TROMPA: Towards Richer Online Music Public-domain Archives

Deliverable 6.4

Working Prototype for Music Scholars v1

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Executive Summary

This document introduces the TROMPA Music Scholars Use Case, focussing on examples from two very different musical repertories which have been identified as showing a broad range of TROMPA facilities likely to be of use to Music Scholars. In this document, these are referred to jointly as the Music Scholars Use Case.

The Digital Score Edition (DSE) component (Section 2), is at the heart of most of the interactions between Music Scholars and the TROMPA framework. This has a role at various points within TROMPA, giving access to TROMPA scores and other resources for display and interaction of various kinds. It incorporates novel important components which have general application across the project: flexible and comprehensive annotation tools (see Deliverable D5.5-1), and an authentication technology which allows users to publish their annotations, or keep them private if they prefer,.

The investigative possibilities TROMPA can offer to scholarly users, who are most likely to use the DSE as their principal interface, are exemplified by two main showcases, focussing on two contrasting repertories: 'Mahler's symphonies' (Section 3.1) and 'Early Music' (3.2).

In the Mahler showcase, a score of the opening 100 bars of Gustav Mahler's 4th Symphony will be displayed, in which annotations to the detailed tempo and expression marks therein have been (and will continue to be) provided by a team of expert musicologists, inviting further comments from other registered TROMPA users which will become available to others under the control of their submitter. A collection of audio recordings of the music, exclusive to TROMPA and aligned with the score for playback, will also be presented, to which further annotations/comments will be linked to provide a means for users to offer opinions concerning the interpretations of the score-markings by different famous conductors.

The Early Music showcase demonstrates how a user can select a score for display by using faceted search within the TROMPA Contributor Environment, can annotate it as above, but also can use selections of musical passages within the score for searching online resources external to TROMPA. This will be achieved by passing the MEI-encoded musical content of a selected passage to the Contributor Environment as a task which will process the data into a suitable format and send a query to the external resource via its API. In this case, extracts from TROMPA's 16th-century scores of vocal music will be used to locate images of original 16th-century music prints from major music libraries via F-TEMPO.

Finally, we show how this work is integrated with other work-packages in TROMPA, and outline our plans directed at Music Scholars for the final year of the project.

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#	Date	Description
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v0.2	27 May 2020	2nd version after review
v1.0	28 May 2020	Final version

Table of Contents

1. Introduction

It was originally planned that each TROMPA use-case would develop a working demonstrator program, or prototype, to be used to build crowd-sized communities for that specific case who would interactively work on tasks such as OMR error-correction. However, as became clear during plenary discussions at various TROMPA project meetings, this is not an appropriate model for Music Scholars, since (a) the numbers involved was likely to be well below the 'crowd' necessary to develop a product-style prototype, and (b) the requirements and activities of scholars are very largely unpredictable, varying with the topic of their investigations, while any such demonstrator program could only focus on a single task out of an indefinite range of possibilities. On the other hand, it was also realised that the work of Music Scholars demands reliable application, and rigorous testing, of two essential components of the TROMPA framework: the Digital Score Edition (DSE - T5.2) and Annotation Tools (T5.5). Accordingly, with the agreement of the TROMPA Steering Committee, GOLD is working to serve both of these technical tasks while showing how Music Scholars will make use of them, and other TROMPA facilities, in the two example showcases outlined here (Mahler Symphonies, Section 3.1, below, and Early Music, Section 3.2).

This document introduces TROMPA's Musical Scholars Use Case by briefly describing the current technical state of the Digital Score Edition (DSE) component, which is at the heart of most of the interactions between Music Scholars and the TROMPA framework. It then shows some of the investigative possibilities TROMPA can offer to scholarly users, who are most likely to use the DSE as their principal point of entry. These possibilities are exemplified by two use-cases, focussing on two contrasting repertories, Early Music and Mahler's symphonies, and our plans to engage the music-loving public as well as professional experts in annotating and commenting on the music and recorded performances of it. Finally, we show how the work is integrated with other TROMPA work-packages.

