

# A Visualization Tool for the CIRMMT Distinguished Lecture Series

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*The CIRMMT Distinguished Lecture (DL) series consists of over seventy 1-hour videos of leading scholars and artists discussing their interdisciplinary work, a unique video encyclopedia of Music, Science and Technology. Though this collection in itself is already an invaluable research and pedagogical tool, searching videos in the collection is not a trivial task given the diversity of fields and topics. To facilitate the navigation in the collection, we developed a visualization tool representing textual metadata of videos in a hierarchical bubble chart. In this paper we describe the distinguished lecture series and discuss the iterative prototyping of the visualization tool, as well as avenues for future developments.*

## INTRODUCTION

The Centre for Interdisciplinary Research on Music Media and Technology (CIRMMT)<sup>1</sup>, based in Montreal, Quebec, Canada, is a leading research institution aimed at fostering interdisciplinary research across sound/music, science and technology. Founded in 2001, it has quickly established itself at the forefront of research institutions at the intersection of these areas. Thanks to strong support from McGill University and its partners (Université de Montréal, Université de Sherbrooke and recently École de technologie supérieure), to a large number of individual and group grants from provincial and federal agencies, as well as to a variety of industrial partnership projects, CIRMMT has built unique facilities for the scientific study of sound and music. Among such facilities, a novel 400+ square meter ultra-quiet, large-scale multimedia room which is one of the most advanced research and performance spaces using the latest virtual acoustics techniques and cutting-edge performance measurement equipment. Altogether, CIRMMT serves around 130 members and collaborators, more than 200 graduate and undergraduate students, and many industrial partners.

### CIRMMT RESEARCH STRUCTURE

CIRMMT's research is currently organized in four research axes (RA). These axes are guiding the selection of speakers for distinguished lectures. A short summary of each research direction is presented here, a full description is available on the Centre's website<sup>2</sup>.

- *Instruments, Devices and Systems* (RA1) encompasses engineering and mathematics research applied to sound and music. Topics include instrument and room acoustics, digital signal processing and new interfaces for musical expression.
- *Music Information Research* (RA2) focuses on computer applications for music information research. Research topics include digital music libraries, optical music recognition and computer-aided analysis of large amounts of music.
- *Cognition, Perception and Movement* (RA3) focuses on the scientific study of music, from the performer to the listener. Research topics include embodiment and movement synchronization and music cognition & perception.
- *Expanded Musical Practice* (RA4) focuses on artistic research. Research topics include the creation of works involving science and technology, the documentation of creative processes and the evaluation of the impact of technology in the arts.

### CIRMMT DISTINGUISHED LECTURE SERIES

The *Distinguished Lecture* (DL) series is one of the main public events organized by the Centre. Together with the *live@CIRMMT* concert series, it aims to foster interdisciplinary research by inviting world-class researchers to present an overview of their research to a broad audience, with typically 6 or 7 lectures yearly. To date, 94 lectures were held, of which 71 videos are available online constituting a unique, freely accessible resource for the community.

Starting in October 2005, distinguished researchers and artists from around the world have been invited to Montreal to present a 1-hour overview of their research, which most of the time spans over several decades. Video recordings of the talks were made early on, though initially only as a means of archiving the events for internal records.

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<sup>1</sup><http://www.cirmmt.org>

<sup>2</sup><http://www.cirmmt.org/research/axes>

Over the years, with the increase of the number of talks, the CIRMMT direction realized the strong potential of the DL as pedagogical tool for anyone interested in the intersection of science, technology and sound/music. A dedicated YouTube channel<sup>3</sup> was then established and the lectures were posted online, cf. Fig. 1.

