

# Abstracts



17º Brazilian Symposium on Computer Music  
Federal University of São João del-Rei  
25-27 September 2019  
<http://compmus.ime.usp.br/sbcm/2019/>



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# Full Papers

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## A computer-based framework to analyze continuous and discontinuous textural works using psychoacoustics audio descriptors

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- Jonatas Manzolli (University of Campinas - Brazil)

**Keywords:** Music Analysis and Synthesis ; Music Information Retrieval ; Music Perception, Psychoacoustics and Cognition

This paper introduces research on computer-aided musical analysis using psychoacoustics audio descriptors. The main musicological application is to analyze compositions centered on timbre manipulations that explore sound masses and granular synthesis as their builders. Our computer tools are implemented with psychoacoustics models, such as Critical Bandwidths and Loudness and spectral features extractors such the Centroid and Spectral Spread. A review of the literature, contextualizing the state-of-art of audio descriptors, is followed by a definition of the musicological context guiding our analysis and discussions. Further, we present methods and results concerning a comparative analysis on two acousmatic pieces: Schall (1995) of Horacio Vaggione and Asprezas (2018) of the author. As electroacoustic works, there are no scores for them, therefore, segmentation and musical analysis is an important issue to be solved. Consequently, the article ends with a discussion on that aspect of the computational musicology addressed by the research presented here.

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## J-Analyzer: A Software for Computer-Assisted Analysis of Antônio Carlos Jobims Songs

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**Keywords:** Music Analysis and Synthesis

The present paper describes structure and functioning of J-Analyzer, a computational tool for assisted analysis. It integrates a research project intended to investigate the complete song collection by Brazilian composer Antônio Carlos Jobim, focusing on the aspect of harmonic transformation. The program is used to determine the nature of transformational relations between any chordal pair of chords present in a song, as well as the structure of the chords themselves.



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## Identifying Narrative Contexts in Brazilian Popular Music Lyrics Using Sparse Topic Models: A Comparison Between Human-Based and Machine-Based Classification

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- André Dalmora (University of Campinas - Brazil)
- Tiago Tavares (University of Campinas - Brazil)

**Keywords:** Computational Musicology ; Music Information Retrieval

Music lyrics can convey a great part of the meaning in popular songs. Such meaning is important for humans to understand songs as related to typical narratives, such as romantic interests or life stories. This understanding is part of affective aspects that can be used to choose songs to play in particular situations. This paper analyzes the effectiveness of using text mining tools to classify lyrics according to their narrative contexts. For such, we used a vote-based dataset and several machine learning algorithms. Also, we compared the classification results to that of a typical human. Last, we compare the problems of identifying narrative contexts and of identifying lyric valence. Our results indicate that narrative contexts can be identified more consistently than valence. Also, we show that human-based classification typically do not reach a high accuracy, which suggests an upper bound for automatic classification.

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## Iracema: a Python library for audio content analysis

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**Keywords:** Music Expressiveness ; Music Information Retrieval ; Software Systems and Languages for Sound and Music

This paper introduces the alpha version of a Python library called Iracema, which aims to provide models for the extraction of meaningful information from recordings of monophonic pieces of music, for purposes of research in music performance. With this objective in mind, we propose an architecture that will provide to users an abstraction level that simplifies the manipulation of different kinds of time series, as well as the extraction of segments from them. In this paper we: (1) introduce some key concepts at the core of the proposed architecture; (2) list the current functionalities of the package; (3) give some examples of the application programming interface; and (4) give some brief examples of audio analysis using the system.

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## A technical approach of the audience participation in the performance "O Chaos das 5"

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- Igino Silva Junior (Federal University of São João del-Rei - Brazil)
- Flávio Schiavoni (Federal University of São João del-Rei - Brazil)
- Mauro César Fachina Canito (Federal University of São João del-Rei - Brazil)
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**Keywords:** Computer Music and Creative process ; Internet and Web Applications ; Music, Society and Technology

Since HTML 5 and web audio were released, we have seen several initiatives to construct web based instruments and musical applications based on this technology. Web based instruments involved composers, musicians and the audience in musical performances based in the fact that a web instrument embedded in a web page can be accessed by everyone. Nonetheless, despite the fact that these applications are accessible by the network, it is not easy to use the network and these technologies to synchronize the participants of a musical performance and control the level of interaction in a collaborative musical creation scenario. Based on a multimedia performance created in our research group, O Chaos das 5, we present in this paper some scenarios of interaction and control between musicians and the audience that can be reached using a server side programming infrastructure along with the HTML5. In this performance, the audience took part of the musical soundscape using a cellphone to access a set of digital instruments. These scenarios and the

proposed solutions brought up a set of possibilities to balance control and interaction of audience participation into live performance using web instruments.

