music is written in *separate parts* rather than in score
- To present the piece as a score, the transcriber needs expert knowledge in mensural notation, especially for triple meter, where the *duration* of notes is *context dependent*

Goal

Provide a method to semiautomatically transcribe digital images of mensural sources into symbolic scores—with the voices properly aligned—encoded in Mensural MEI files

Method: MIR Pipeline



STEP 1

Optical music recognition (OMR)

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Manual correction of results (i.e., recognized symbols)

Tool used: *MuRET*

OMR framework

STEP 2

Automatic mensural scoring up (or automatic mensural voice alignment)

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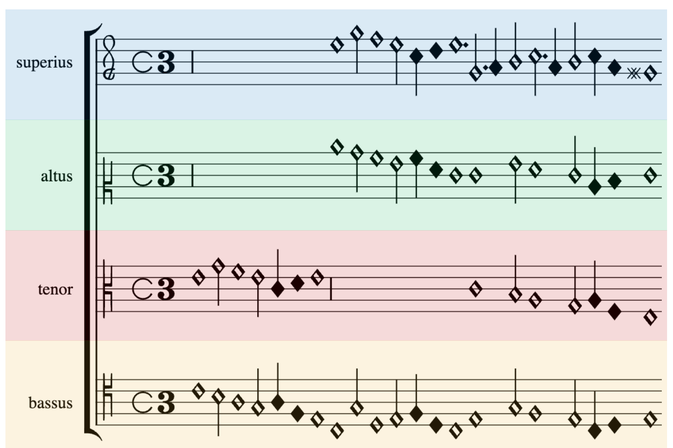
Editorial corrections (i.e., correction of scribal errors)

Tool used: *Measuring Polyphony (MP) Editor*

Online editor for mensural notation



The interoperability between both tools (MuRET and the MP Editor) was presented in a previous paper with other co-authors (Desmond et al. 2022)*

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* Desmond, Karen, Laurent Pugin, Juliette Regimbal, David Rizo, Craig Sapp, and Martha E. Thomae. "Encoding Polyphony from Medieval Manuscripts Notated in Mensural Notation." In *Music Encoding Conference*. 2022.

The Issue

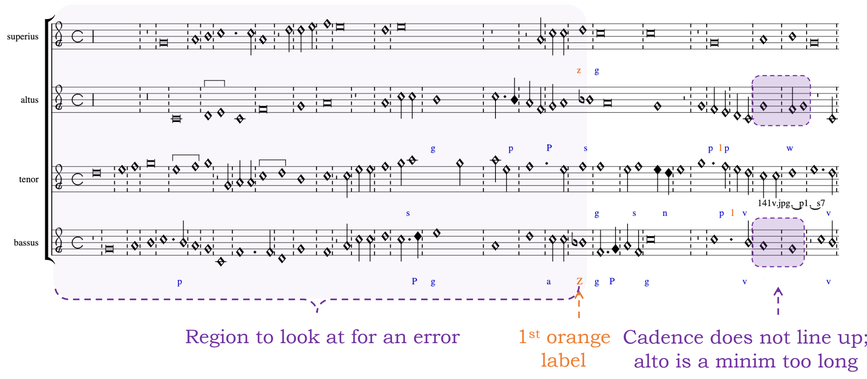
- OMR frameworks are optimized for correcting the results of the OMR process (STEP 1)
- However, this is not true for the correction of the voice alignment process (STEP 2)

What do we do?

- **Proposal:** Indicate counterpoint errors, specifically illegal dissonances, in the score, to facilitate the correction of the voice alignment process in STEP 2
- **How:** Integration of humlib's dissonant filter (DF) into the MP Editor to label the dissonances in the score rendered by the MP Editor
  This was presented in a previous paper with other co-authors (Desmond et al. 2022)*

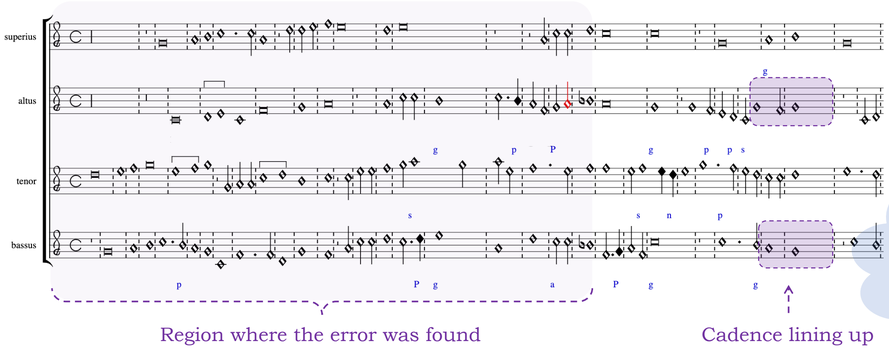
- Modified the DF in the MP Editor to distinguish between **legal** and **illegal** dissonances:
  - Legal dissonances marked in blue
    → Examples: passing tones (**p**), neighbour tones (**n**), suspensions (**s**), agents (**g**)
  - Illegal dissonances marked in orange
    → Examples: unknown dissonances (**z**), unknown dissonances sounding against another dissonant note (**y**), unknown dissonance in parallel motion to another voice that is an identifiable dissonance (**l**)

Example of scored-up OMRed piece in the MP Editor with DF



- Cadence is incorrect
- Cadential suspension should start a minim earlier → so that alto and bass arrive at the resolution on the downbeat of the measure
- To find the error, we look for the orange illegal dissonances → these are caused by an error at or before that point
- Orange z below the bass indicates illegal dissonance with altus
  → solution: change altus
  A semibreve into a minim (see next image)

Corrected piece (note changes in vertical sonorities)



The red note was shortened by a minim (see previous image)

Now all labels are legal (blue)

Dataset

- Corpus: Guatemalan Cathedral polyphonic choirbook 1 (GuatC 1)
- Dataset: OMR files of randomly selected pieces (approx. 20% of the corpus)
- Divided into two sets for the experiment
- NDF Dataset: Pieces that the experimenter did not use the dissonant filter during correction
- DF Dataset: Pieces that the experimenter used the dissonant filter during correction
- NDF and DF OMR files at https://github.com/martha-thomae/GuatC1/tree/Experiment

Findings

- Using the DF, the correction time decreased because the experimenter only had to focus on the region preceding the first orange label
- Using the DF, the correction accuracy increases because the experimenter can try different solutions and see their effect in the voice alignment and dissonance labels
- Using the DF, previously undetected OMR errors were found
- The use of the DF proved to be sensitive to changes in style, however, as it did not work well in the one piece that was composed in the XVIII c. due to the presence of stylistic changes (e.g., seventh chords)
- The use of the DF allowed us to notice an error missed by two different transcribers (experimenter and choral public domain library transcriber)

Acknowledgements

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