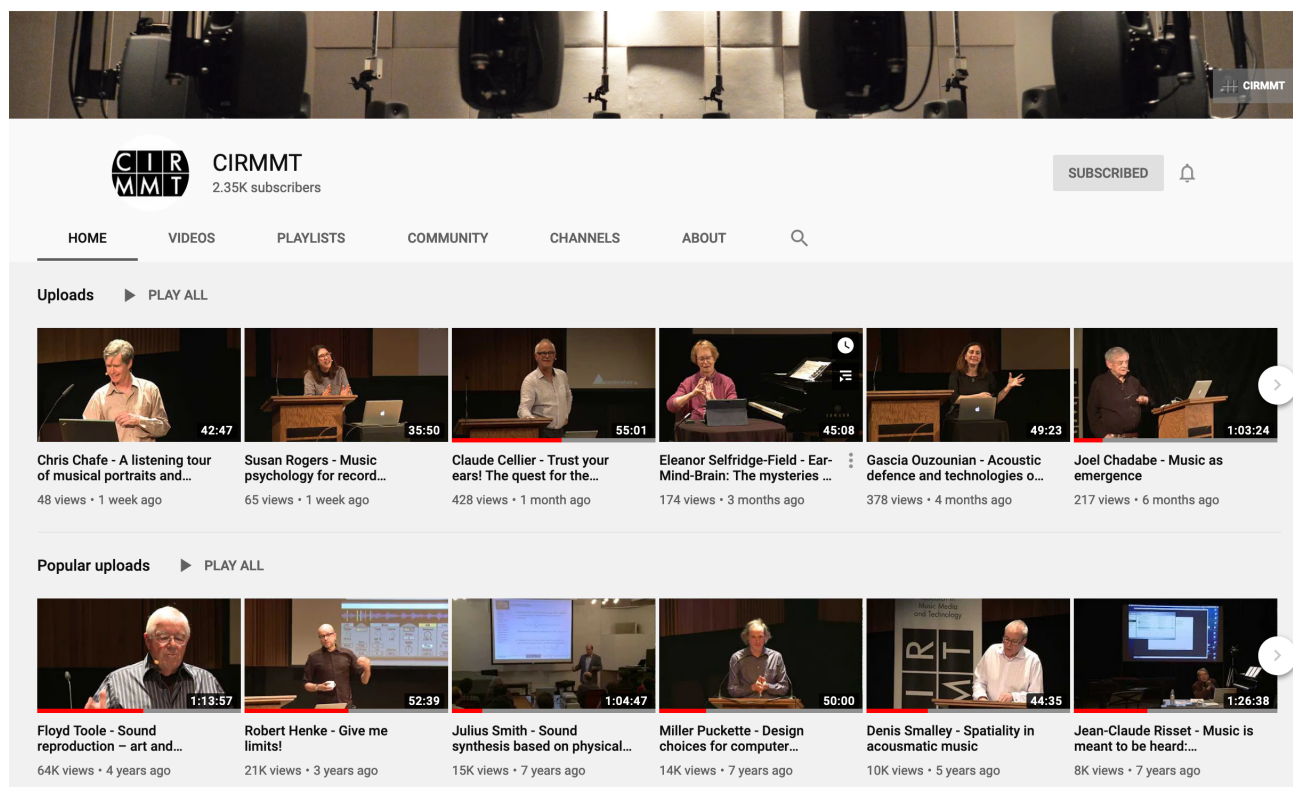


Figure 1: Front page of CIRMMT's YouTube channel. Note the large spectrum of topics, but also the wide variation in the number of views for each lecture. Screenshot taken on January 27, 2020.

The Distinguished lecture series showcase researchers who made crucial contributions to their fields, with topics varying from computer music/sound and music computing, to psychology, cognition and neuroscience of music, from audio processing and music information retrieval to music composition and education. It not only provides accurate and recent information spanning many research careers, it has also an invaluable historical importance. This is the case for the videos of seminal researchers and artists such as David Wessel and Jean-Claude Risset, who sadly already passed away. Their videos illustrate their research and artistic achievements in what constitutes a first-hand, sometimes unique reference to their outstanding work.

It is important to note that the CIRMMT video channel actually encompasses more than the DL videos, as it also hosts videos of other high-profile CIRMMT events such as CIRMMT Student Symposium Keynotes and CIRMMT Seminars<sup>4</sup>. Though we refer to the DL series in this paper, we actually included these other videos in the DL series video collection and in the visualization tool, raising the current total number of available videos to 84.

## ARCHIVING LECTURES AND ESTABLISHING A DL DATASET

Apart from the YouTube channel, CIRMMT created a webpage dedicated to the DL videos around 2012<sup>5</sup>. Though meaningful when a handful of videos were available, it rapidly became less useful due to the constant increase in the number of videos. This can be seen in Fig. 2, that although only displaying a few of the most recent DLs, already shows the limitations of this solution.

<sup>3</sup><https://www.youtube.com/c/CIRMMT>

<sup>4</sup>[live@CIRMMT](mailto:live@CIRMMT) concert videos, although regularly recorded, are unfortunately not available to the public due to more complex copyright management

<sup>5</sup><http://www.cirmmt.org/video>

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## 2019–2020

- Nov 21, 2019 – [Susan Rogers: Music psychology for record makers \[NEW!\]](#)
- Oct 24, 2019 – [Claude Cellier: Trust your ears! The quest for the optimum \(digital\) audio representation](#)
- Sep 19, 2019 – [Eleanor Selfridge-Field: Ear–Mind–Brain: The mysteries of musical similarity](#)