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## BUZU: Retrieving public transportation data for sonification

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**Keywords:** Computer Music and Creative process ; Multimedia Systems ; Music Formats, Data Structures and Representation

This paper discusses the conception, design and exhibition of BUZU, an audiovisual installation that generates an auditory image of the São Paulo bus transportation system. BUZU makes perceptible information of both the systems planning and behavior during a particular week in October 2017. The work is an artistic outcome of the InterSCity project, an inter-institutional research initiative concerning the Future Internet and the Smart Cities. Along with the discussion of the BUZU creation process we will examine mining and processing strategies related to the sonification of big data, the data-to-sound mapping methods, the auditory structure for displaying the material and the public exhibition of the work in the context of an artistic event.

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## Composing through Interaction: a framework for collaborative music composition based on human interaction on public spaces

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**Keywords:** Computer Music and Creative process ; Music Expressiveness ; Real-time Interactive Systems

Urban public art is a kind of art that is produced and demonstrated in public places, based on the function and connotation of the city itself exerts. As an essential artistic content in the contact of human life, the introduction of technology is a significant trend in public art, and with it, the interaction has become an increasingly relevant aspect of public art in the digital context. In this way, this work presents an environment for creating random collaborative music from interaction in public spaces using mobile technology. The result is a composition that goes towards to John Cage's methods. However, in our case, all participants are composers and their interactions with space work as the component that brings randomness to composition. A case study was conducted with volunteer students divided into groups. Participants made use of two versions of Compomus - an app developed for immersive interaction with sound. One version encourages movement through the environment, while the other explores the spatiality of sound in a simulated public environment within the university. The interaction of the participants generated ten compositions, five from the first version and five compositions from the second version of the developed application. The sounds resulting from the interaction were made available to the public through a website.

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## State of art of real-time singing voice synthesis

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**Keywords:** Music Analysis and Synthesis ; Real-time Interactive Systems ; Software Systems and Languages for Sound and Music

This paper describes the state of art of real-time singing voice synthesis and presents its concept, applications and technical aspects. A technological mapping and a literature review are made in order to indicate the latest developments in this area. We made a brief comparative analysis among the selected works. Finally, we have discussed challenges and future research problems.

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## Visualizing Air Drums: Analysis of Motion and Vocalization Data Related to Playing Imaginary Drums

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- Tiago Tavares (State University of Campinas - Brazil)

**Keywords:** Movement and Gesture ; Real-time Interactive Systems ; Sensors and Multimodal Signal Processing

Air drums, or imaginary drums, are commonly played as a form of participating in musical experiences. The gestures derived from playing air drums can be acquired using accelerometers and then mapped into sound control responses. Commonly, the mapping process relies on a peak-picking procedure that maps local maxima or minima to sound triggers. In this work, we analyzed accelerometer and audio data comprising the motion of subjects playing air drums while vocalizing their expected results. Our qualitative analysis revealed that each subject produced a different relationship between their motion and the vocalization. This suggests that using a fixed peak-picking procedure can be unreliable when designing accelerometer-controlled drum instruments. Moreover, user-specific personalization can be an important feature in this type of virtual instrument. This poses a new challenge for this field, which consists of quickly personalizing virtual drum interactions. We made our dataset available to foster future work in this subject.



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## Sustainable Interfaces for Music Expression

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**Keywords:** Music, Emotion and Communication ; Music, Society and Technology

The creation of Digital Musical Instruments (DMI) tries to keep abreast the technological progress and sometimes it does not worry about some possible side effects of its development. Obsolescence and residues, rampant consumption, constant need to generate innovation, code ephemerality, culture shock, social apartheid, are some possible traps that an equivocated DMI development can bring up to society. Faced all these possibilities, we are trying to understand what can be a sustainable Digital Instrument analyzing several dimensions of sustainability, from economical to cultural, from social to environmental. In this paper, we point out some possibilities to try to reach up more sustainable instruments development bringing up the human being and values like cooperation and collaboration to the center of the DMI development discussion. Through some questions, we seek to instigate a paradigm shift in art-science and provide a fertile field for future research.

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## Ha Dou Ken Music: Mapping a joysticks as a musical controller

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- Gabriel Lopes Rocha (Federal University of São João del-Rei - Brazil)
- João Teixeira (Federal University of São João del-Rei - Brazil)
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**Keywords:** Digital Music Systems and Services ; Movement and Gesture

The structure of a digital musical instrument (DMI) can be splitted up in three parts: interface, mapping and synthesizer. For DMI's, in which sound synthesis is done via software, the interaction interface serves to capture the performer's gestures, which can be mapped under various techniques to different sounds. In this work, we bring videogame controls as an interface for musical interaction. Due to its great presence in popular culture and its ease of access, even people who are not in the habit of playing electronic games possibly interacted with this kind of interface once in a lifetime. Thus, gestures like pressing a sequence of buttons, pressing them simultaneously or sliding your fingers through the control can be mapped for musical creation. This work aims the elaboration of a strategy in which several gestures captured by the interface can influence one or several parameters of the sound synthesis, making a mapping denominated many to many. Buttons combinations used to perform game actions that are common in fighting games, like Street Fighter, were mapped to the synthesizer to create a music. Experiments show that this mapping is capable of influencing the musical expression of a DMI making it closer to an acoustic instrument.

