Optical Music Recognition and Data Import/Export

Music 253/ CS 275A
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Optical Music Recognition

History of efforts from c. 1968

- CCARH survey in 1993-4: 37 projects, 7 responses

Why is optical recognition difficult?

- **Semantic meaning** of many objects depends on graphical context more than shape

Sources and their legibility:

- *Manuscripts*: very irregular
- *Out-of-copyright prints*: images often deteriorated
- *In-copyright prints*: not legal to copy
- *Errors* in source

Biggest problems for OMR developers

- **Superimposition** of objects in 2D image
- Constraints imposed by **output formats**
Basic problems in optical data acquisition

- Image is **crooked**
- Elements of **layout unconventional**
How does OMR work?

- **Separation** of lines and other matter
- **Isolation** of objects
- **Recognition** of objects
- Export to a format for
  - storage
  - printing
  - sound
  - data interchange
Why is OMR difficult?

**Problems of image quality:**
- Ideally
  - Staff lines are straight
  - Spacing is uniform
  - The scanned material is clean (unspotted)
  - Slurs are symmetrical
  - Beams are parallel
  - All lines are unbroken
- Reality is different!

**Problems of graphical context**
- Symbols affecting interpretation of pitch
  - Key signatures
  - Octave alterations \(1^\text{st}\) \& \(3^\text{rd}\)
- Symbols affect interpretation of duration
  - Meter signatures
  - Tempo indicators
  - Fermatas \(\sim\)
- Symbols relating to dynamics or technique
  - Dynamics marks \(pp\; sf\; ff\)
  - Repetition of note-groups \(\times\), of sections \(\circ\; \%\)
  - Instrumental technique \(\text{fla.}\; \text{v.}\; \text{f.}\)
More difficulties

Multiple configurations for same objects

Methods of evaluation and control

- Musical **accuracy**?
- Handicaps for **post-processing**
- Controls for **input quality**
- Comparison of **output formats**
- **Weighing speed** against accuracy and usability

<table>
<thead>
<tr>
<th>Input</th>
<th>Capture format</th>
<th>Post-Processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carter</td>
<td>00:20</td>
<td>SCORE</td>
</tr>
<tr>
<td>CCARH</td>
<td>2:30 + 7:05</td>
<td>MuseData</td>
</tr>
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</table>
Samples from Library of Congress site
Random material from loc.gov
Samples 2:
More random material from loc.gov
Close-up views of conventionally typeset music

Surface imperfections

1. Visual surface problems

Figure 1. Surface imperfections: skewing and ambiguous positioning (uppermost note).

Surface imperfections

Figure 2. Surface imperfections: note the broken staff line at the top right and the variable width of both staff- and barlines.
Close-up views (2)

Missing contextual information

Figure 3. Insufficient information: the half note and the natural sign both lack closure. Compare the hypothetical white space in the half note with the actual white space bordered by the stem, the notehead, and the contingent flag in the tied octaves of Figure 4.

Graphic imperfections

Figure 4. Flawed information: the eighth notes on the first beat are incompletely filled. Note the variable distance between the staccato dots and the notes to which they pertain.
Close-up views (3)

Dirt

Variable appearance of equivalent objects

Figure 5. Superfluous information: dirt.

Figure 6a. Compare the stem lengths in this passage with those in Ex. 6b.

Figure 6b. Compare the stem lengths with those of Ex. 6a.
Close-up views (4)

Touching objects

Unconventional presentations

Figure 7. Superimposition: slurs touch noteheads. Note also that the flag of the first eighth note crosses a leger line.

Figure 8. Issues in music representation:
**SharpEye: File operations**

- Comes from Shetland Islands
- Source code available
- Exports to MusicXML

**Four-step process**
- **Capture** a page image
- **View** the auto-image
- **Correct** the image
- **Save/export** the result

**Vis-à-vis MuseData:**
- SE: score-based
- MD: part-based
SharpEye: Raw Capture
SharpEye: Correcting the interpretation

- **Edit mode:**
  - Captured image below
  - Interpreted image above
  - Live object in red
  - Available symbols in red
SharpEye: Scroll view
SharpEye: System edits
SharpEye: Data-interchange options
Other OMR Software

- Neuratron PhotoScore: [http://www.neuratron.com/photoscore.htm](http://www.neuratron.com/photoscore.htm) [Sibelius]
- SmartScore: [http://www.musitek.com/](http://www.musitek.com/)
Important questions about OMR software

• What does “accuracy” mean?
  • Text recognition optimal error rate: 40/2000 chars

• What kinds of errors?
  • Global variables?
  • Local events?
  • Non-MIDI objects

• What output formats are available?
  • MIDI-level features only?
  • Graphical position?
  • Markup?