Methodologies for Creating Symbolic Early Music Corpora for Musicological Research

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Motivation

- Scores are increasingly being made available in machine-readable symbolic formats
  - Music XML, MEI, MIDI, Sibelius, Finale, etc.
- Software is increasingly used to carry out studies spanning hundreds of pieces (or more)
  - jSymbolic, music21, Humdrum, MIDI Toolbox, etc.
- Naïve approaches to constructing corpora can limit or bias studies performed on them
  - Can lead to erroneous results and conclusions
  - Worse, these problems may not be apparent to those conducting the studies

Goals of this work

- Propose a robust methodology for creating early music computational research corpora
  - Identification of pitfalls
  - Creation of a model workflow and templates
- Create a sample corpus using this methodology
  - Duos from Josquin and La Rue Masses
- Perform experiments to validate and learn from the sample corpus
  - Using jSymbolic features, statistical analysis and machine learning

Big problem areas

- Interpreting the original notation
  - Many ways to represent and interpret early music in modern notation
  - Essential to have all works in the corpus transcribed using a consistent methodology
- Encoding the music in a computer-readable file
  - Inconsistent encoding can result in unexpected consequences
    - Especially when machine learning is used

Problems with inconsistency and incompleteness

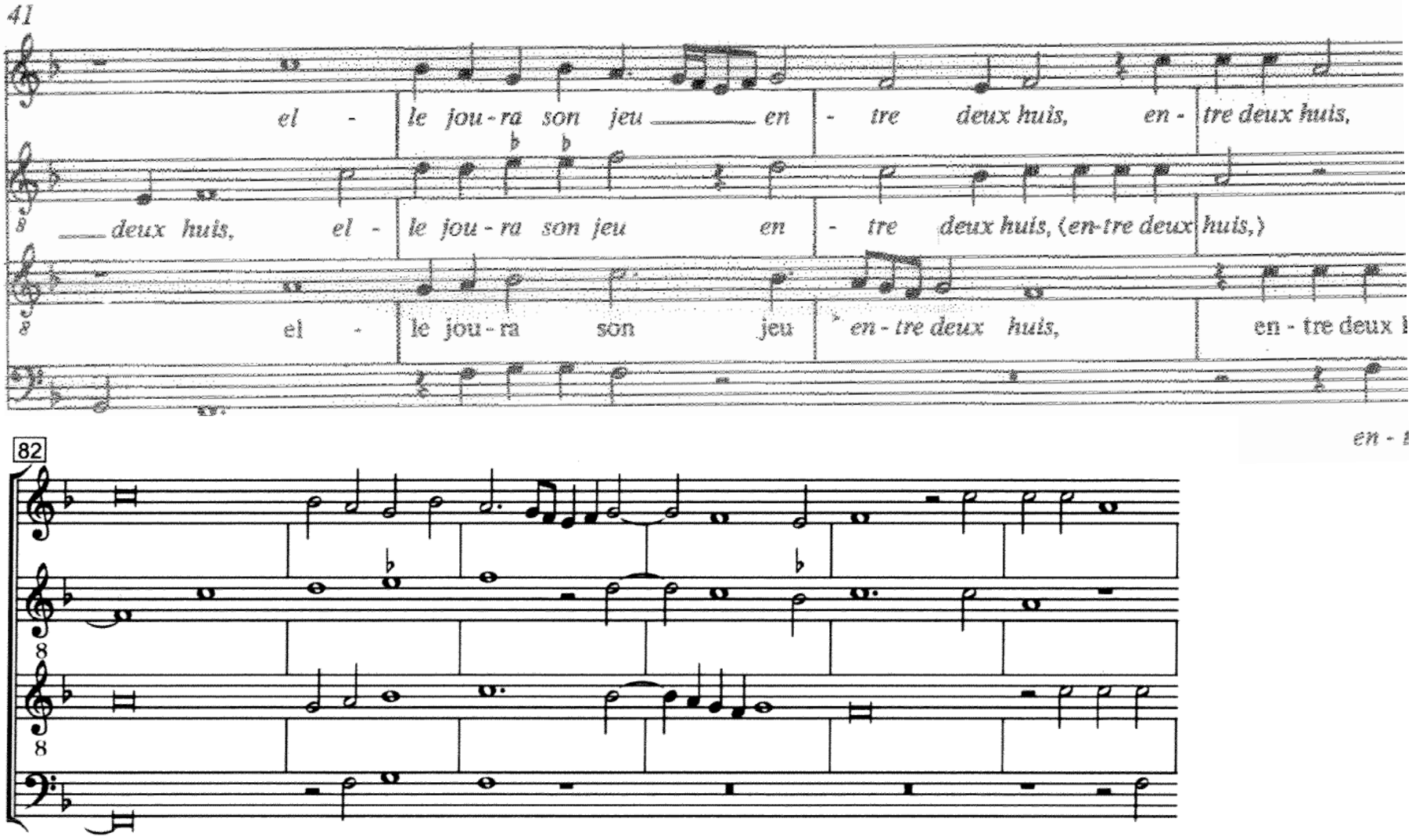
- Computers will be confused if different encoders adopt different standards or make different assumptions
  - Computers will interpret these subjective differences as real differences intrinsic to the music
- Data to be processed by a computer should explicitly specify all necessary information
  - Cannot expect computers to have the same implicit musical knowledge human experts do
  - Many automated algorithms require that information be complete and unambiguous
    - If these decisions are not made explicit in encodings, then algorithms may make their own inappropriate assumptions, or may be unable to process the music at all

Sample interpretation problems (1/2)