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## TumTá and Pisada: Two Foot-controlled Digital Dance and Music Instruments Inspired by Popular Brazillian Traditions

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**Keywords:** Music, Society and Technology ; Real-time Interactive Systems ; Sensors and Multimodal Signal Processing

This paper presents the development process of "TumTá", a wearable Digital Dance and Music Instrument that triggers sound samples from foot-stomps and "Pisada", a dance-enabled MIDI pedalboard. It was developed between 2012 and 2017 for the use of Helder Vasconcelos, a dancer and musician formed by the traditions of Cavalo Marinho and Maracatu Rural from Pernambuco. The design of this instrument was inspired by traditional instruments like the Zabumba and by the gestural vocabulary from Cavalo Marinho, with an intention to make music and dance at the same time. The development process of this instrument is described in the three prototyping phases conducted by three approaches: building blocks, artisanal and digital fabrication. The process of designing digital technology inspired in Brazillian traditions is analyzed and the lessons learned and future works are presented.

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## Cognitive Offloading: Can ubimus technologies affect our musicality?

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- Leandro Costalonga (Federal University of Espirito Santo - Brazil)
- Marcelo Pimenta (Federal University of Rio Grande do Sul - Brazil)

**Keywords:** Music Perception, Psychoacoustics and Cognition ; Music, Society and Technology

An interaction design that lean towards musical traits based on and constrained by our cognitive and biological system could, not only provide a better user experience, but also minimize collateral effects of excessive use of such technology to make music. This paper presents and discuss innate abilities involved in musical activities that - in the authors' viewpoint - could be considered in design guidelines to computer music technologies, specially those related to ubimus.

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## Reflection and practice on generative music structuring: the formal problem of ergodicity

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**Keywords:** Artificial Intelligence, A-Life and Evolutionary Music Systems ; Computer Music and Creative process ; Music Analysis and Synthesis

This article approaches the issue of structural silence in algorithmic composed works. We do this firstly by promoting a reflection on the subject of musical form, then by the presentation of an automated compositional method. The problem of concern is introduced starting from personal experience, and going through references in computer music literature. It is, then, detailed by the study of two theoretical works by twentieth century composers Henri Pousseur - with the concept of General Periodicity -, and James Tenney - with the concept of Temporal Gestalt -, the last one whom inspired the use of the word ergodicity to designate the formal situation of perceptual stasis.

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## The development of libmosaic-sound: a library for sound design and an extension for the Mosaicode Programming Environment

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- Flávio Schiavoni (Federal University of São João del-Rei - Brazil)

**Keywords:** Digital Sound Processing ; Music, Society and Technology ; Software Systems and Languages for Sound and Music

Music has been influenced by digital technology over the last few decades. With the computer, the musical composition could trespass the use of acoustic instruments demanding to musicians and composers a sort of computer programming skills for the development of musical applications. In order to simplify the development of musical applications, several tools and musical programming languages arose bringing some facilities to lay-musicians on computer programming to use the computer to make music. This work presents the development of a Visual Programming Language (VPL) for audio applications in the Mosaicode programming environment, simplifying sound design and making the synthesis and manipulation of audio more accessible to digital artists. It is also presented the implementation of libmosaic-sound library for the specific domain of Music Computing, which supported the VPL development.

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## Combining Effects in a Music Programming Language based on Patterns

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**Keywords:** Music Expressiveness ; Music Formats, Data Structures and Representation ; Software Systems and Languages for Sound and Music

HMusic is a domain specific language based on music patterns that can be used to write music and live coding. The main abstractions provided by the language are patterns and tracks. Code written in HMusic looks like patterns and multi-tracks available in music sequencers, drum machines and DAWs. HMusic provides primitives to design and combine patterns generating new patterns. The objective of this paper is to extend the original design of HMusic to allow effects on tracks. We describe new abstractions to add effects on individual tracks and in groups of tracks, and how they influence the combinators for track composition and multiplication. HMusic allows the live coding of music and, as it is embedded in the Haskell functional programming language, programmers can write functions to manipulate effects on the fly. The current implementation of the language is compiled into Sonic Pi, and we describe how the compiler's back-end was modified to support the new abstractions for effects.

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## Prototyping Web instruments with Mosaicode

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- Frederico Resende (Federal University of São João del-Rei - Brazil)
- Luan Gonçalves (Federal University of São João del-Rei - Brazil)
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**Keywords:** Software Systems and Languages for Sound and Music

Many HTML 5 features enable you to build audio applications for web browsers, simplifying the distribution of these applications, and turning any computer, mobile, and portable device into a digital musical instrument. Developing such applications is not an easy task for lay-programmers or non-programmers and may require some effort by musicians and artists to encode audio applications based on HTML5 technologies and APIs. In order to simplify this task, this paper presents the Mosaicode, a Visual programming environment that enables the development of Digital Musical Instruments using the visual programming paradigm. Applications can be developed in the Mosaicode from diagrams – blocks, which encapsulate basic programming functions, and connections, to exchange information among the blocks. The Mosaicode, by having the functionality of generating, compiling and executing codes, can be used to quickly prototype musical instruments, and make it easy to use for beginners looking for learn programming and expert developers who need to optimize the construction of musical applications.