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## 2018–2019

## DISTINGUISHED LECTURES

- May 02, 2019 – [Joel Chadabe: Music as emergence](#)
- Apr 11, 2019 – [Udo Zölzer: DAFX digital audio effects and applications](#)
- Mar 21, 2019 – [Daniel Russell: Animations as educational tools for understanding the acoustics of musical instruments](#)
- Feb 21, 2019 – [Steven Takasugi: A machine for deception: Electro–acoustic composition as sleight of hand](#)
- Nov 29, 2018 – [Sally Jo Cunningham: Engagement with personal music collections](#)
- Oct 18, 2018 – [William Hartmann: Sound source localization: How the auditory system copes with confusing data](#)
- Sep 20, 2018 – [Richard Lyon: Extracting meaning from sound: Experiences in machine hearing](#)

## CIRMMT–OICRM–BRAMS STUDENT SYMPOSIUM (COBS) KEYNOTE

- May 09, 2019 – [Gascia Ouzounian: Acoustic defence and technologies of listening during the First World War](#)

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## 2017–2018

## DISTINGUISHED LECTURES

- Mar 15, 2018 – [Sylvie Gibet: Gesture: a language to sense, express, control](#)
- Feb 01, 2018 – [Trevor Wishart: Composing the real](#)
- Dec 13, 2017 – [Bill Seaman: Recombinant music: Generative approaches](#)
- Nov 09, 2017 – [Toshifumi Kunimoto: YAMAHA's musical instruments and audio products as DSP applications](#)
- Oct 09, 2017 – [Joseph Myers: Recital halls, rehearsal rooms, and research spaces](#)

## CIRMMT STUDENT SYMPOSIUM KEYNOTE

- May 17, 2018 – [Eric Heller: Journey into psychoacoustics](#)

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## 2016–2017

## DISTINGUISHED LECTURES

- Apr 20, 2017 – [Dan Gauger: Giving people control of our most important human sense – hearing](#)
- Feb 23, 2017 – [Benoit Fabre: Musical instruments and players – an acoustical approach to the relations between](#)

Figure 2: Top part of the CIRMMT Video page showing in list form the most recent DL dates, speaker and title with links to the videos. Screenshot taken on January 27, 2020.

### DISTINGUISHED LECTURE DATASET

In early 2018, a collaborative effort, headed by CIRMMT administrator Jacqueline Bednar, was carried out to create a DL dataset of all available lecture videos, as well as of videos of student symposium keynotes and selected seminars. This dataset includes basic information such as lecturer's name, affiliation, date, talk title and newly prepared 100-word summaries and keywords for each talk.

Nine CIRMMT graduate students were hired to watch from 4 to 6 videos each and prepare the required information for each video. After receiving the data from each student, the administrator verified the consistency across the various contributions, aiming to achieve a coherent description of the videos.

### HOMOGENIZING KEYWORDS

A complex issue when describing information, notably in interdisciplinary research, is to select an optimal number of keywords to describe each item uniquely and, at the same time, restrict the number of choices to a minimum. For our prototype, a list of keywords was created taking into account a balanced distribution of topics for each research axis, with 5 or 6 keywords per axis.

In the current implementation of the visualization, each DL is associated with only one keyword, a choice needed to facilitate the implementation of the visualization, though a simplification considering the interdisciplinary nature of the talks. On the other hand, research axes do share keywords.

Table 1: Choice of keywords per research axis.

Research Axis	Keywords
RA1	Audio processing, Computer music systems, Musical acoustics & instruments, New interfaces for musical expression, Room acoustics
RA2	Audio processing, Computer music systems, Music information retrieval, Music theory, Musicology
RA3	Composition, Movement, Music performance & education, Music theory, Neurosciences, Perception & cognition
RA4	Composition, Computer music systems, Music performance & education, Music production, Musicology, Perception & cognition

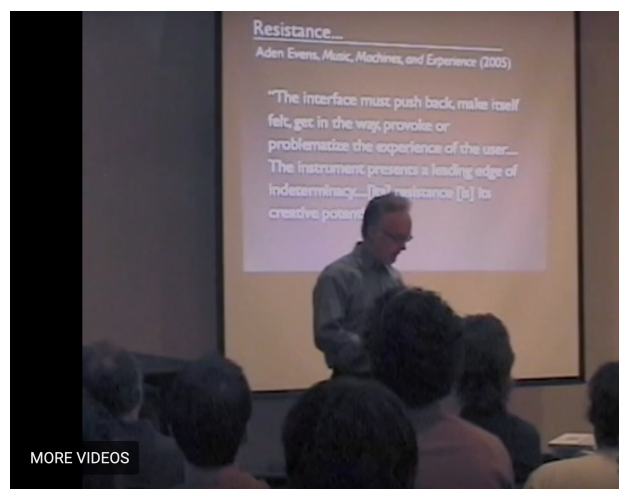
## IMPROVING VIDEO PRODUCTION, EDITION AND VISIBILITY

As previously mentioned, though filming of the DL series has been implemented early on, videos were mainly aimed for archiving. To make the talks openly available and take into account the constant increase of the video collection, apart from inherent copyright issues, a few other actions were needed:

- Improve on the quality of the videos.
- Streamline the editing of video recordings.
- Increase visibility of the collection.

