

Innovative MIR Applications at the Bayerische Staatsbibliothek

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ABSTRACT

This short position paper gives an insight into the digitization of music prints in the Bayerische Staatsbibliothek and describes two music information retrieval applications in the Bayerische Staatsbibliothek. One of them is a melody search application based on OMR data that has been generated with 40.000 pages of digitized music prints containing all compositions of L. van Beethoven, G. F. Händel, F. Liszt, and F. Schubert. The other one is the incipit search in the International Inventory of Musical Sources (Répertoire International des Sources Musicales, RISM).

CCS Concepts

• **Information Retrieval** → • **Specialized Information Retrieval** → • **Multimedia and multimodal retrieval** → • **Music retrieval**.

• **Applied Computing** → • **Computers in other domains** → • **Digital Libraries and Archives**.

Keywords

Optical Music Recognition; Digital Library; Digitization.

1. DIGITIZATION OF MUSIC MATERIAL

It is the intent of the Bayerische Staatsbibliothek to digitize as many of its holdings as possible. In the Music Department, mostly paper-based material is being digitized (music prints, music manuscripts, music books, music journals, libretti). On a smaller scale, there also exist a workflow for digitizing sound carriers, especially music cassettes and video cassettes. However, the audio files that are generated from the sound carriers, are not accessible for the library users for legal reasons. The digitization of sound carriers is solely done for preservation reasons.

A more detailed description about the digitization and presentation of music documents of the Bayerische Staatsbibliothek can be found in [1].

The focus in this paper is on optical music recognition. Therefore, we will concentrate here on the digitization of music prints as they are used as input for the OMR process. The digitization of music prints in the Bayerische Staatsbibliothek is initiated via three different ways:

- project-based digitization
- digitization requested by users (“digitization on demand”)
- digitization by Google

The project-based digitizations are mostly financed by third-party funds (e.g. from the Deutsche Forschungsgemeinschaft, DFG). During the last years, the Music Department of the Bayerische Staatsbibliothek has put an emphasis on digitizing its core holdings from the 16th and 17th century and on digitizing complete editions of selected composers. As of May 2018, 20,965 music prints have been digitized and put online, among others in the following digitization projects:

- Printed sheet music of the 16th and 17th century with music for several voices
- Complete edition of Ludwig van Beethoven’s works (Breitkopf & Härtel, 1862 – 1865)
- Complete edition of Georg Friedrich Händel’s works (edited 1858 – 1902 by Friedrich Chrysander)
- Complete edition of Franz Liszt’s works (ed. 1907 – 1936 by Carl Alexander)
- Complete edition of Felix Mendelssohn Bartholdy’s works (ed. 1874 – 1877 by Julius Rietz)
- Complete edition of Franz Schubert’s works (Breitkopf & Härtel, 1884 – 1897)
- Complete edition of Robert Schumann’s works (ed. 1879 – 1893 by Clara Schumann)

Another trigger for digitizations is the request of a user. Any user (even without a library card) can initiate the digitization of a music print (and also of other library holdings). The Bayerische Staatsbibliothek offers this service via a web form¹ and bills the user. However, the digitized version of the music print is added to the digital collections of the Bayerische Staatsbibliothek and is accessible free of charge by everybody.

If a user needs a high-resolution digital copy of a music print for research purposes, then the DaFo-service² can be used (“Daten für die Forschung”, “data for research”) in order to get JPEG-files with a resolution of 300 ppi.

The third pillar for the digitization activities of the Bayerische Staatsbibliothek is its cooperation with Google³. This cooperation started in 2007 and contained the digitization of the copyright-free older holdings including the digitization of music prints from the 18th and 19th century. Unfortunately, a lot of music prints from this period have no publication date in our catalogue and can therefore not be included in the Google workflow. We have to respect the copyright law and can therefore only digitize music

¹ <https://www.bsb-muenchen.de/en/search-and-service/registration-loan-order/ordering-media-or-copies/document-delivery-altes-buch>

² <https://www.bsb-muenchen.de/en/search-and-service/registration-loan-order/ordering-media-or-copies/high-resolution-digital-copies>

³ <https://www.bsb-muenchen.de/en/about-us/cooperations/google>

prints that have been published before a certain year. This rule cannot be applied if there is no publication date.

All digitization efforts of the Bayerische Staatsbibliothek resulted in a digital collection of 2.3 million titles (as of April 2018), among which are 21,000 digitized music prints and 3,700 digitized music manuscripts.

2. A NEW OMR APPLICATION

In mid-2016, the Bayerische Staatsbibliothek started an OMR-project with the aim to generate OMR data from its digitized music prints and to develop a melody search application based on the OMR data. During the first project phase, several OMR programs have been tested on a subset of our digitized music prints. We used Audiveris, Capella Scan, SharpEye, and SmartScore for this test. It is almost impossible to compare the test results of the different OMR programs in an objective way as has already been stated in different papers [2] [3]. Our choice for a specific OMR program was based on the rate of music pages that have successfully passed the OMR process and the subjective analysis of the OMR result. It turned out that SmartScore worked best for our digitized music prints.