1.1 Music Scholars

The term Music Scholars is used within TROMPA to mean experts in any particular musical repertory, its sources and the various contexts in which music has been composed and performed: historical, religious, social, political, cultural. This includes professional academic musicologists as well as non-professionals, who often possess high levels of expertise, but without formal training or qualifications. Although not a main focus of TROMPA, teaching is often an important role for this category of users (especially the professional musicologists), and the project's resources and tools have good potential for exploitation in future music pedagogy.

1.2 Digital Score Edition

The main entry point to TROMPA for Music Scholars is the Digital Score Edition (DSE) component (see Deliverable 5.2-1), which has a role at various points within TROMPA. (It is not a music editor, per se, but rather a highly featured display interface.) This gives access to TROMPA scores and other resources for display and interaction of various kinds (including playback of audio and video recordings). Users will soon be able to search for works within the Contributor Environment via faceted metadata search, and visually display scores from two different formats: Public-domain score images (derived from PDF files) and encoded scores (stored as MEI files, usually converted from MusicXML - MEI offers several types of functionality not present in MusicXML which TROMPA

exploits heavily in its data modes and other aspects). The DSE offers normal functions for display, such as scroll and zoom, and for navigation, such as next/previous page commands.

1.3 Annotations

A important feature of the DSE for Music Scholars made possible by TROMPA's data model and facilitated by the use of Web Annotations, MEI, and Linked Data using the MELD framework, is the facility to enter and view annotations to any note or measure of music in a score (see Deliverable 5.5-1). These may be made public to all viewers of the score in question, or their visibility reserved for private purposes by the user or a selected group of users; this is enabled by storing annotations in Personal Online Datastores (PODs) implemented by the W3C Solid platform, allowing users to retain ownership of their data up until the point of (voluntary) publication under public license to the TROMPA Contributor Environment. Such annotations can form the basis for discussions with a user group, or provide materials for a discourse which might be worked up into a scholarly presentation or published output.

1.4 Two exemplary use cases

To demonstrate the unique advantages offered to Music Scholars by the DSE, we have devised two use cases drawing on very different musical repertories: Gustav Mahler's symphonies and Early Music (mainly polyphonic vocal music of the 16th century). These are described in detail in Section 3, below.

1.5 Public engagement and future development

Finally, we describe our plans for public engagement and future development within the Music Scholars use case. These have been affected to a significant extent by the COVID19 crisis, but as we outline in Section 4, below, this can to some extent be exploited as an opportunity for TROMPA, due to our commitment to web-based online presentation and user-interaction.

2. Music Scholars and the Digital Score Edition interface

2.1 Current status

The Music Scholars Use Case makes extensive use of the Digital Score Edition interface (DSE; described in Deliverable 5.2-1). This is based on a prototype 'Selectable Score' interface developed by David Weigl (MDW) and Alastair Porter (UPF) with additional programming by Federico Zubani (GOLD). The following features of the DSE are of special interest to Scholars:

- ❖ Selection of TROMPA resources (scores, recordings, videos, etc.)
- ❖ Score annotation
- ❖ Control of annotation visibility
- ❖ Flexible annotation types

2.1.1 Selection of TROMPA resources (scores, recordings, videos, etc.)
- ❖ Managed by low-level interaction (transparent to the user) with the TROMPA Contributor Environment
- ❖ Faceted search via metadata

2.1.2 Score annotation

- ❖ Selection and annotation of notes or whole measures displayed in a score
- ❖ Click on individual notes or 'marquee' selection by dragging

2.1.3 Control of annotation visibility

- ❖ Personalised control of public/private annotations
- ❖ Solid integration; annotations stored in user's POD until 'published'

2.1.4 Flexible annotation types

- ❖ Annotation types may be simple textual comments, or might include links to other TROMPA resources, to external resources, or to other annotations

2.2 Future work

2.2.1 Immediate next steps

- ❖ Enable direct interaction for users with TROMPA Contributor Environment from the DSE
- ❖ Display annotations as appropriate for the user
- ❖ Improve interface design (cosmetic) and user experience
- ❖ Appoint a new musicologist at GOLD to devise new use-cases using TROMPA resources and pilot applications, and to recruit online participants to test and critique them

