

A PORTUGUESE EPOPEE SEEN THROUGH SOUND

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Coimbra, Portugal**Abstract**

Sonification has gained importance in the last few years due to the technological development in the areas of sound synthesis and manipulation. This area allows to transform and understand large data sets that can be too ample and complex to analyse without these tools. This paper describes the development of a musical sonification project applied to the area of Literature that maps the data of the Portuguese epic poem, *The Lusiads* by Luís de Camões, into sounds. This work intends to show that Sonification can be applied to different and not so common areas and create new ways of reading and understanding texts, in this case, a well-known and important poem from Portuguese Literature.

KeywordsAuditory Display
Data Representation
Musical Sonification
Information Design
Lusiads

1. INTRODUCTION

Sonification is a very interdisciplinary and relatively new field, which is gaining more and more importance due to the huge progress of computers in recent years (Kramer et al. 2010, Hermann and Hunt 2005). The evolution of computers not only improved the technologies available but also increased the generation of large and complex amounts of data, which changed the way we learn, communicate and explore the information received (Kramer et al. 2010, Hermann and Hunt 2005). All these factors led to the emergence of the sonification field, which joins concepts like perception, acoustic, design, arts and engineering (Kramer et al. 2010).

This field can be briefly described as a subtype of the auditory display that uses non-verbal sounds to represent information (Barrass and Kramer 1999, Kramer et al. 2010, Hermann, Hunt and Neuhoff 2011). The sonification method transforms data, its characteristics and relationships, into acoustic signals, where sound has the function to communicate data and provide support for information analysis (Frazier 2013, Hermann and Hunt 2005, Kramer et al. 2010, Minciacchi and Rosenboom 2015, Park et al. 2010, Vicinanza 2014). There is also a Sonification approach called Musical Sonification, which was explored in the project described in this paper to take advantage of the action of listening to music and its characteristics and particularities to represent information (Ben-Tal and Berger 2004). It is possible to use the changes over the course of a music such as pitch, amplitude, timbre, tempo, rhythm to create a mental image that can be used to represent data.

Sonification can easily communicate larger and dynamic data because it provides two new dimensions to represent it: the sound itself (and its characteristics) and the idea of time (Kramer et al. 2010, Minciacchi and Rosenboom 2015). A sonification system allows showing vast amounts of data in a small period, giving a general overview of the information, as well as the existing trends and patterns. Also the interdisciplinarity of this field provides conditions to use sonification to improve visualisation systems.

The work presented in this paper explores the field of Musical Sonification applied to poetry. This project transforms the characteristics of a popular and relevant Portuguese poem, *The Lusíads*, into music. A preliminary sketch of this work was presented at the 4th International Workshop on Musical Metacreation (MUME), which allowed to test different approaches for the sonification: how many instruments should be used and how to use them and how to represent different levels of information (Coelho, Martins, and Cardoso 2016).

Comparisons between music and language are traditionally established at the syntax and rhetoric level, which derives from the fact that both music and language are sounds organised in time (Lerdahl 2001). Although these two areas share the same roots, the evolution led to the specialisation of each one: music in pitch organisation and language in word and sentence meaning (Lerdahl 2001). However, poetry exists in this evolutionary divergence because it combines speech with elements of a musical heritage: rhythmic and metrical patterns. The sound can represent something that maps or graphics are not capable: the rhythm of the data (House and Brooks 2013, Vanhemert 2013). According to these comparisons, it makes sense to explore the poetry in Sonification, which can enrich the poetry analysis and turn this process easier and more appealing to people unfamiliar with poetry.

The will to create a different sonification process, which can take advantage of the sound characteristics to provide poetry information, led to the development of this project. The sonification in Literature can create a new way of reading and understanding text, which was the motivation for this work. Our main goal was to build a software application that could convey information about the poem and create a new vision of a so well-known and essential book of Portuguese Literature, where the user can experience the poem through a customised navigation and explore different sections of the story told. This work explores the use of sonification techniques in poetry, where it is not common to apply these type of processes, but whose understanding can be improved with their application. With this purpose in mind, we created a musical and visual interface that reflects not only the sequential structure of the poem but also its external structure.