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## PSYCHO library for Pure Data

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- Alexandre Porres (University of São Paulo - Brazil)

**Keywords:** Music Perception, Psychoacoustics and Cognition ; Real-time Interactive Systems ; Sound Analysis and Synthesis

This paper describes the PSYCHO library for the Pure Data programming language. This library provides novel functions for Pure Data and is a collection of compiled objects, abstractions and patches that include psychoacoustic models, measures and conversions. Most notably, it provides models related to Psychoacoustic and Sensory Dissonance, such as Sharpness, Roughness, Tonalness and Pitch Commonality. This library is an evolution and revision of earlier research work developed during a masters and PhD program. The previous developments had not been made easily available as a single and well documented library. Moreover, the work went through a major overhaul, got rid of the dependance of Pd Extended (now an abandoned and unsupported project) and provides new features. This paper describes the evolution of the early work into the PSYCHO library and presents its main objects, functions and contributions. The library is already available for download and use, but still at a beta phase at the time of this writing.

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## Low-Latency f0 Estimation for the Finger Plucked Electric Bass Guitar Using the Absolute Difference Function

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- Christian Fonseca (State University of Campinas - Brazil)
- Tiago Tavares (State University of Campinas - Brazil)

**Keywords:** Music Information Retrieval

Audio-to-MIDI conversion can be used to allow digital musical control by means of an analog instrument. Audio-to-MIDI converters rely on fundamental frequency estimators that are frequently restricted to a minimum delay of two fundamental periods. This delay is perceptible for the case of bass notes. In this paper, we propose a low-latency fundamental frequency estimation method that relies on specific characteristics of the electric bass guitar. By means of physical modelling and signal acquisition, we show that the assumptions of the method relies on generalize throughout electric basses. We evaluate our method in a dataset with musical notes played by diverse bassists. Results show that our method outperforms the Yin method in low-latency settings, which indicates its suitability for low-latency audio-to-MIDI conversion of the electric bass sound.

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## Comparing Meta-Classifiers for Automatic Music Genre Classification

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- Tiago Tavares (State University of Campinas - Brazil)

**Keywords:** Music Information Retrieval

Automatic music genre classification is the problem of associating mutually-exclusive labels to audio tracks. This process fosters the organization of collections and facilitates searching and marketing music. One approach for automatic music genre classification is to use diverse vector representations for each track, and then classify them individually. After that, a majority voting system can be used to infer a single label to the whole track. In this work, we evaluated the impact of changing the majority voting system to a meta-classifier. The classification results with the meta-classifier showed statistically significant improvements when related to the majority-voting classifier. This indicates that the higher-level information used by the meta-classifier might be relevant for automatic music genre classification.

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## A chord distance metric based on the Tonal Pitch Space and a key-finding method for chord annotation sequences

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- Lucas Marques (Federal University of Alfenas - Brazil)

**Keywords:** Music Analysis and Synthesis ; Music Information Retrieval

Music Information Retrieval (MIR) is a growing field of research concerned about recovering and generating useful information about music in general. One classic problem of MIR is key-finding, which could be described as the activity of finding the most stable tone and mode of a determined musical piece or a fragment of it. This problem, however, is usually modeled for audio as an input, sometimes MIDI, but little attention seems to be given to approaches considering musical notations and music-theory. This paper will present a method of key-finding that has chord annotations as its only input. A new metric is proposed for calculating distances between tonal pitch spaces and chords, which will be later used to create a key-finding method for chord annotations sequences. We achieve a success rate from 77.85% up to 88.75% for the whole database, depending on whether or not and how some parameters of approximation are configured. We argue that musical-theoretical approaches independent of audio could still bring progress to the MIR area and definitely could be used as complementary techniques.

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## Predicting Music Popularity on Streaming Platforms

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- Carlos Soares Araujo (Federal University of Amazonas - Brazil)
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- Rafael Giusti (Federal University of Amazonas - Brazil)

**Keywords:** Music Analysis and Synthesis ; Music Information Retrieval

Online streaming platforms have become one of the most important forms of music consumption. Most streaming platforms provide tools to assess the popularity of a song in the forms of scores and rankings. In this paper, we address two issues related to song popularity. First, we predict whether an already popular song may attract higher-than-average public interest and become "viral". Second, we predict whether sudden spikes in public interest will translate into long-term popularity growth. We base our findings in data from the streaming platform Spotify and consider appearances in its "Most-Popular" list as indicative of popularity, and appearances in its "Virals" list as indicative of interest growth. We approach the problem as a classification task and employ a Support Vector Machine model built on popularity information to predict interest, and vice versa. We also verify if acoustic information can provide useful features for both tasks. Our results show that the popularity information alone is sufficient to predict future interest growth, achieving a F1-score above 90% at predicting whether a song will be featured in the "Virals" list after being observed in the "Most-Popular".