2.2.2 During the next 6 months

❖ Repurpose our original plan for a Mahler Festival event (May 2020) as an online survey (see 3.1 & 4 below)

❖ Work on new use-cases devised by GOLD musicologist (to explore possibilities for musicology or other kinds of music study, including pedagogy)

❖ Implement basic music playback in the DSE, with visual indication of the current point of playback

❖ Integrate external searches as CE tasks, using passages selected in the DSE as queries; display of results

3. Two Music Scholars showcases

3.1 Mahler

The 2020 Mahler Festival, to take place in Amsterdam during May 2020, was seen as a good platform for TROMPA to work together with our RCO partners to bring together musicologists with members of the music-loving public. With this in mind, an event was planned (scheduled for 15 May) to be held at the RCO's headquarters. In the current crisis, the live event - in common with the entire Mahler Festival - has been cancelled (see Section 4). We now plan to substitute this with an online survey and showcase.

We have assembled a team of internationally respected Mahler experts who have been considering the detailed tempo and expression marks in the 4th symphony. These are mostly in German, and sometimes idiosyncratic, showing Mahler's intense desire to ensure the maximum expressive impact in performance. As such, they cannot always be easily translated into other languages, such as English or Dutch, and a variety of interpretations due to differing scholars' opinions are to be expected. Similarly, there is little uniformity between conductors' recorded interpretations. This use-case will explore the range of the textual and musical interpretations, and allow non-expert listener's to express their opinions, based on what they read of the scholars' work and hear in the recordings. Listeners will be asked to record their reactions to different recorded performances to see how they feel the different conductors have realised Mahler's intentions, based on what the scholars reveal about the tempo and expression marks in various versions of the score (which exhibit varying degrees of the composer's authority).

Normal, Mahler-loving listeners cannot be expected to be experienced readers of musical scores. However, if a score is sufficiently 'signposted' graphically with links to discussion of relevant features, and a visual indication is given of the current point of playback (current measure highlighted onscreen), music-reading is not directly necessary. The DSE offers this via annotations and the playback mechanism. Listeners will then be able to view the annotations as they hear the music and respond with their own comments.

(The basic requirements of such an interface were anticipated in Section 2.2, 'Orchestras', of **D2.2 - Complete Requirements**[1], which could in principle be implemented in large part using the DSE.)

3.2 Early Music

As anticipated in Deliverable D2.2, Section 2.1, 'Early Music', TROMPA gives good opportunities for the scholarly or less formal investigation of historical repertories involving a wide range of document and resource types. This is being enacted as an Early Music showcase, described below, to demonstrate how TROMPA's technological framework enables this kind of study, which could, of course, be applied across many other musical repertories from different historical periods.

The music created before, say, 1800 is less complicated than later repertories, and thus makes fewer demands on aspects like music-encoding, score-rendering and display. It is thus useful for the testing of methods that may be scaled, extended and adapted as necessary for later music. These

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[1] This deliverable is confidential to the consortium only

include state-of-the-art developments in music encoding and score rendering (sometimes in 'obsolete' styles of notation), MIR indexing and musical analysis.

The musical formats which scholars/enthusiasts of early music will wish to use as a starting point for exploration might include any of those envisaged in the design of the TROMPA CE: original source-images (PDFs, etc.), encoded scores (e.g. MEI, MusicXML or MIDI) and audio. The main functionality which TROMPA uniquely will be able to provide is music-content based searching of TROMPA and external resources. This will be achieved through direct interaction with search APIs using selected score-passages as the basis of search queries.

Scholarly users may wish to search or discover related musical material via metadata or musical content (score or audio).

For a metadata-based search the standard paradigm will be a conventional faceted search conducted via a dialog in the DSE (e.g. "All madrigals for four voices published in Venice in the 1540s", or "Works in Latin printed in Antwerp"); this generates a query to the Contributor Environment and returns a list of works matching the query with associated links.

Content-based searching is more complex: the query might be expressed as a code-string representing a melodic fragment or motif, or it might be based on a selected region of the score or audio which is then itself encoded and used as a search-by-example query. Depending on the nature of this query (number of voices, etc.) a suitable index will be used for searching.