- Editors sometimes transpose works to different keys
  - When arranging for specific ensembles
  - Because they believe that the original proper pitch was higher or lower than specified in the source
- Performers can be expected to add accidentals without explicit instructions in the score
  - e.g. *music ficta*
  - Different performers may make different decisions

Sample interpretation problems (2/2)

- Mensuration signs indicate metrical organization
  - But are not quite the same as time signatures
  - And original parts have no barlines, ties are never used
    - Some editions use barlines, some do not
- Note values are larger than those of common Western notation
  - The beat generally falls on the semibreve (whole note)
  - Different editions may use the original, halved, quartered or smaller note values


41
el - le jou - ra son jeu en - tre deux huis, en - tre deux huis,
deux huis, el - le jou - ra son jeu en - tre deux huis, (en-tre deux huis,)
el - le jou - ra son jeu en - tre deux huis, en - tre deux
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Overview of our approach (1/2)

- Use modern notation
  - In order to permit the use of established computational tools that can only process modern notation
- Make as few editorial decisions as possible
  - Encoders thus avoid imposing their subjective interpretations on others
  - e.g. do not add accidentals not specified in the source
    - If a given researcher wishes to add accidentals in a particular way, they can reprocess the files to be consistent in the way they feel is best

Overview of our approach (2/2)

- If an editorial decision must be made, be unwaveringly consistent
  - e.g. use barlines and time signatures, as required by modern notation, but always use the whole note as the beat if this is what is in the source
- If an editorial decision must be made, document it precisely and completely
  - And distribute the resultant workflow with the corpus
  - Those using the corpus will then be made explicitly aware of what decisions were made
    - And can reprocess the corpus to incorporate different editorial decisions if they wish

Sample encoding problems (1/2)

- Some encoding formats do not allow all information of interest to be encoded
  - e.g. MIDI cannot distinguish between a C# and a Db
- Any given piece of analysis software will only be compatible with a limited number of encoding formats
  - But one wants researchers to be able to use the software of the choice
  - MIDI is by far the closest thing to a universal format
    - But MIDI is a deeply flawed format

Sample encoding problems (2/2)

- Encoding software may make editorial decisions of its own, especially under default settings
  - These can vary across software packages
    - Or even across different versions of the same software
    - e.g. Finale and Sibelius may incorporate rubato into saved files if not explicitly told to quantize rhythm
  - Unless care is taken, the encoding software may do this without the knowledge of the encoders operating it

Overview of our encoding approach (1/3)

- Create a detailed workflow and follow it
  - Without exception!
- Use precisely the same software for all encodings (Sibelius)
  - Under the same operating system and settings
- Use pre-constructed templates
  - To maximize consistency and avoid human error
- Use automated scripts
  - To speed the process up
  - e.g. “ManuScript,” the Sibelius scripting language

Overview of our encoding approach (2/3)

- Avoid encoding methodologies that throw out information (when possible)
- Follow consistent labelling standards
  - e.g. if a piece is to be played by viola, always label it exclusively as “viola,” not as a mix of “viola” and “alto,” for example
- Encode provenance in the files
  - In case a file becomes separated from its encapsulating dataset

Overview of our encoding approach (3/3)

- Publish the corpus using multiple different file formats
  - e.g. MIDI, Music XML, Sibelius, etc.
    - Be sure to include MIDI as one of these because of its universality (and despite its flaws)
  - Offers researchers choice
  - Generate all versions from a single original master file
- Verify all final files
  - Manually
    - Labour intensive, but necessary to avoid unforeseen problems (of which there can be many)
  - Automatically
    - To detect things that were missed manually

Our corpus (1/3)

- Duos (surrounded by double bars) from Masses composed by two contemporaries:
  - Josquin Desprez
    - 33 Duos from 11 secure Masses
    - c. 1450-55 to 1521
    - Varied career in France and Italy
  - Pierre de la Rue
    - 44 Duos from 26 secure Masses
    - c. 1452 to 1518
    - Hapsburg-Burgundian chapel, Low Countries and Spain
- Meconi, *Grove:*
  - "Despite differences in style, La Rue's music was probably most strongly influenced by that of Josquin. … There are curious parallels between the works of the two."

Our corpus (2/3)

- Began with Music XML masses downloaded from the Josquin Research Project (JRP)
  - Used Sibelius to extract the duos
- Added additional duos by transcribing them directly using Sibelius
- Processed, cleaned and verified all duos from all sources using the workflow described earlier
  - e.g. restoring original note values
  - To ensure consistency, among other things

Our corpus (3/3)

- Final version will be posted publicly once the paper is accepted
  - Including Sibelius, Music XML, MIDI, MEI and PDF versions of the Duos
  - Including the detailed workflow and templates

Experiments

- We conducted a series of experiments with our Duos corpus
  - To quantitatively explore the effects of using different encoding methodologies
- Trained machine learning models to distinguish the Josquin Duos from the La Rue Duos
  - Used three different version of the corpus, encoded different ways
- I will only summarize the results here
  - Detailed results and analysis are available in the written paper . . .

Experimental conclusions

- The cleaned, consistent version of the dataset produced better results than the original files before cleaning
  - Because inconsistent encoding practices create obscuring noise
- Combining Josquin pieces consistently encoded one way with La Rue pieces consistently encoded another way resulted in grossly inflated performance
  - Because the system "cheated" by basing its classifications on encoding practice rather than the underlying music
  - An important warning not to blindly combine data from different sources

Conclusions and contributions

- Provided a set of principles and workflow for constructing proper early music research corpora
- Constructed a sample corpus of Duos from Masses using this workflow
- Showed experimentally that using consistently and systematically encoded music produces better and safer results

Thanks for your attention

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DDMAL Distributed Digital Music Archives & Libraries Lab

SIMSSA | Single Interface for Music Score Searching and Analysis

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