### VIDEO PRODUCTION AND EDITING

Improving the limited quality of the videos was mostly solved with a simple administrative decision: move the DL series to an auditorium already equipped with theatrical lights<sup>6</sup>. To streamline the editing of the recordings, it was decided to hire CIRMMT students to both film the talks and later edit the videos right after they were recorded, speeding up the whole process<sup>7</sup>.



(a) Early recording example, lecture by Butch Rovin, January 2008.



(b) Example of setup after 2012, lecture by Ed Campion, February 2016.

Figure 3: Screen shots of two distinguished lectures eight years apart.

Since 2013, the talks take place at McGill University's Tanna Schulich Hall, a 170-seat auditorium equipped with theatrical lights that are easily adjusted to fit the needs of the DL series. While keeping the original two-camera setup, a dedicated video feed for the slides was added to the recordings so that slides can be easily read. Finally, CIRMMT also provides courses to students on how to operate the cameras and edit the videos, with the added benefit of offering them training that can be useful for their careers.

The result is that the quality of the videos has skyrocketed and now the Centre has a proven, streamlined procedure to film and make edits to the talks which become available in a short lapse of time. Furthermore, dozens of students have received training and have done a professional-level job editing the various videos.

<sup>6</sup>Issues such as the availability of theatrical lighting for videos were not initially considered. The result was that sometimes the speaker was barely seen in the videos due to the high intensity of the slide projector. Similarly, given that the talks typically took place in the late afternoon in a room with several windows, daylight changes between the beginning and the end of the talks did cause drastic light variations.

<sup>7</sup>Until then, students filming the lectures did it in a volunteer basis. Editing of the early recordings was mostly done by the CIRMMT administrator or by a professional editor.

## VISIBILITY OF THE COLLECTION

Though in itself a useful tool, the CIRMMT webpage displaying the list of videos is certainly of limited use, cf. fig. 2, calling for a better solution to help navigate the video collection in the form a visualization of its main characteristics.

A more complex issue is the wide variability in the number of views for the different videos, as seen in fig. 1. While some of the lectures have excellent visibility (i.e. sometimes way more than ten thousand views), others are not well-known, with only a few hundred views each.

Clearly, this discrepancy does not correlate to variations in the quality of, or interest in, the different lectures. Rather, it seemed clear that access to the talks is overwhelmingly based on YouTube recommendation, not from the CIRMMT homepage. This situation brings both advantages, e.g. academic talks might get visibility that greatly overdoes typical academic video views, and drawbacks, in this case the fact that viewers who arrive at a given lecture do not necessarily learn about the others.

One of the main goals of the visualization tool is to provide a more user-friendly way of discovering the DL videos, helping viewers get a better sense of the richness of the information available in the DL series as a whole.

## VISUALIZATION ITERATIONS

Information visualization is a well established research field. Decades ago, Card, MacKinlay and Schneiderman edited an overview of seminal works in information visualization [2]. Though more recently works provided guidelines to carefully design information visualizations, e.g. [8], making sense of available data visualization techniques and tools can still be a complex endeavour [4].

Our dataset is composed of video recording of lectures, associated with textual metadata, partially obtained through manual annotation. Creating techniques and tools to browse and analyse these diverse types of data requires combining knowledge from research communities such as multimedia information retrieval, text mining, and natural language processing; human-computer interaction, information visualization, and search user interfaces [3]. Previous works addressing similar topics include those by Schoeffmann et al. [6], who recently surveyed tools for video interaction including browsers with visual displays and by Kucher and Kerren [5], who proposed a taxonomy of visualization techniques specific to textual datasets.