Since the search mechanism makes use of approximate, rather than exact, matching, results not only include the same music, but other works which share a high proportion of the same musical content. This related material may include different versions/arrangements of the music, and variants which are sufficiently close to register in searches as 'similar' (e.g. different voice parts of a polyphonic work). This kind of related material is likely to be of great interest to music scholars, as it sometimes reveals unexpected relationships between works, or even can be used to demonstrate influences between composers.

External searches can also be used to find other related material – musical literature, people, places, institutions, historical events - which helps to contextualise the music in question. This is made possible by the use of metadata and Linked Data searches via RDF. For example, we can use metadata to find recordings via MusicBrainz.

4. Engaging users and the public

Both of the use cases outlined before (see Section 3) are intended to engage members of the public and to offer some understanding of the way scholars carry out musicological investigations. They also will give important insights into the types of source material with which scholars work. In the case of Mahler, the perhaps surprising number of different states of the published score that exist for his 4th symphony, as well as various manuscript copies (including the autograph MS) and contemporary arrangements, will show the often complex task faced by a scholar or conductor in considering what to use as a basis for their own interpretation. In the Early Music case, it will be possible for the first time to consult not just a modern edition, but also, in many cases, representative examples of the original source material of a work, which is often extremely different in appearance from a modern score.

4.1. Initial target audience & recruitment strategies

Although the Mahler event was always intended to have an online 'legacy' (in that after the physical event it was intended that the materials and interface would be left online for casual listeners to add their own comments), it was not envisaged to have an exclusively online presence. We expected to recruit a modest sized audience (perhaps 50) at the ACO headquarters in May 2020. Thereafter, we were intending to promote the online materials heavily and to reach somewhat more (perhaps 100).

The Early Music use case is not directly aimed at a physical event, though it is planned to form part of a third TROMPA workshop probably (in April 2021), where we expect to report on its progress. It will, however, have a continuing online presence as a feature of TROMPA, linked from the main web site. We shall actively promote it via social media and blogs, to recruit several hundred users to try it out.

4.2. Impact of COVID-19 crisis

The Mahler Festival (Amsterdam, May 2020) has had to be cancelled due to the restrictions caused by the COVID-19 crisis. For this reason we have been forced to completely overhaul our plans for the Mahler event scheduled for May 15, 2020. We intend, by repurposing the event as an online survey, to treat this as an opportunity for TROMPA rather than a crisis.

However, a serious setback is that our principal UK Mahler expert, Dr Paul Banks, fell ill with the virus and has been unable to work since early April 2020 (happily, he is now recovering well). Fortunately we have various resources in hand which allow us to continue the work in an online format. We have a full MEI encoding of Mahler's 4th symphony (although we shall focus on the first 100 bars, or roughly 5 minutes of music). We also have a set of initial expert annotations, which can form the basis for our revised virtual 'event' (repurposed as an online survey). This has been provided by our international team of Mahler experts, who are still in place and will continue to contribute. Finally, and exclusive to TROMPA, we have access to a set of historical recordings, both audio and video, of Mahler's 4th symphony provided by the ACO, mostly recorded live at the Concertgebouw; extracts of these will be made available for comments from the Mahler experts and the public at large.

In this way we can demonstrate the flexibility and reach of an online approach enabled by the interactive annotation and other facilities provided by TROMPA.

5. Current and future integration with other TROMPA WPs

5.1. Relation with TROMPA WP3

WP3 tasks	Currently integrated	To be integrated in next version
Music description	n/a	n/a
Audio processing	n/a	n/a
Visual analysis of scores	n/a	x
Alignment of musical resources	n/a	x
Multimodal cross-linking	n/a	n/a

5.1.1 Visual analysis of scores and Alignment of musical resources

When viewing a score image (e.g. from a PDF of a historical document) for which an encoded score is also available, it is important to maintain active links between the two forms. This way, locations of page/system-breaks can be aligned dynamically as either format is navigated by the user. In order to achieve this, at a minimal level the barlines in the graphical image must be identified and aligned with their equivalents in the MEI encoding. For this minimal alignment, we make use of currently existing robust OMR technologies such as Audiveris[2] or the Deep Optical Measure Detector[3]. Once barline locations have been identified and aligned the TROMPA implementation of the MELD framework further enables dynamic linking between audio/video recordings of the music and the scores displayed to the user, so that, for example, pages can be 'turned', or a moving indicator displayed, in synchronisation with audio playback. We envisage this to be in place for M29.

