<BLINDED_PROJECT_NAME>: Providing enriched access to classical music encodings

Enriching access to classical music

Classical music represents both treasured cultural heritage, and a live, contemporary tradition, continuously re-interpreted through practice, performance, analysis, and listening enjoyment. Music libraries and archives preserve classical music resources, but underserve more dynamic interactions with this repertoire. We must enrich such interactions to engage, broaden, and diversify the classical music audience, thus sustaining this tradition.

<BLINDED_PROJECT_NAME> is an international project addressing this challenge, combining music information retrieval (MIR) technologies and crowd-sourcing approaches to publish, contextualise, and augment classical music resources. Building on large existing repositories, *<BLINDED_PROJECT_NAME>* aims to provide services for discovery, enhancement, and contribution of musical scores, recordings, analyses, and interpretations, applying open technologies to ensure reusable, scalable, and sustainable access to music data. Musical score encodings play a central part, both as resources of primary interest and as structural frameworks for interlinking multimodal musical representations.

Technological means of contextualising and enriching score

Data infrastructure

<BLINDED_PROJECT_NAME> captures, generates, and exposes data through an infrastructure consisting of a knowledge graph describing musical resources, consumed and enriched through a collection of use-case specific APIs. These resources -- e.g., score encodings, images, multimedia recordings and alignment information, and performance metadata -- are not stored within a central repository, but rather reside at any web addressable location, interlinked and augmented with metadata by reference. The knowledge graph employs a representation combining standard data models (including schema.org, SKOS, Dublin Core, and PROV), mapped to more specific representations addressing individual use cases via Linked Data graph serialisations.

Bootstrapping musical encodings

The Music Encoding Initiative schema (MEI) offers a comprehensive semantic representation of musical structure, enabling notational elements to be targeted and described as Linked Data, and visually augmented, annotated, juxtaposed, and interacted with inside a web browser (Pugin, 2018; Weigl & Page, 2017) using musical score to associate and interweave multimodal music-related materials (Lewis, Weigl, Bullivant, & Page, 2018). This makes MEI a natural fit for *<BLINDED_PROJECT_NAME>* ambitions. However, its usefulness is currently limited by the

relative scarcity of MEI encodings available for public-domain musical works. We plan to counteract this limitation by transcribing public-domain encodings available in other formats (e.g., MusicXML, **kern) into MEI; by commissioning the creation of high quality public-domain encodings in corporation with the scholarly community, and through crowd-contribution initiatives; and, by applying Optical Music Recognition (OMR) techniques to generate encodings from digitised score images available from the International Music Score Library Project (IMSLP) [1] and other sources.

In each case, we take advantage of MEI's tolerance for underspecified score structures: while the prospect of fully encoding, say, Mahler's Symphony no. 1, is daunting to say the least, generating a measure-level encoding (without specifying notes) is much more immediately achievable. Although incomplete, such underspecified structures are sufficient to provide a measure-level framework for multimodal alignment (e.g., of different orchestral recordings, or of scholarly descriptions). Special attention can then be paid to particular salient passages, filling in note-level encodings as available effort permits. Such *enrichable scores* provide manageable targets for crowdsourcing microtasks (Bozzon et al, 2014), allowing user communities of varying levels of expertise to flag differences between snippets of digitised score images and single-measure MEI engravings, or to correct such transcription errors, allowing the iterative enrichment of MEI structures over time.

Motivating scenarios

<BLINDED_PROJECT_NAME> aims to engage a variety of audiences, comprising music performers, scholars, and enthusiasts, with corresponding differences in resource and interaction requirements (e.g., performers and scholars annotate notes and measures within digital scores; enthusiasts search for recordings of movements or works). These varying requirements can be addressed using the same underlying knowledge graph, resulting in a positive feedback loop whereby additions and improvements provide immediate benefits across use cases.

Performance companion

A dedicated *<BLINDED_PROJECT_NAME>* component will act as a performance and rehearsal companion for musicians (singers, orchestral players and conductors, and solo instrumental performers), employing MIR feature extraction techniques to track, characterise, and analyse performances in real-time. Audio-score alignment algorithms match the derived features with the explicit musical structure provided by MEI, enabling quantitative comparisons across performances via this shared reference frame (e.g. to compute similarities to a reference recording, or to visualise the evolution of an individual's performances over time). The generated metadata and performance recordings are contributed back into the knowledge graph (pending performer permission), where they can be discovered, annotated, and reused by others.

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[1] https://imslp.org

Digital score edition

Digital score edition components present authored views of musical score interlinked with multimodal information resources via the knowledge graph. These resources are incorporated by reference, cleanly separating content from layers of scholarly enrichment, and enabling multiple views of the same source material to be expressed by different authors. MEI allows the encoding of alternative versions or passages, as well as details of editorial or performer's decisions to be recorded with full provenance.

Semantic search

<BLINDED_PROJECT_NAME> will support the discovery and retrieval of musical encodings and associated materials using conventional faceted metadata-level queries (e.g., "Madrigals for four voices published in Venice in the 1540s"), but also by content-based techniques searching within representations of musical score (Crawford, Badkobeh, & Lewis, 2018). Through expert- and crowd-sourced semantic alignments, we anticipate supporting explorations of musical material incorporating extra-musical information resources -- e.g., large digitised collections of books (Downie, Dougan, Bhattacharyya, & Fallaw, 2014) and historical newspapers (Liem, 2018).

Conclusion

The *<BLINDED_PROJECT_NAME>* project leverages automated computational analyses, human insight, and semantic technologies to enrich and contextualise classical music resources in the public domain. MEI score encodings provide a musical structure through which to interweave references to multimodal content and bibliographical, analytical, and provenancial metadata toward this effort.

The project is within its starting phase, and many open problems remain -- not least around representing changes to MEI files tracking these enrichment processes, and on establishing best practices of data representation spanning MEI encodings and knowledge graphs. We hope to involve and benefit from voices within the Music Encoding community in tackling such issues as we work towards richer online music public-domain archives.

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