# **Studio and Laboratory Reports**

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## NESCoM Research Report (2019)

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- Daniel Coura (Federal University of Espirito Santo - Brazil)
- Marcus Vinícius Neves (Federal University of Espirito Santo - Brazil)
- Fabiano Costa (Federal University of Espirito Santo - Brazil)
- Helder Rocha (Federal University of Espirito Santo - Brazil)

**Keywords:** Computational Musicology ; Computer Music and Creative process ; Digital Sound Processing

The NESCoM is a multidisciplinary research center formed by musicians, engineers and computer scientists. The main research interest lies with sonology, audiotacticle musical analysis, ubiquitous music, interactive multimedia installations, and the design of computer music technology in general. Overall, the common ground for the NESCoM projects lies with the human-aspects, both cognitive and motor, behind a musical activity. This can come, for instance, in the shape of an audiotactile analysis of musical interaction applied to a new digital musical interface designed to overcome human physical constraints or the composition of a cinema soundtrack based on perceptual models of the audience. In this paper, it is reported a short description of the ongoing projects of the NESCoM and the future works.



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## Computer Music research at FEEC/Unicamp: a snapshot of 2019

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- Tiago Tavares (State University of Campinas - Brazil)
- Bruno Masiero (State University of Campinas - Brazil)

**Keywords:** Computer Music and Creative process ; Music Information Retrieval

This is a lab report paper about the state of affairs in the computer music research group at the FEEC/Unicamp. This report discusses the people involved in the group, the efforts in teaching and the current research work performed. Last, it provides some discussions on the lessons learned from the past few years and some pointers for future work.

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## Alice: Arts Lab in Interfaces, Computers, and Everything Else - Research report (2019)

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- Flávio Schiavoni (Federal University of São João del-Rei - Brazil)
- André Gomes (Federal University of São João del-Rei - Brazil)
- João Teixeira (Federal University of São João del-Rei - Brazil)
- Frederico Resende (Federal University of São João del-Rei - Brazil)
- Igino Silva Junior (Federal University of São João del-Rei - Brazil)
- Gabriel Lopes Rocha (Federal University of São João del-Rei - Brazil)
- Avner Paulo (Federal University of São João del-Rei - Brazil)
- Igor Andrade (Federal University of São João del-Rei - Brazil)
- Mauro César Fachina Canito (Federal University of São João del-Rei - Brazil)
- Rômulo Augusto Vieira Costa (Federal University of São João del-Rei - Brazil)

**Keywords:** Computer Music and Creative process ; Digital Music Systems and Services ; Software Systems and Languages for Sound and Music

Located in the Computer Science Department of the Federal University of São João del-Rei, but not limited to just this space, Alice has emerged as a research group focused on the development of software and technologies for the field of music computing. But over time, ALICE eventually gave birth to a transdisciplinary group, called Orchidea, focused on the development of digital art, encompassing students from diverse fields, such as Computer Science, Theater, Architecture and Music. In this way, this work aims to describe

and present the various initiatives and proposals carried out by the ALICE and Orchidea groups, addressing the development of technological products, through the tools implemented and the external tools used for teaching and for artistic creation. In addition, this work describes the current researches that are under development by the members of the groups, also highlighting the development of the digital performance titled “ The Chaos das 5 ” and all the aspects and learning that we have obtained so far with this performance.

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## A retrospective of the research on musical expression conducted at CEGeME

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**Keywords:** Movement and Gesture ; Music Expressiveness ; Software Systems and Languages for Sound and Music

CEGeME - Center for Research on Musical Gesture and Expression is affiliated to the Graduate Program in Music of the Universidade Federal de Minas Gerais (UFMG), hosted by the School of Music, Belo Horizonte, Brazil, since 2008. Focused on the empirical investigation of music performance, research at CEGeME departs from musical content information extracted from audio signals and three-dimensional spatial position of musicians, recorded during a music performance. Our laboratories are properly equipped for the acquisition of such data. Aiming at establishing a musicological approach to different aspects of musical expressiveness, we investigate causal relations between the expressive intention of musicians and the way they manipulate the acoustic material and how they move while playing a piece of music. The methodology seeks support on knowledge such as computational modeling, statistical analysis, and digital signal processing, which adds to traditional musicology skills. The group has attracted study postulants from different specialties, such as Music, Computer Science, Engineering, Physics, Phonoaudiology and Music Therapy; as well as collaborations from professional musicians instigated by specific inquiries on the performance in their instruments. This

paper presents a brief retrospective of the different research projects conducted at CEGeME.

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## MusTIC: Research and Innovation Group on Music, Technology, Interactivity and Creativity

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- Geber Ramalho (Federal University of Pernambuco - Brazil)

**Keywords:** Computer Music and Creative process ; Multimedia Systems ; Music, Society and Technology

MusTIC is a research and innovation group concerned in conceiving and developing products and experiences that have impact on music, education, visual and performing arts, and entertainment. In particular, we have been working with tools, methods, and concepts from physical computing, interaction design, and signal processing to build new interfaces for artistic expression, to develop tools for rapid prototyping, and to improve education through robotics and gamification.