5.2. Relation with TROMPA WP4

WP4 tasks	Currently integrated	To be integrated in next version
Crowd-powered improvement	n/a	n/a
Annotators	n/a	x
Incentivisation of TROMPA crowds	n/a	n/a

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[2] https://github.com/audiveris
[3] https://github.com/cemfi/measure-detector

Campaign design	n/a	n/a

5.2.1 Annotators

Users will be able to annotate scores by inserting comments, links and other cross-references, and these will be embedded within the MEI encoding so that a visual indication of their presence and nature can be displayed. Furthermore, it is envisaged that they should be able to 'annotate' an existing annotation, as a means of continuing a scholarly discourse about questions that may arise. The 'ownership' of all annotations will be under the control of their contributor until the point at which they are 'published'; this is enabled by the use of the W3C Solid platform as mentioned above in Section 1.3. We envisage this to be in place by M29.

5.3. Relation with TROMPA WP5

WP5 components	Currently integrated	To be integrated in next version
Score edition component	X	n/a
Processing library	n/a	X
Multimodal integration	n/a	X
Performance assessment	n/a	n/a
Annotation tools	n/a	X

5.3.1 Processing library

One way in which Music Scholars can take advantage of the exclusive facilities of the TROMPA environment is by making calls to certain components of the CE Processing Library. To demonstrate this, in the next version of the DSE, we intend to permit Music Scholars to interrogate the API (external to TROMPA) of a musical-content-based full-text search service using a passage of music selected in the DSE as query. The external service we shall use, F-TEMPO,[4] strongly related to the Early Music use-case described above (Section 3.2), currently holds indexes for about half-a-million pages of 16th-century printed music, representing a significant proportion of the musical repertory of the age. To construct a query it is necessary to process the MEI of a musical passage selected by the user to extract sequences of diatonic intervals, encoded in the alphanumeric format required by F-TEMPO, and send this as a JSON request (with certain parameters) to F-TEMPO's API; then the returned results (which also will be in JSON) need to be parsed and presented to the user within the DSE. This requires the implementation of some simple string-processing routines within the CE Processing Library and a workflow for handling them. We envisage this to be in place for M29.

We shall also run F-TEMPO's indexing methods (or a customised adaptation of them) over MEI or MusicXML files of other music repertories represented in the CE, so that musical similarities of whole

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[4] f-tempo.org

pieces, pages or shorter passages between works in the TROMPA CE can be investigated by Music Scholars and others. We intend this to be implemented for the final version of the DSE (M34).

5.3.2 Multimodal integration

The DSE will enable users to select from the resources of TROMPA's Contributor Environment by means of a dialog interacting to provide faceted searches through the CE's multimodal component (REF TO MULTIMODAL COMPONENT). We envisage this to be in place for M29.

5.3.3 Annotation tools

Users will be able to annotate scores by inserting comments, links and other cross-references, and these will be embedded within the MEI encoding so that a visual indication of their presence and nature can be displayed. Furthermore, it is envisaged that they should be able to 'annotate' an existing annotation, as a means of continuing a scholarly discourse about questions that may arise. The 'ownership' of all annotations will be under the control of their contributor until the point at which they are 'published'; this is enabled by the use of the W3C Solid platform as mentioned above in Section 1.3. We envisage this to be fully in place by M29.

5. Conclusion

In this document we have described the current technical state of the Digital Score Edition (DSE) component at the heart of most of the interactions between Music Scholars and the TROMPA framework, shown some of the investigative possibilities TROMPA offers to Music Scholars, exemplified by two main use-cases: Early Music and Mahler's symphonies. We have outlined our plans to engage the music-loving public as well as professional experts in annotating and commenting on these contrasting musical repertories and (in the Mahler case) recorded performances of it exclusive to TROMPA. Finally, we describe how these plans are integrated with other TROMPA work-packages .