BUILDING AN INFRASTRUCTURE FOR A 21ST-CENTURY GLOBAL MUSIC LIBRARY

Cory McKay
Marianopolis College, CIRMMT
cory.mckay@mail.mcgill.ca

Ichiro Fujinaga
McGill University, CIRMMT
ich@music.mcgill.ca

ABSTRACT

This paper provides an overview of the major international MIRAI (Music Information Research and Infrastructure) and SIMSSA (Single Interface for Music Score Searching and Analysis) research projects, and of the software and musical data produced by them. This is intended to encourage the MIR research community to make use of these resources, and to encourage research collaboration in developing them further in the future.

1. INTRODUCTION

Many libraries and other data repositories have, in recent years, made significant progress in making textual data accessible to researchers via relatively sophisticated search tools. Unfortunately, researchers and others still face a number of significant barriers when trying to search and access music in comparable ways.

The MIRAI project is intended to address this issue by creating a rich and flexible infrastructure for a global music library consisting of audio, scores and metadata. This will greatly facilitate large-scale data-intensive musicological research. This requires:

- Designing workflows for gathering musical information.
- Converting and formatting this information to be easily accessible by people and computers.
- Conducting research on the information behavior of music scholars.
- Developing user-centered analytical tools to navigate and promote research using this data.

The MIRAI project is tightly integrated with the SIMSSA project [1], which is specifically focused on creating a framework for making scores accessible to researchers, analyzing them via automatic tools and making all the resultant information easily searchable. In essence, the goal is to make scores from music libraries around the world accessible via a unified web interface. This work is divided into two axes, respectively focused on:

- Collecting digital images of scores and extracting searchable digital scores from them using optical music recognition (OMR) technology.
- Developing tools and techniques for large-scale search and analysis of the resultant scores.

The SIMSSA research puts a special emphasis on early music scores, which have received relatively little attention from the MIR community to date. Our goal is to ensure that musicological and music theoretical researchers studying this music will be well served, as well as researchers studying other diverse types of music.

Sections 2 to 6 below describe highlights of the MIRAI and SIMSSA-related initiatives currently underway.

2. CANTUS ULTIMIS

This project applies the latest OMR technologies to plainchant manuscripts [2] in order to transform the existing CANTUS database of nearly 400,000 chant records into a state-of-the-art research environment in which both music and text are fully searchable. We have recently processed and made available online the St. Gall manuscripts, two of the oldest surviving chant manuscripts.

3. ELVIS, VIS AND RODAN

The ELVIS Database is an open, crowd-sourced collection of music in symbolic notation, currently totaling over 4,000 pieces. This project incorporates the VIS music analysis framework [3], which makes use of music21 to provide powerful music analysis functionality. Integration with the Rodan framework [4] makes it possible to easily design custom music analysis workflows. A web app is available for accessing, searching, automatically analyzing and visually exploring musical data.

4. JSYMBOLIC

jSymbolic is software for extracting high-level classification features from MEI or MIDI files, and for making these features accessible for statistics-based searching or processing using machine learning algorithms. 111 features are currently extracted by jSymbolic, which is part of the jMIR framework [5].

5. DIVA, NEON AND VEROVIO

Diva [6] is a digital document viewer designed for the websites of libraries, archives and museums so that they can present high-resolution images of documents via a user-friendly interface. Diva supports the International Image Interoperability Framework (IIIF) in order to support interoperability between image repositories.

Neon [7] is a browser-based music notation editor designed for dealing with neumes. It can serve as a standalone tools, or as a component of optical music recognition workflows.

Verovio [8] is a library for engraving MEI music scores into the SVG vector image format. It can be used to display scores, or simply be used as a conversion tool.

6. LIBER USUALIS

This is a first basic prototype of the type of integrated system we are working towards. The Liber Usualis is a liturgical service book and an important source for Gregorian chant. Preparing this prototype involved performing OMR and OCR (optical character recognition) on all 2,340 page images in this book, while maintaining notation and image correspondence. A web application was developed that allows basic query input based on n-gram indexing of the notation content, and which highlights the locations of results in situ on the page image. More information is available at liber.simssa.ca.

7. FUTURE RESEARCH AND COLLABORATIONS

Our focus is on making still more musical data and analysis tools available to users in a unified way. We are beginning work on building a large-scale unified music search engine, currently code-named *Misirlou*, which will provide users with the ability to search digitized music scores. Images hosted by our partner libraries will be automatically transcribed, and the extracted music notation will be stored and analyzed by our suite of search and indexing tools. Users will then search our data, and will be able to retrieve the original image from the host library. This is the ideal partnership situation for libraries, as they maintain control over public access and quality of metadata, while our tools make their collections usable in a global context.

As we expand our scope from symbolic data and metadata to audio, we are very interested in developing improved ways of making audio data and extracted information accessible to researchers. In particular, we are looking at developing an audio equivalent of the IIIF, the *International Audio Interoperability Framework (IAIF)*, which will provide researchers with access to the specific audio they need in a standardized and accessible way.

Both MIRAI and SIMSSA are very much active projects supported by long-term funding. We would like to encourage members of the MIR research community to try out the tools and data we have already released, and we are enthusiastically receptive to future collaborations, as well as to suggestions as to user needs we could meet. We would also be very grateful to any researchers or institutions with access to musical data that they would be willing to share over our frameworks. More information on the overall projects is available at simssa.ca.

8. ACKNOWLEDGEMENTS

We would like to thank the Social Sciences and Humanities Research Council of Canada (SSHRC) and the Fonds de recherche du Québec - Société et culture (FRQSC) for their generous funding. We would also like to acknowledge the formidable contributions of our many collaborators on the MIRAI and SIMSSA projects.

9. REFERENCES

[1] I. Fujinaga, A. Hankinson, and J. Cumming. “Introduction to SIMSSA (Single Interface for Music Score Searching and Analysis),” *Proceedings of the International Workshop on Digital Libraries for Musicology,* pp. 100–102, 2014.

[2] K. Helsen, J. Bain, I. Fujinaga, A. Hankinson, and D. Lacoste. “Optical Music Recognition and Manuscript Chant Sources.” *Early Music* vol. 42, pp. 555–58, 2014.

[3] C. Antila, and J. Cumming. “The VIS Framework: Analyzing Counterpoint in Large Datasets,” *Proceedings of the International Society for Music Information Retrieval,* pp. 71–76, 2014.

[4] A. Hankinson. “Optical Music Recognition Infrastructure for Large-Scale Music Document Analysis,” Ph.D. Dissertation, Schulich School of Music, McGill University, Montreal, Canada, 2014.

[5] C. McKay. “Automatic Music Classification with jMIR,” Ph.D. Dissertation, Schulich School of Music, McGill University, Montreal, Canada, 2010.

[6] A. Hankinson, W. Liu, L. Pugin, and I. Fujinaga. “Diva: A Web-Based Document Image Viewer.” *Proceedings of the Conference on Theory and Practice in Digital Libraries,* 2012.

[7] G. Burlet, A. Porter, A. Hankinson, and I. Fujinaga. “Neon.js: Neume Editor Online.” *Proceedings of the Conference of the International Society for Music Information Retrieval,* pp. 121–26, 2012.

[8] L. Pugin, R. Zitellini, and P. Roland. “Verovio: A Library for Engraving MEI Music Notation into SVG,” *Proceedings of the International Society for Music Information Retrieval Conference,* pp. 107–12, 2014.