The second phase of our OMR-project involved the generation of OMR data for a subset of our digitized music prints. We used the complete editions of the following composers with a total of 40,000 pages: Ludwig van Beethoven, Georg Friedrich Händel, Franz Liszt, and Franz Schubert. Because of the large quantity of music pages, we did not correct the OMR-data that have been generated by SmartScore. We therefore have to deal with OMR data that contains quite a few errors and have to design fault-tolerant use cases.

In the third project phase we developed a melody search application “musiconn-Notensuche (musiconn.ScoreSearch)” based on the OMR data. The melody search string can be entered either via a virtual piano keyboard or by entering the names of the notes in a search field. Figure 1 shows a screenshot in musiconn-Notensuche where the beginning melody of Beethoven’s string quartet op. 59/1 has been entered and the first two records of the result list are displayed. The first search result is the cello theme of Beethoven’s string quartet, and the second result is a partly match where the first 9 note of the 12-note search string appear in Händel’s oratoria *Jephtha*.

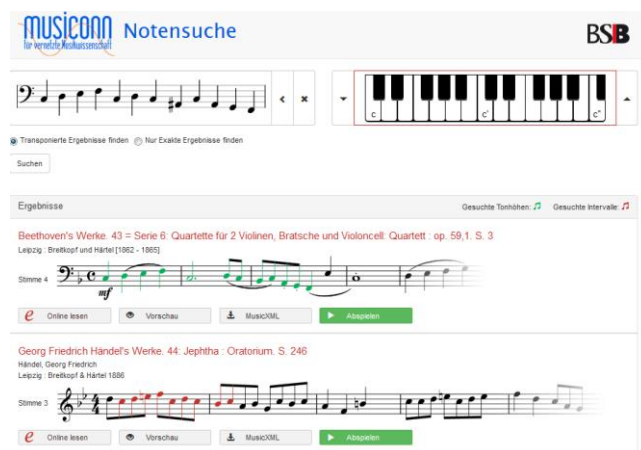


Figure 1: Example for a melody search in Musiconn-Notensuche

The website of musiconn-Notensuche is available at <https://scoresearch.musiconn.de/ScoreSearch/>.

3. INCIPIT SEARCH IN 1 MILLION MUSIC MANUSCRIPTS

Another MIR-application in the Bayerische Staatsbibliothek is the RISM-OPAC⁴. The RISM-OPAC is the presentation system of the RISM database (“Répertoire International des Sources Musicales, International Inventory of Musical Scores”). RISM is an international organization with the aim to document musical sources worldwide⁵. Its database currently includes 1.1 million records (mostly music manuscripts, as of May 2018).

The RISM-OPAC is based on a cooperation between RISM, the Bayerische Staatsbibliothek and the Staatsbibliothek zu Berlin – Preußischer Kulturbesitz. The Staatsbibliothek zu Berlin hosts the cataloguing system Muscat which has been developed by RISM and is used by RISM working groups in 35 countries for cataloguing music sources. The Bayerische Staatsbibliothek is responsible for the implementation and the hosting of the RISM-OPAC. The RISM-OPAC is a heavily used application; from May 2016 until May 2017 an average of around 75,000 searches per month have been processed by the RISM-OPAC.

The RISM records are detailed descriptions of musical sources and include one or several music incipits per record. The cataloguers create the incipits manually by using the Plaine&Easie code⁶. The RISM-OPAC allows searches on almost all fields of the RISM records, including an incipit search which can be entered either by typing the names of the notes on the computer keyboard or by using a virtual piano keyboard in the advanced search page of the RISM-OPAC. During the incipit search, the rhythm is not taken into account; only the melodic contour is relevant for the result list. More information about the incipit search in the RISM-OPAC can be found in [4].

In July 2018, a new version of the RISM-OPAC was released. Among other developments, it contains an improved incipit search where the technology of the OMR application described in section 4 has been applied to the RISM-OPAC.

4. OUTLOOK

The OMR application described in section 3 is still in a prototype status. The Bayerische Staatsbibliothek is currently evaluating how this application should be further developed.

The RISM-OPAC has been a production system since 2010 and undergoes development phases with inclusion of new features approximately every 1 to 2 years. The next plans for the RISM-OPAC are to include crowd-sourcing possibilities and to look for synergies between the two systems RISM-OPAC and Muscat.

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⁴ <https://opac.rism.info>

⁵ <https://www.rism.info>

⁶ <http://www.iaml.info/plaine-easie-code>

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