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## LCM-Ufrgs Research Group Report: What are we doing in Computer Music?

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- Rodrigo Schramm (Federal University of Rio Grande do Sul - Brazil)

**Keywords:** Digital Sound Processing ; Music Information Retrieval

In this paper, we present an historical overview and a brief report of main recent activities of LCM (Laboratorio de Computação Musical) of Ufrgs.

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## Computer Music Research Group - IME/USP Report for SBCM 2019

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- Paulo Vitor Itaboraí de Barros (University of São Paulo - Brazil)

**Keywords:** Digital Sound Processing ; Music Information Retrieval ; Sensors and Multimodal Signal Processing

The following report presents some of the ongoing projects that are taking place in the groups laboratory. One of the notable characteristics of this group is the extensive research spectrum, the plurality of research areas that are being studied by its members, such as Music Information Retrieval, Signal Processing and New Interfaces for Musical Expression.





# Posters

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## A cluster analysis of benchmark acoustic features on Brazilian music

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- Carlos Thomaz (University Center of FEI - Brazil)

**Keywords:** Brain-Computer Interfaces and Physiological Signals ; Music Information Retrieval ; Music Perception, Psychoacoustics and Cognition

In this work, we extend a standard and successful acoustic feature extraction approach based on trigger selection to examples of Brazilian Bossa-Nova and Heitor Villa Lobos music pieces. Additionally, we propose and implement here a computational framework to disclose whether all the benchmark acoustic features extracted in such approach are statistically relevant, that is, non-redundant. Our experimental results show that not all these well-known features might be necessary for trigger selection, given the multivariate statistical redundancy found, which associated all these acoustic features into only 3 clusters with different factor loadings and, consequently, representatives.

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## The taste of scales and chords

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**Keywords:** Computational Musicology ; Music Perception, Psychoacoustics and Cognition

Reliable crossmodal correspondences between basic tastes and music features have been found in recent studies. In this work, we explore associations between scales, chords and tastes. Several of these elementary musical structures show non-random patterns of matching with basic tastes. Moreover, their aggregate dyadic consonance anti-correlates with the relative frequency of their matching to bitter taste.

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## Automatic onset detection using convolutional neural networks

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**Keywords:** Artificial Intelligence, A-Life and Evolutionary Music Systems ; Music Analysis and Synthesis ; Music Information Retrieval

A very significant task for music research is to estimate instants when meaningful events begin (onset) and when they end (offset). Onset detection is widely applied in many fields: electrocardiograms, seismographic data, stock market results and many Music Information Research (MIR) tasks, Automatic Music Transcription, Rhythm Detection, Speech Recognition, etc. Automatic Onset Detection (AOD) received, recently, a huge contribution coming from Artificial Intelligence (AI) methods, mainly Machine Learning and Deep Learning. In this work, the use of Convolutional Neural Networks (CNN) is explored by adapting its original architecture in order to apply the approach to automatic onset detection on audio musical signals. We used a CNN network for onset detection on a very general dataset, well acknowledged by the MIR community, and examined the accuracy of the method by comparison to ground truth data published by the dataset. The results are promising and outperform another methods of musical onset detection.

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## Harmonia: a MuseScore's plugin to teach music

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- João Teixeira (Federal University of São João del-Rei - Brazil)
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**Keywords:** Computational Musicology ; Computer Music and Creative process ; Music Notation, Printing, and Optical Recognition

Information and Communication Technologies (ICTs) have been characterized as a very effective resource for promoting innovation in the way of teaching and learning. In relation to the musical area, computer software of musical notation, like MuseScore, has been more and more used for the musical compositions and to teach and learn music writing, musical arrangement, composition and counterpoint. MuseScore is a free software that can easily be applied to academic purposes, such as universities, for teaching students in music fields and can also be used in the professional life of students who have graduated from courses that use it. In addition, it allows the implementation of plugins for various purposes, such as the analysis of scores in relation to various preset parameters. In this context, this work aims to present the development of the Harmonia, an open source plugin for MuseScore focused on teaching musical analysis and automatic verification of scores based in harmony predefined rules.

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## Audio Encryption Scheme based on Pseudo-orbit of Chaotic Map

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**Keywords:** Digital Sound Processing

Chaos-based encryption uses a chaotic dynamic system to encrypt a file. The aim of this study was to investigate the use of the chaotic Cubic Map to encrypt data, in particular, audio files. A simple algorithm was developed to encrypt and decrypt an audio data. The effectiveness of the method was measured by means of the correlation coefficient calculation, spectral entropy and also by comparing waveforms. The measurements were shown to lead to satisfactory confusion levels of the original data, within a few seconds. This indicates that the Cubic Map can be used as a source for encryption keys, with as good or better security indicators when compared to other schemes.