To the best of our knowledge, there are not many sonification works in this domain, one of the few exceptions being the sonification of Chinese poetry, *Text-to-Music* (Huang, Lu, and Ren 2011). This project transforms the characteristics and dynamics of the poem to durations of musical elements, which allows people, who are not familiar with Chinese poetry, to appreciate it in an easier way (Huang, Lu, and Ren 2011; Ren 2007).

To better explain the model of Musical Sonification presented herein, the remainder of this paper starts by providing an overview of the key aspects of *The Lusiads*. Then, there is a description of the application built and the sonification process applied in this work. The paper ends with a conclusion, where the Sonification area and the results obtained with this project are objects of reflection.

2. THE LUSIADS

The Lusiads is a Portuguese epic poem written by Luís de Camões (1524-1580). This book was published in 1572, and it has been the subject of numerous analyses over time (Sena 1980). The poem belongs to the epic genre, a literary genre that comes from the Greek-Latin Antiquity (Camões 2011, Gaio n.d., Pais 1994). This book is inspired by Virgil's *Aeneid* or Homer's *Iliad* and *Odyssey*, i.e., epopees. It is written in verse, in a high style, and intends to magnify the achievements of the heroes, in this case, the Portuguese people. Camões narrates the voyage of the explorer Vasco da Gama to India, and through this story, he tells the Portuguese deeds and extols the strength of his people (Sena 1980).

2.1. Poem characteristics

The poem has a total of 1102 stanzas of eight verses each, which are divided into ten cantos and two epic cycles (Fig. 1). The verses are decasyllables because they contain ten poetic syllables and the stanza has a rhyme scheme constant throughout the whole poem, consisting of crusade rhymes in the first six verses and paired rhymes in the last two—*a b a b a b c c* (Pais 1994, Gaio n.d.). The internal structure of the poem follows the epic genre rules, so it is divided in Proposition, Invocation, Dedication and Narration (Pais 1994, Gaio n.d.).

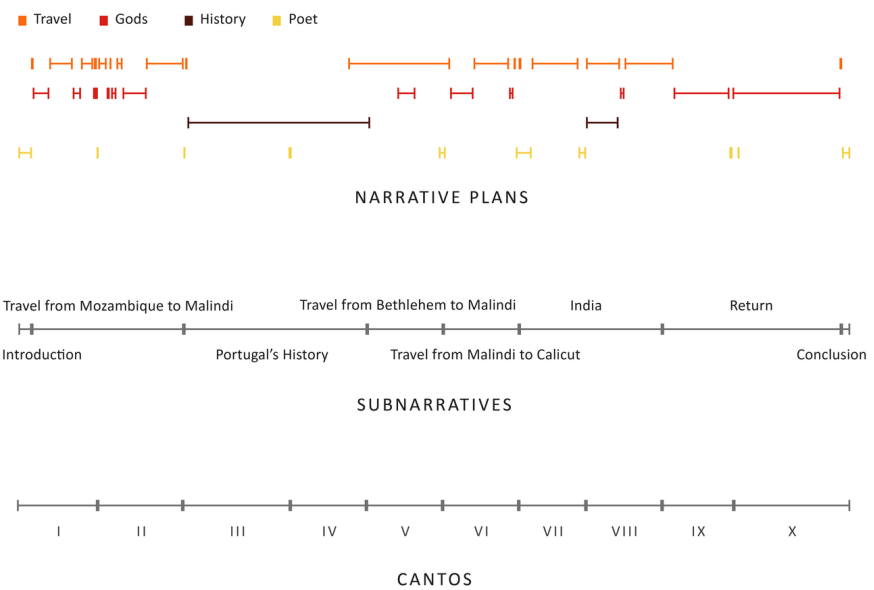
The Lusiads can also be divided, as shown in Fig. 1, into four narrative plans, which intersect and coexist over the narrative (Michelli 2003, Sena 1980):

1. Travel plan, which consists in the narration of the events during the trip from Lisbon to India;

2. Gods' plan, which includes the gods' interventions, intersected with the travel plan, where the gods make decisions that affect the fate of the Portuguese people;
3. Portugal History plan, which is the narration of Portugal's history by Vasco da Gama to the King of Malindi;
4. Poet plan, mostly located at the end of each canto, where Camões reflects the state of the world.

The poem is also divided, according to some studies, in various subnarratives (Fig. 1) that represent the main events of the book (Sena 1980). Different characters make the narration of the story, such as Luís de Camões itself or Vasco da Gama (Pais 1994).

