Multimedia from the 17th-Century Book to the 21st-Century Web – A Playable Digital Edition of Michael Maier's "Atalanta fugiens"

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A playable digital edition of Michael Maier’s Atalanta fugiens

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Furnace & Fugue

Furnace and Fugue is both a digital edition of and scholarly essays on Michael Maier’s Atalanta fugiens, a 17th-century alchemical emblem book. Each of the book’s 50 multilingual emblems includes a fugue for three voices, which represents the race between Atalanta and Hippomenes. The project modernized the polyphonic fugues into animated notation that is playable in a web browser.

Key Features

Our goals were to extend the limitations of the physical book and engage both musicologists and non-musicians.

We did this by:

- providing readers with a visual playback cue via note highlighting
- allowing readers to independently isolate the audio playback of the voices
- providing a piano roll visualization to highlight the melodic contours and imitative structures
Production Pipeline

Extract and clean music data

- Sibelius
- Sibelius-to-MEI plugin
- MEI
- Cleaned MEI
- Clean MEI (XSLT)

Generate timings to match recordings

- Adjust MEI for timing extraction (XSLT)
- MEI with timing adjustments (see aside)
- Extract timing (JSNode script with Verovio)
- Performance tempo and begin-time offset data (XML)
- Table of MEI elements with timing (XML)

Generate CMN

- Verovio on the command-line
- Common Music Notation (SVG)

Generate final output

- Final assembly and insertion into HTML template
- Table of audio filenames (XML)
- Final HTML/SVG fragment (see aside)

The boxes in this process diagram are hyperlinked to a repository containing code or sample data.
Example Challenge:
Accommodating “long” duration notes

The following is one instance of many complications that arose from the incorporation of different tools, collaborators, and practices.

The problem

Verovio’s interpretation of the duration of the notes marked as ‘long’ in the MEI doesn’t always match the performance practice recorded in the audio. (In performance, the durations vary)

\[ \text{\textbackslash measure xml:id="m-445" n="12\textbackslash" perf-dur="8\textbackslash"} \]
\[ \text{\textbackslash staff xml:id="m-446" n="1\textbackslash"} \]
\[ \text{\textbackslash layer xml:id="m-447" n="1\textbackslash"} \]
\[ \text{\textbackslash note dur="long\textbackslash" oct="4\textbackslash" pnum="71\textbackslash"} \]
\[ \text{\textbackslash accid xml:id="m-449\textbackslash" accid="n\textbackslash"} \]
\[ \text{\textbackslash verse xml:id="m-452\textbackslash" n="1\textbackslash"} \]
\[ \text{\textbackslash syl xml:id="m-453\textbackslash" wordpos="t\textbackslash"} \]
\[ \text{\textbackslash rit\textbackslash} \]
\[ \text{\textbackslash syl\textbackslash} \]

This modified MEI is then transformed into an intermediate MEI which is only used to generate timing data. The note with ‘long’ duration is converted into a series of half notes (the pitch of which is irrelevant).

These ‘dummy’ notes provide the timing for the original long note — the begin time is the start of the first note, and the end time is the end of the last note. Verovio consumes the MEI and provides the timing data.

The result

The timing data is incorporated into the SVG published on the final website, using the custom attributes @data-time-start and @data-time-end, which allow the Javascript to synchronize animation with audio playback.
Lessons Learned

COMPLICATION
Collaborating across disciplines, practices, and media formats
Performers recording audio, engravers notating in Sibelius, encoders working with MEI, and web programmers working with HTML, SVG, and Javascript — which all needed to come together and create a single, synchronized web artifact.

SOLUTION
Change of practice to accommodate pipeline requirements
Some problems could be overcome through automated scripting, but some could not. For example, the performers had to sing against a click track, and the programmer had to perform manual copy editing.

ADVICE
Have early, frequent conversations with collaborators
Be sure to discuss how everyone’s pieces fit into the larger process. Build and test the whole process as early as possible against real, complicated data; don’t wait for collaborators to finalize up their work.

COMPLICATION
Tool biases
General-purpose tools such as Sibelius and Verovio have particular ways of handling “edge cases,” that don’t always integrate well. In our case, our material dated from the early 17th century — and we were re-publishing in two different modern variants in two format (PDF and the web).

SOLUTION
Custom scripting and manual editing
Unlike human collaborators, tools’ behaviour often can’t be changed; instead, solutions involved a combination of scripted workarounds, manual interventions, and changed expectations.

ADVICE
Use MEI as an intermediate format
MEI is great because it is both human- and machine-readable, and easily processed by custom scripts, allowing for custom accommodations and workarounds.

In order to facilitate troubleshooting, break your process into many steps, creating intermediate MEI files along the way for inspection.

COMPLICATION
Unexpected complexity
Integrating live performance, notation, visualizations, and web technologies is complicated — inevitably more complicated than you think! Throw in versioning and modernization and multiple output formats (interactive web and PDF) and you have a lot of moving parts.

SOLUTION
Strong project management, continuous communication, flexible timelines
An early prototype with oversimplified test data suggested that this process would be straightforward; it was not. Real data presented many unexpected complications and led to time budget overruns.

ADVICE
Assume that it will take longer and be harder than expected
Plan early, but expect changes of plans. Establish strong communication and clear expectations between collaborators.

As much as possible, favor automated interventions over manual ones; it is better to develop a repeatable automated process than manually copy edit.
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Crystal Brusch is the publication designer for Furnace and Fugue.

Patrick Rashleigh is the lead developer and UX lead for the music in Furnace and Fugue.

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