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## Digital Design of Audio Signal Processing Using Time Delay

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- Mauricio Perez (University of São Paulo - Brazil)
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- Regis Rossi Alves Faria (University of São Paulo - Brazil)

**Keywords:** Digital Sound Processing

This paper describes the design in PureData of some audio signals processes in real time like delay, echo, reverb, chorus, flanger e phaser. We analyze the technical characteristics of each process and the psychoacoustic effects produced by them in human perception. The approach of these process is based mostly on Roads (1996), Berardino and Puckette (2006).



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## 3A: mAchine learning Algorithm Applied to emotions in melodies

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**Keywords:** Artificial Intelligence, A-Life and Evolutionary Music Systems ; Music, Emotion and Communication ; Real-time Interactive Systems

At every moment, innumerable emotions can indicate and provide questions about everyday attitudes. These emotions can interfere or stimulate different goals. Whether in school, home or social life, the environment increases the itinerant part of the process of attitudes. The musician is also passive of these emotions and incorporates them into his compositions for various reasons. Thus, the musical composition has innumerable sources, for example, academic formation, experiences, influences and perceptions of the musical scene. In this way, this work develops the mAchine learning Algorithm Applied to emotions in melodies (3A). The 3A recognizes the musician's intentions of melodies in real time and sharpens moments of emotion generating accompaniment melody. Initially, it is using the Gregorian modes for each intention of composition. In case, the musician changes the mode or tone, the 3A has an adaptation to continuing the musical sequence. Currently, 3A uses artificial neural networks to predict and adapt melodies. 3A generates results in digital midi and sound files. It started from mathematical series for the formation of melodies that present interesting results for both mathematicians and musicians. For the implementation and tests, Chuck language was utilized.

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## Instrumental Sensibility of Vocal Detector Based on Spectral Features

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**Keywords:** Digital Sound Processing ; Music Analysis and Synthesis ; Music Information Retrieval

Detect voice in a mixture of sound sources remains a challenger task in MIR research. The musical content can be perceived in many different ways as instruments vary. We evaluate how instrumentation affects singing voice detection in pieces using a standard spectral feature (MFCC). We train Random Forest models with song remixes with specific sets of sound sources and evaluate this model over the original mixes. We conduct a preliminary analysis of the classification accuracy results.

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## Characterization of the sonority associated to woodwinds instruments through spectral analysis

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- Yubiry González (Federal University of ABC - Brazil)
- Ronaldo Prati (Federal University of ABC - Brazil)

**Keywords:** Digital Sound Processing ; Music Analysis and Synthesis ; Sound Analysis and Synthesis

The sonority is one of the definitions widely used by musicians when trying to define the color or timbral balances associated with individual or groups of instruments, such as for ensembles or orchestras. This definition obeys to subjective musical parameters associated with "color balance", "sound amplitude", among others. In the field of musical acoustics, it is well known that the sounds coming from musical instruments depend on several acoustic physical parameters such as Intensity, Frequency, and the number of harmonics, as well as other aspects including, association with its manufacturing process, such as geometry and materials used for construction. This work presents, from a spectral analysis of the timbre with the use of Fast Fourier Transform (FFT), Spectral Power Density (DPE) and Spectrograms, the characterization of the subjective concept of "sonority", for some instruments of the Woodwind family: Piccolo flute, transverse flute, clarinet and oboe. It is concluded that the stage of sound evolution as the attack and sustenance, allow the establishment of harmonics whose powers are fundamental to define the timbric "color" associated with each instrument, as well as the number of harmonics allowed to establish parameters of "sound identity", useful for the generation of a coefficient extracted from the obtained spectral analysis, which allows to advance in the characterization of the Sonority. The generalization of the method is suggested for all families of musical instruments.

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## Batebit Controller: Popularizing Digital Musical Instruments' Technical Development Process

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- Filipe Calegario (SENAI Innovation Institute for ICT - Brazil)
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**Keywords:** Computer Music and Creative process ; Multimedia Systems ; Real-time Interactive Systems

In this paper, we present an ongoing research project related to popularizing the mindset of building a new digital musical instrument. We developed a physical kit and software intended to provide beginner users with the first grasp on the development process of a digital musical instrument. We expect that, by using the kit and the software, the users could experiment in a short period the various steps in developing a DMI such as physical structure, electronics, programming, mapping, and sound design. Our approach to popularizing the DMI development process is twofold: reducing the cognitive load for beginners by encapsulating technical details and lowering the costs of the kit by using simple components and open source software. In the end, we expect that by increasing the interest of beginners in the building process of digital musical instruments, we could make the community of new interfaces for musical expression stronger.