Fig. 1
General structure of the poem *The Lusiads*.



2.2. Dataset

The characteristics to be sonified can be divided into three main areas, as shown in Fig. 2:

1. Narrators, where the intervention of the different narrators was explored;
2. Narrative Plans, where the intersection and intensity of the plans of the story was sonified;
3. Subdivisions, which includes the sonification of the subnarratives, episodes and emotions identified in the poem.

Furthermore, we also explored the verses characteristics and the rhyme scheme to create the rhythm and the prophecies presented during the poem. We created a database to keep all this information and to communicate with the sonification system.

3. PROJECT

The project of Musical Sonification that was developed transforms the main features of the poem, *The Lusiads*, into sound. The principal idea was to build a software application that allows the user to experience the poem in an innova-

tive way and to obtain different types of information depending on the custom navigation performed by the user.

Fig. 2
Information sonified
in the application.

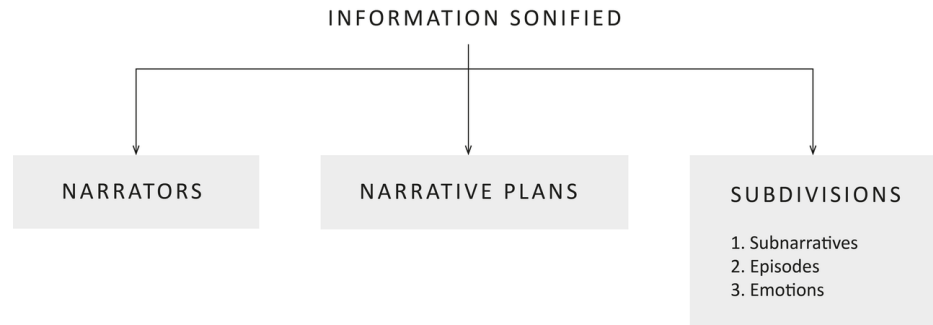
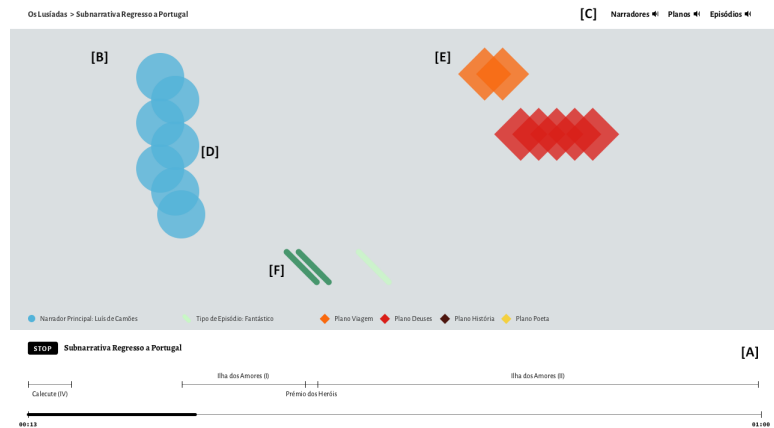


Fig. 3
Screenshot of
the application.