## INITIAL PROTOTYPES

Initial explorations with visualizations for CIRMMT DL videos were made during McGill's Music Technology graduate seminar MUMT 620 in the winter of 2019. A class assignment was proposed in which groups of students should devise and implement visualizations for the distinguished lecture dataset. Initial visualization strategies included a Sunburst [7], shown in Fig. 4, and a Dendrogram, shown in Fig. 5

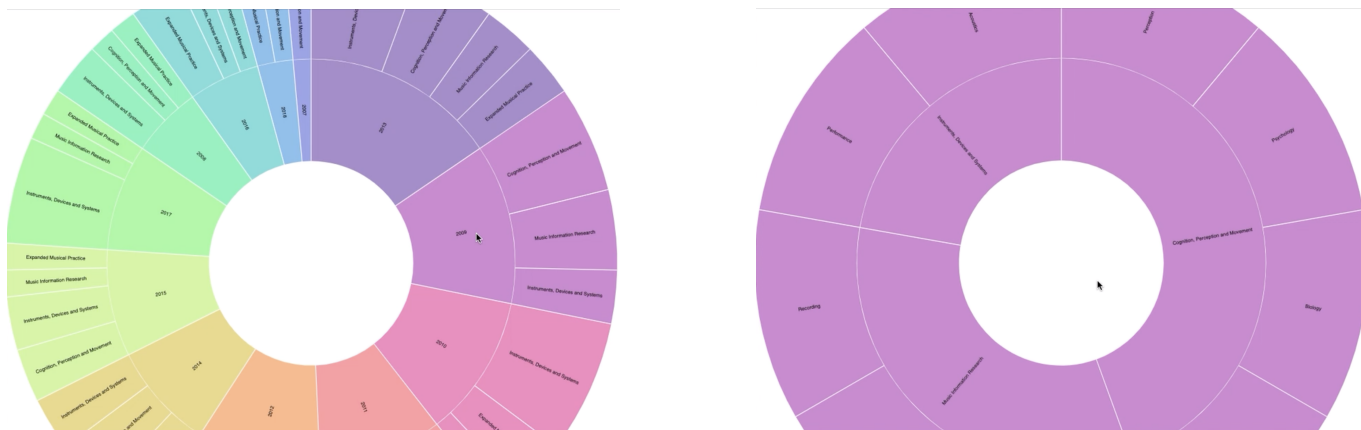


Figure 4: Sunburst visualization of distinguished lectures.

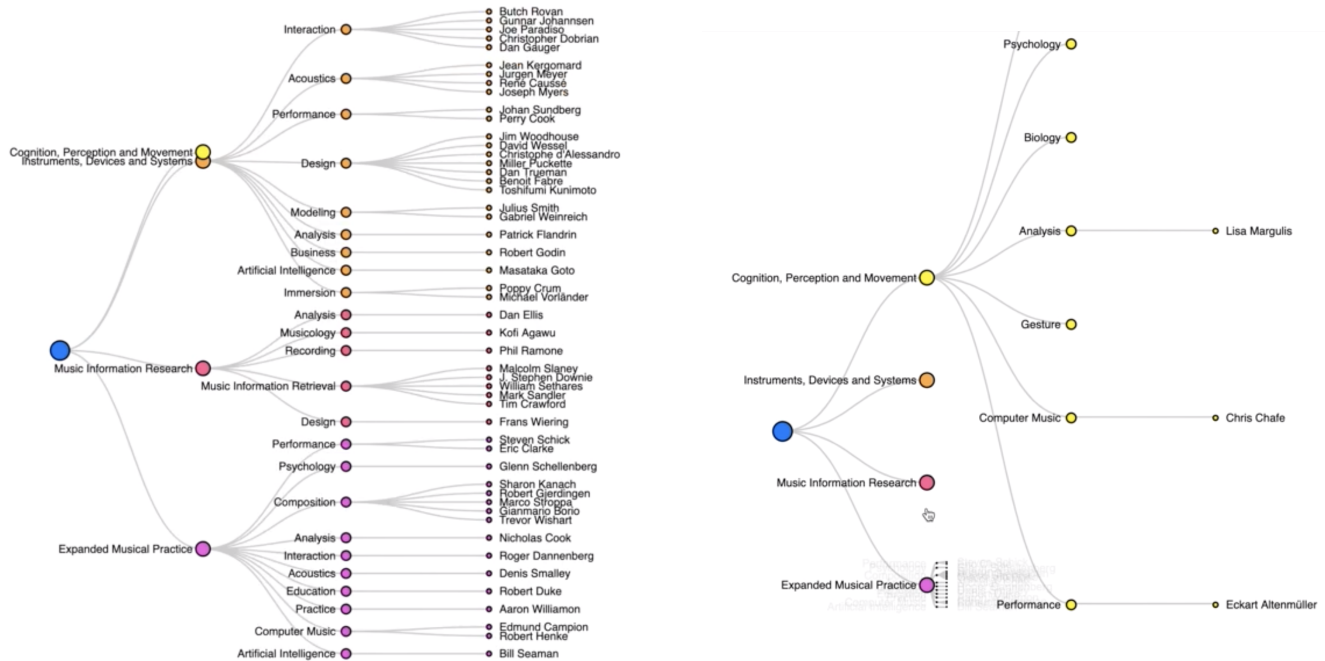


Figure 5: Dendrogram visualization of distinguished lectures.