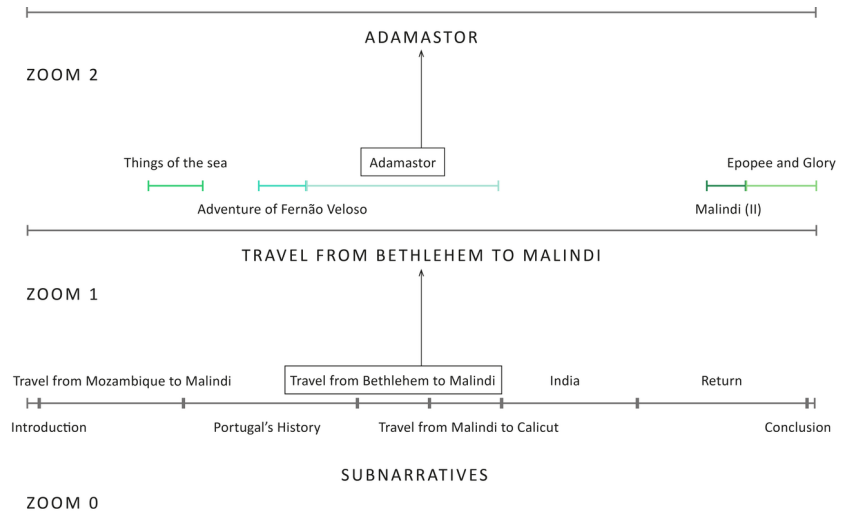
3.1. Features

To satisfy this goal, the application offers different features to improve the user experience. The user can control the reproduction of the sound result and navigate across the different sections of the book by the timeline in the interface (Fig. 3 [A]). The project also has a visual component that works as a label and guides the user through the sonified information, which improves the process of sound visualisation (Fig. 3 [B]). The application allows the user to select the information that he/she wants to hear by the filters (Fig. 3 [C]), which improves the understanding process between what is listened and what is shown.

Besides the previous features, the application offers, as a form to navigate through the poem, three types of zoom, whose information has different levels of specificity (Fig. 4). Therefore, the user can select the section to be sonified:

1. **Zoom 0:** Where the user can listen to the sonification of the whole poem and only the higher level divisions of the poem are sonified. The sound result in this zoom has a total of 80 bars, which means that each bar represents 13 stanzas of the poem.
2. **Zoom 1:** This type of zoom is available after selecting a canto, subnarrative or bigger episode, which is sonified. The difference between this and the previous zoom is that at this level, the presence of each plan is sonified instead of its intensity. The scale used is eight stanzas of the selected excerpt per bar.
3. **Zoom 2:** Level of higher detail, which is activated after the choice of a specific episode and offers a sonification of the selected passage. The scale applied at this level is one stanza to one bar.

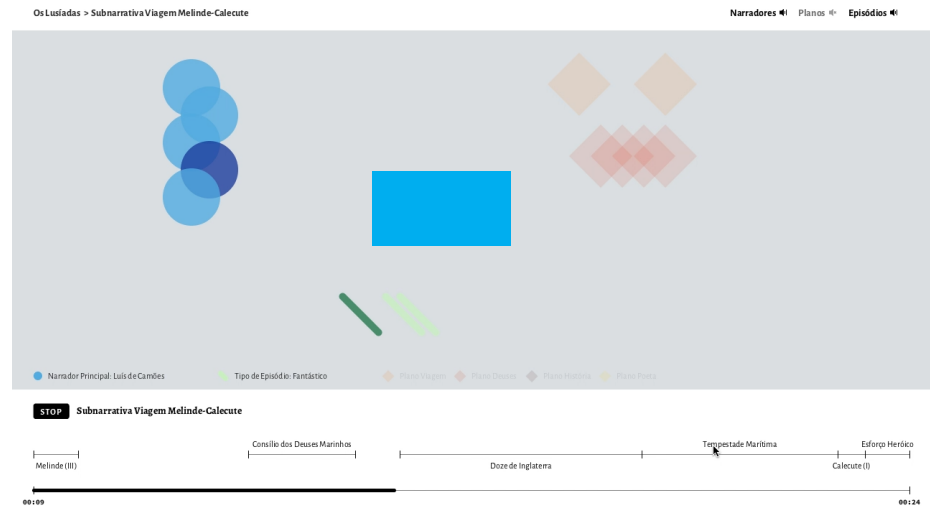
220 **Fig. 4**
Scheme of
different zooms.



Zooms

The link in Fig. 5 has a demonstration of the application's functionalities being in use.

Fig. 5
Demonstration of the final
application (<https://vimeo.com/201050778>)