### CURRENT PROTOTYPE

After discussing the pros and cons of the initial prototypes, a third visualization technique was chosen, featuring a hierarchical bubble chart<sup>8</sup>, as seen in Fig. 6. In this visualization, at the first viewing level, dark circles represent the four CIRMMT research axes and are not interactive.

Chosen keywords appear in brighter circles that can be clicked upon. The relationship between the keywords and their associated axes is indicated by traces uniting keywords to axes when the cursor passes over the corresponding area in the visualization.

<sup>8</sup>The visualization tool is available from <http://www.cirrrmt.org/video>

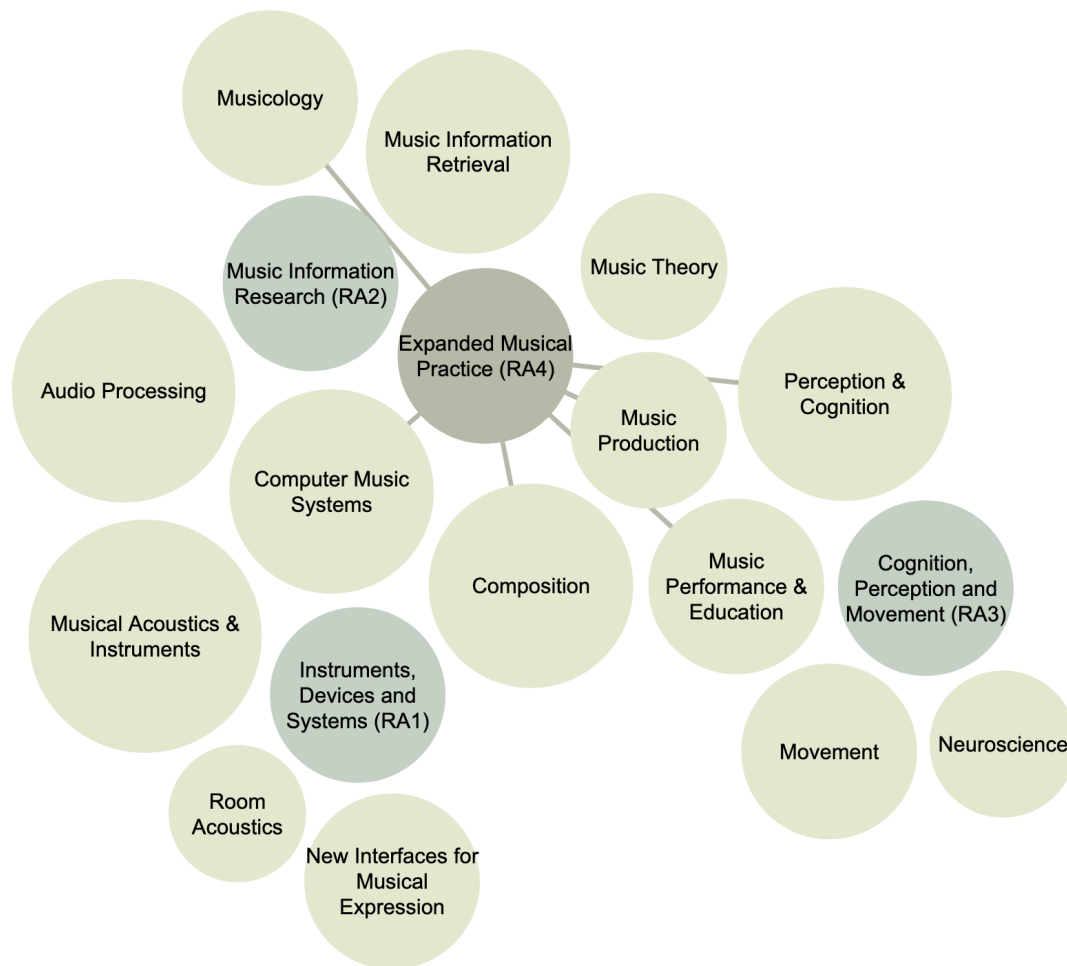
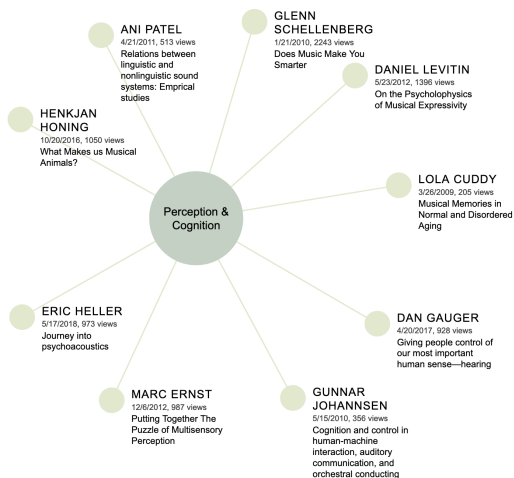