3.2. Technologies and resources

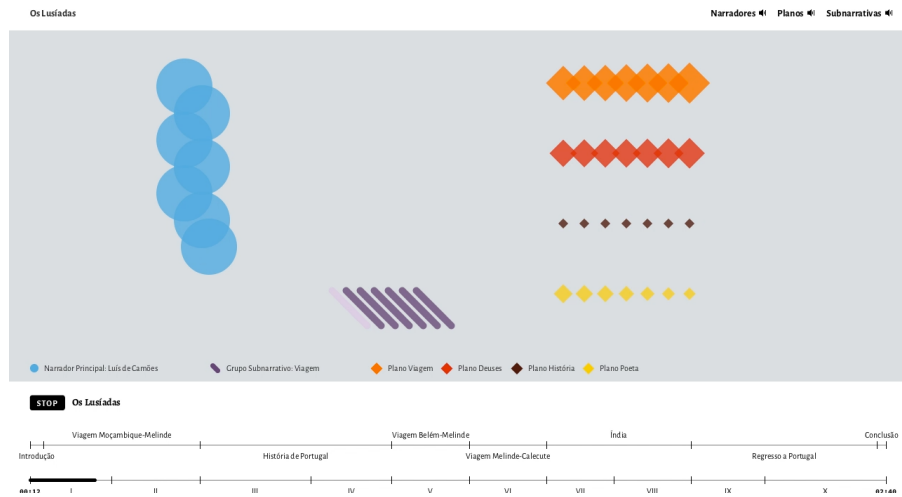
The development of all these functionalities demanded the use of different technologies that were able to communicate with each other. In this way, we used the Processing language to create the interface presented, to control the action of the remaining software and to establish the communication between the user and the other tools. At this level, the connection to the database is identified via the BezierSQLLib library, which allows the access to the information in the database by SQL. This data is then processed in Processing and sent to Max/MSP using the oscP5 library. At this point, a Max/MSP patcher is responsible for the sonification, according to the information received. This process involves the creation of text files that store the sonification inputs. After this, the patcher plays the sound result of the subdivisions of the poem and sends the MIDI notes of the remaining information to be played through Ableton Live. Max is also responsible for sending the information required by Processing to construct the labels and the visual component. Ableton Live is the MIDI sequencer responsible for the reproduction of the narrators and narrative plans. It distributes the

information received by Max/MSP for the respective MIDI channels. We also used a database of sound files, *Soundtracks, datasets for music and emotion*, as a resource (Eerola and Vuoskoski 2010). This dataset is an archive of movie sound samples classified in a set of emotions. These samples are applied in the sonification of the subdivisions of the poem.

4. SONIFICATION PROPOSAL

The sonification model applied follows essentially two sonification techniques: auditory icons and parameter mapping sonification. The first one takes advantage of the association of information with familiar sounds and the last one consists in the association of information to different sound characteristics (Barrass and Kramer 1999). The final sonification has 120 bpm and a variable number of bars, according to the dimension of the selected excerpt. The link in Fig. 6 has a demonstration of the sonification results for zoom 0.

Fig. 6
Sonification of the zoom 0 (<https://vimeo.com/180120006>)



4.1. Rhyme scheme

The creation of the harmonic structure of the output music is based on a simple model of 8 bars. This pattern is mapped from the rhyme scheme of the poem (*a b a b a b c c*): a is mapped to C major, b with F major and c with G major (Fig. 7). The result is a simple cyclic chord progression (C F C F C F G G), one chord/bar, which results in a music in C Major, with no modulations.

Fig. 7
Harmonic structure of the Sonification.

As armas e os Barões assinalados	a	→	C	8 bars
Que da Ocidental praia Lusitana	b	→	F	
Por mares nunca de antes navegados	a	→	C	
Passaram ainda além da Taprobana,	b	→	F	
Em perigos e guerras esforçados	a	→	C	
Mais do que prometia a força humana,	b	→	F	
E entre gente remota edificaram	c	→	G	
Novo Reino, que tanto sublimaram;	c	→	G	

4.2. Narrators

The narrators' interventions in *The Lusiads* are transformed into sound with the use of parameter mapping. Through the whole book, there are 43 different narrators that were divided, for the purpose of the sonification, into six types: main, secondary, mythological, crew, Portuguese and foreign. Each of these types is associated with a different instrument, respectively, tuba, flute, trombone, oboe and horn. Each instrument plays the song during the intervention of the correspondent narrator type. The melody played at this stage follows the pattern described earlier and is computed at the bar level: for each block, a variable sequence of 10 notes (six eighth notes and four sixteenth notes) of the chord's scale is generated. Therefore, the bar has the same size of the poem verse, 10 notes to 10 syllables. At the visual level, each bar of the narrator is represented by a blue circle, whose position and colour change according to the rhyme and the narrator type, respectively (Fig. 3 [D]). Although this information is sonified at every zoom, the sound results change because with the increase of the detail is possible to hear narrators with minor interventions.