Figure 6: The hierarchical bubble chart visualization of the DL series. Darker circles indicate CIRMMT research axes, while brighter ones are associated with keywords. In this case, as the cursor was placed on top of the dark circle representing RA4, related keywords are shown connected to it.



(a) Perception & cognition.

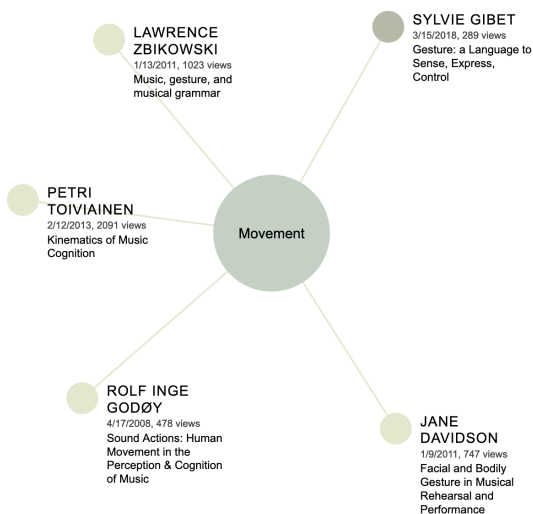


(b) Musical acoustics & instruments.

Figure 7: Examples of keywords-based lists of lectures.

When clicking on a given keyword circle, another view appears (2nd level) showing the chosen keyword in the centre of the screen with its associated talks around it. Information displayed for each talk include speaker name, talk title and date, as well as the current number of views in YouTube. Examples of two keywords with their associated talks are shown in Fig. 7

When in the second level, by clicking on a bubble representing a talk, the YouTube video of the talk appears on the right of the screen and includes the information already displayed around the bubble (talk), plus the speaker affiliation and the 100-word summary of the talk. Once here, the talk is visible as an embedded YouTube video.



**SYLVIE GIBET**

University of South Brittany, France  
**Gesture: a Language to Sense, Express, Control**  
 Distinguished Lecture, March 15, 2018, 289 views



Gesture is used as a means of communication in a variety of circumstances, however deeper knowledge of the mapping that occurs between the language units and the motion is required. Gibet proposes a perception/production approach for explaining motion and language production/comprehension related to sign language, theater, and musical gestures. She offers a methodological approach for the extraction of meaningful components of motion in the decoding process and use of these components to re-synthesize motion in the encoding process. Beyond this, Gibet describes the tools developed for specific analysis/synthesis models adapted to gestures: avatar technology as well as the synthesis models and methods employed.

Figure 8: The final level of the visualization showing the talks associated with a chosen keyword on the left and on the right the video and information of a specific talk chosen (darker bubble).



By clicking on the keyword at the second level, the user is taken back to the first level where they can start again exploring the set of keywords.

## PROTOTYPE IMPLEMENTATION

The visualization is implemented in JavaScript using the data visualization library `d3.js` [1], which is a Document Object Model (DOM) manipulation library that allows for generating data-driven documents and visualizations.

The visualization is based on a force directed graph layout provided by the module `d3-force`. The module implements a force simulation and provides parameters for charge, link, center, and collision forces. These parameters were hand-tuned to match the visualization.

The video dataset is stored in a file with comma-separated values, which is loaded into an array containing all the nodes in the graph. The links between the nodes are created by iterating through the nodes, adding a link for each connection. This results in two arrays describing the nodes and links of the graph. The arrays are passed to the `forceSimulation` of the `d3-force` function which generates the coordinates for each node and link. The node array is also passed to the `select` function of `d3`, which generates a Simple Vector Graphics (SVG) group for each node. A circle is drawn in each group along with a text label. As SVG doesn't support text wrapping, the label is attached as a HTML tag using the `foreignObject` tag of SVG, which allows for embedding HTML in a SVG drawing. For animating the shapes, the object returned from the `forceSimulation` function provides the `tick` event that updates the coordinates of the nodes and links at each frame.