4.3. Narrative Plans

Narrative plans are also transformed into sound with the application of parameter mapping. The four plans — Travel, Gods, Portugal History, Poet — are associated, each one, with a different percussion instrument — conga bongo, xylophone, clog box and clavestine. Each instrument follows a different rhythmic pattern, repeated at every bar. The plans are also represented by a diamond, whose colour changes with the type of plan (Fig. 3 [E]).

At zoom 0, the intensity of each plan, in other words, the variation of its number of stanzas in each canto, is mapped to the volume of the correspondent sound and shown by the variation of the diamond size. At the other levels, the presence of each plan in the story is mapped, so each instrument plays when the corresponding plan exists.

4.4. Subdivisions

As shown in Fig. 2, the subdivisions of the poem were divided into three groups: subnarratives, episodes and emotions. The method followed here was auditory icons, so each subdivision is assigned with a familiar soundtrack. Every group in this section is represented by a stroke, whose colour scheme changes with the type represented (Fig. 3 [F]).

Subnarratives

The subnarratives of the poem are played only in zoom 0, before the selection of a canto or subnarrative. The poem has eight subnarratives (Fig. 1) that were grouped into three types to favour the sonification process: Dedication, Travel and History. Each subnarrative group is associated with a music sample that resembles it, which plays during the corresponding event.

Episodes

The episodes are sonified in zoom 1, after the selection of a canto, subnarrative or a longer episode. The poem can be divided in 56 episodes that, in order to be mapped, were grouped into seven types: fantastic, geographic, opinion, reign, warlike, lyric and naturalist. Each type has a similar thematic sound sample that is played during the specific episode.

Emotions

The emotions presented in every episode were collected and stored in an emotion scale: anger, concern, tranquillity and love. This information is mapped into sound in zoom 2, after the selection of a specific episode. Each emotion is assigned to a correspondent sample of the database resource, which is played when the emotion is identified.

4.5. Prophecies

For last, the poem also contains prophecies that tell historical Portuguese events that occur after the time of the narrative. These prophecies are sonified in the last zoom with the application of reverb, while they are present, which gives an echo sensation. The goal in this case was to give the sensation of a prophetic and magical environment because these sections of the poem are mainly controlled by mythological figures.

5. CONCLUSIONS AND REFLEXIONS

Sonification is not a traditional mapping method, which leads to the existence of issues and challenges to overcome for the improvement of this area. How to choose the best sonification technique for a dataset? Can all kinds of data be sonified? Can a sonification system be understood without a visual component? How to make the sound representation easy-to-understand? Will the technology be prepared for the integration and expansion of Sonification? These are some of the issues that emerge from the analysis of the Sonification field. It is necessary to investigate and explore these questions in order to establish suitable methodologies and identify the most promising techniques to address them.

The principal purpose of the project presented herein was to explore Sonification in an area where its application is not typical: poetry. This work allowed us to experiment and test different approaches of sonification until we found one that we believed to be suitable for the project. During this process, we were confronted with some challenges: the creation of the dataset of the poem, the representation of so many levels of information, the choice of the instruments and samples to be used, the technological limitations and the development of a visual guide to the sonification. The solution we found to overcome these issues was the creation of an interactive sonification system that allows the user to explore the poem in a customised way and at his/her own time. This type of interactive systems expands the sonification process because it allows the user to compare different sections of the story and get conclusions. The user can choose the section that he/she would like listen to and the type of information he/she wants to receive, which turns the understanding process of the poem easier. In order to test the

usefulness of this product, some usability tests were applied that, although are not able to fully test the sonification process, were able to understand that the users can create an analysis process from the sonification results. These tests cannot evaluate in detail the user experience, which will be an area to fully analyse in future work, with more suitable techniques. However, it was possible to understand that users were capable of getting conclusions about the story of the poem and create correlations between different types of information and sections of the poem.

The goal of this project was to create an application that can communicate information and also be able to produce a new vision of a book so well-known in the Portuguese Literature. Besides, the results of this work allow us to understand that sound can communicate information and how it can relate with language. This project reinforces the idea that music and language are connected and share the same roots. Poetry emerges between these two areas and joins characteristics of both fields, so it makes sense to explore the poetry in Sonification, to take advantage of the sound as a communication tool and to improve the understanding process of complex and long poetic narratives.

REFERENCES

- Barrass, Stephen, and Gregory Kramer.** 'Using Sonification.' *Multimedia Systems* 7, no. 1 (1999): 23-31.
- Ben-Tal, Oded, and Jonathan Berger.** 'Creative Aspects of Sonification.' *Leonardo* 37, no. 3 (2004): 229-33.
- Camões, Luís de.** 'Os Lusíadas'. Porto, Portugal: Porto Editora, 2011.
- Coelho, Ângela, Pedro Martins, and Amílcar Cardoso.** 'A Musical Sonification of the Portuguese Epopee.' Paper presented at the MUME, Paris, France, 2016.
- Eerola, Tuomas, and Jonna K Vuoskoski.** 'A Comparison of the Discrete and Dimensional Models of Emotion in Music.' *Psychology of Music* 39, no. 1 (2010): 18-49.
- Frazier, Sarah.** 'Sonification: Data Like You've Never Heard Before.' (2013). <http://earthzine.org/2013/07/23/sonification-data-like-youve-never-heard-before/>
- Gaio, Tiago.** 'Os Lusíadas.' <http://oslusíadas.no.sapo.pt/indice.html>
- Hermann, Thomas, and Andy Hunt.** 'Guest Editors' Introduction: An Introduction to Interactive Sonification.' *IEEE Multimedia*, 2005, 20-24.
- Hermann, Thomas, Andy Hunt, and John G. Neuhoff.** 'Introduction.' Chap. 1 In *The Sonification Handbook*, edited by Thomas Hermann, Andy Hunt and John G. Neuhoff, 1-6. Berlin, Germany: Logos Verlag, 2011.
- House, Brian, and Katherine Brooks.** 'Quotidian Record: Artist Brian House Turns Tracking Data into a Vinyl Music Experience.' (2013). http://www.huffingtonpost.com/2013/07/26/quotidian-record_n_3653658.html
- Huang, Chih-Fang, Hsiang-Pin Lu, and Jenny Ren.** 'Algorithmic Approach to Sonification of Classical Chinese Poetry.' *Multimedia Tools and Applications* 61, no. 2 (2011): 489-518.
- Kramer, Gregory, Bruce Walker, Terri Bonebright, Perry Cook, John H Flowers, Nadine Miner, and John Neuhoff.** 'Sonification Report: Status of the Field and Research Agenda.' *Faculty Publications, Department of Psychology* (2010): Paper 444.
- Lerdahl, Fred.** 'The Sounds of Poetry Viewed as Music.' *Annals of the New York Academy of Sciences* 930 (2001): 337-54.
- Michelli, Regina.** 'Os Lusíadas, De Luís De Camões: Breve Viagem Estrutural.' Augustus, 2003, 39-48.
- Minciocchi, Diego, and David Rosenboom.** 'Sonification, Perceptualizing Biological Information.' (2015). <http://journal.frontiersin.org/researchtopic/3579/sonification-perceptualizing-biological-information-overview>
- Pais, Amélia Pinto.** 'Para Compreender Os Lusíadas.' 2ª ed. Porto, Portugal: Areal Editores, 1994.
- Park, Sihwa, Seunghun Kim, Samuel Lee, and Woon Seung Yeo.** 'Online Map Interface for Creative and Interactive Music-Making.' Paper presented at the New Interfaces for Musical Expression (NIME), Sydney, Australia, 2010.
- Ren, Jenny; Winsor, Phil; Huang, Chih-Fang.** 'Developing Chinese Style Algorithmic Composition Using Markov Chains—from the Classical Chinese-Poetry Perspective.' Paper presented at the International Computer Music Conference (ICMC), Copenhagen, Denmark, 2007.
- Sena, Jorge de.** 'A Estrutura De "Os Lusíadas" E Outros Estudos Camonianos E De Poesia Peninsular Do Século XVI'. *Obras De Jorge De Sena*. 2 ed. Lisboa, Portugal: Edições 70, 1980.
- Vanhemert, Kyle.** 'Artist Turns a Year's Worth of Tracking Data into a Haunting Record.' (2013). <https://www.wired.com/2013/07/a-years-worth-of-location-data-transformed-into-a-beautiful-record/>
- Vicinanza, Domenico.** 'Sonification: Representing Data through Music.' (2014). <http://www.bbc.co.uk/news/magazine-25975712>