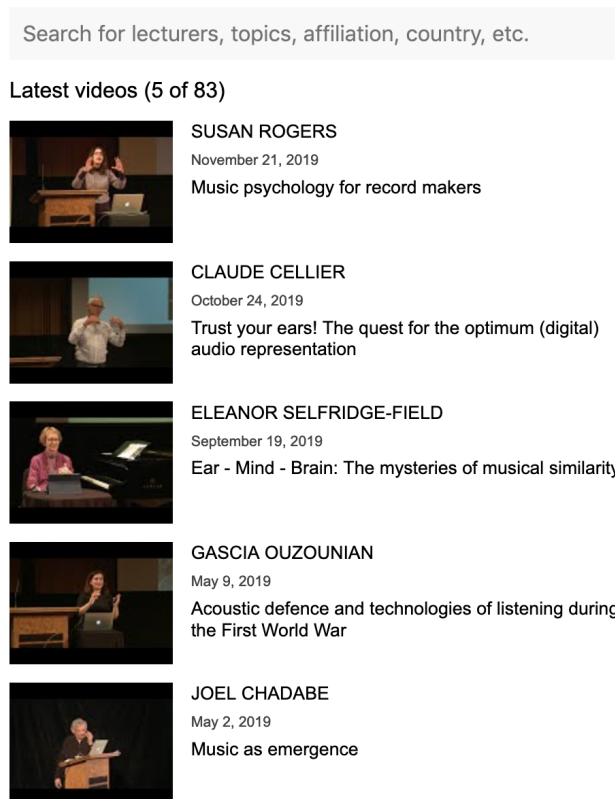


Figure 9: The right side of the initial visualization screen, when the page is loaded. It shows a space for entering text to be searched as well as the latest videos uploaded in reverse chronological order. Screenshot taken on January 27, 2020.

The search functionality is implemented using `fuse.js`, a JavaScript fuzzy-search library. The data from the `.csv` file is passed to a `Fuse` object along with the search options such as which keys to search in. The searchable keys are

- Lecture title
- Lecturer
- Topic
- Keywords

- Summary
- Affiliation
- Country

The search is executed when the user releases a key on the keyboard using the *search* function of the Fuse object. The video player is embedded using the YouTube Player API, and the video view count is obtained by sending a request to the YouTube Data API. The source code for the visualization is released under the MIT License at [https://github.com/IDMIL/CIRMMT\\_visualizations](https://github.com/IDMIL/CIRMMT_visualizations).

## CONCLUSIONS AND FUTURE WORK

This paper presented a visualization tool created to help explore the talks in CIRMMT's Distinguished Lecture Series, a collection of more than 70 videos of leading scholars and artists discussing their work.

After reviewing the DL series characteristics and evolution over time, different visualizations were proposed to help present the talks in a coherent way, allowing viewers to navigate in the video collection. Finally, a detailed description of a fully functional visualization prototype featuring an hierarchical bubble chart is discussed in detail.

Since its completion in the summer of 2019, the visualization tool has been used by the CIRMMT community showing the potential as an entry door to the richness of the content in the DL video series.

### FUTURE WORK

Several improvements are currently planned:

- More advanced choice of keywords. While the present choice of keywords solved our initial needs, for a more advanced solution a novel set of keywords should be selected in collaboration with the staff at the McGill Music Library to ensure coherence and homogeneity.
- Other visualization techniques. The exploration of other visualization possibilities should be carried out to eventually find more adapted techniques to display the contents of the DL series.
- Automatic extraction of features from videos and their transcriptions. Automatic extraction of features can provide a more adapted way to obtain meaningful information to populate the dataset, reduce the manual workload to create metadata associated to the videos, and inform their browsing.

## ACKNOWLEDGMENTS

The CIRMMT Distinguished Lecture Series and the visualizations presented in this paper are a joint effort of dozens of people that started some 15 years ago.

Essential players in establishing and maintaining the DL series include former and current CIRMMT directors & associate directors (Stephen McAdams, Sean Ferguson, Gary Scavone, Isabelle Cossette, Fabrice Marandola, Catherine Guastavino, Jean Piché and Jérémie Voix) and staff (Sara Gomez, Jacqueline Bednar, Julien Boissinot, Yves Méthot, Harold Kilianski and Sylvain Pohnu, among others), as well as axis leaders, student representatives and the dozens of students involved in the organization, recording and editing of the lectures, and the creation of the dataset.

Thanks also to the other graduate students who took the seminar MUMT620 in the winter of 2019: Mark Bennett, Mathias Kirkegaard, Josh Rohs and Evan Savage.

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