# Art

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## Tecnofagia: A Multimodal Rite

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- Luzilei Aliel (Federal University of São Paulo - Brazil)
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- Ricardo Thomasi (Federal University of São Paulo - Brazil)

**Keywords:** Computer Music and Creative process ; Multimedia Systems ; Real-time Interactive Systems

This is a concert proposal of Brazilian digital art, which brings in its creative core the historical and cultural aspects of certain locations in Brazil. The term TecnoFagia derives from an allusion to the concept of anthropophagic movement (artistic movement started in the twentieth century founded and theorized by the poet Oswald de Andrade and the painter Tarsila do Amaral). The anthropophagic movement was a metaphor for a goal of cultural swallowing where foreign culture would not be denied but should not be imitated. In his notes, Oswald de Andrade proposes the “cultural devouring of imported techniques to re-elaborate them autonomously, turning them into an export product.” The Tecnofagia project is a collaborative composition and collective performance group that seeks to broaden aspects of live electronic music, video art, improvisation and performance, taking them into a multimodal narrative context with essentially Brazilian sound elements such as speech, accents and phonemes; instrumental tones; soundscapes; historical, political and cultural contexts. In this sense, Tecnofagia goes beyond techniques and technologies of interactive performance, because it provokes glances for a Brazilian art-technological miscegenation. That is, it seeks a musical gesture emerging from the encounters between medias, art, spaces, culture, temporalities, objects, people and technologies, at the moment of performance.

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## Graph Composer: music composition from graph design

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- Pedro Arthur (National Institute of Pure and Applied Mathematics - Brazil)
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**Keywords:** Computer Music and Creative process ; Music Expressiveness ; Real-time Interactive Systems

The Graph Composer is an app that allows the user to compose music through the design of a graph. You can create or modify an existing graph, listen and modify the composition in real time. Insert new nodes and connect them, change the corresponding note by clicking over the node and selecting a new one from the scale, define its duration over time and select a decoration to change the sound sequence.



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## Per(sino)ficaco

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- Fabio Carvalho (Federal University of So Joo del-Rei - Brazil)
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**Keywords:** Acoustics, Diffusion and Sonorization ; Computer Music and Creative process ; Music, Society and Technology

The bell's culture is a secular tradition strongly linked to the religious and social activities of the old Brazilian's villages. In So Joo del-Rei, where the singular bell tradition composes the soundscape of the city, the bell's ringing created from different rhythmic and timbral patterns, establish a language capable of transmitting varied types of messages to the local population. In this way the social function of these ringing, added to real or legendary facts related to the bell's culture, were able to produce affections and to constitute a strong relation with the identity of the community. The link of this with the bells, therefore transcends the man-object relationship, tending to an interpersonal relationship practically. Thus, to emphasize this connection in an artistic way, it is proposed the installation called: PER (SINO) FICAO. This consists of an environment where users would have their physical attributes collected through the use of computer vision. From the interlocking of these data with timbral attributes of the bells, visitors would be able to sound like these, through mapped bodily movements capable of performing syntheses based on original samples of the bells. Thus the inverse sense of the personification of the bell is realized, producing the human bellification.

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## O Chaos das 5

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**Keywords:** Computational Musicology ; Movement and Gesture ; Music, Society and Technology

"O Chaos das 5" is an audiovisual digital performance. The guideline of the performance is inspired by Alice, from Lewis Carroll book - Alice in the Wonderland, as a metaphor to take the audience to a synthetic and disruptive wonder world. The concept of the performance is to conceive the possibility to the audience to interact through digital interfaces creating an immersive and participatory experience by combining three important layers of information (music, projections and gestures) through their cellphones. Once that the audience members take part of the show on an immersive aspect, there is no stage or another mark to limit the space of the performers and the audience. The name of the performance, "O Chaos das 5" sounds like a pun since "tea" in portuguese is "chá". A translation to English like "The 5 o'clock chaos" or "The 5 o'clock tea" do not keep the pun and lost the cacophonous meaning. The Musical Layer is composed by the digital devices to be accessed by the public on their cellphones and with 5 musicians improvising with their unconventional

digital musicians. The Visual Layer projections made in real time presents an aesthetic that puts the computer in scene, opening the "Black Box" and exposing the machine in its realistic imaging. Public interaction is given by the capture of images and data to be used in the projections. The Gesture Layer counts with a performance that mixes a set of gestures, improvisations and physically interactions with the audience in the space of the show. The plot is organized in a first welcome, three scenes and a final credit show. The welcome consists of a preparation movement that precedes the spectacle itself where the public is invited to be part of the show. A countdown marks the time to guide the public through the universes that is about to come. The first scene presents a synthetic universe, with glissandos that refer to the Metastasis of Xenakis sounding a dip in free fall among digital images while a reverse set of movements guides the gestural performance. This fall ends in the second scene, a real-world experience, where the city's sound landscape contrasts with the saturated urban scene presented by the disputed territories of cities. To run away from this reality, the third scene leads us to an experience of sur-reality that presents the contrast between the agitation of reality and the calm of surreality.

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## Body Building Music: The Kinase Instalation

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- João Monnazzi (University of São Paulo - Brazil)
- Regis Rossi Alves Faria (University of São Paulo - Brazil)

**Keywords:** Movement and Gesture ; Real-time Interactive Systems ; Sensors and Multimodal Signal Processing

In the midst of various media interactions arising from the technological development of the 21st century, we present one in which music can open new paths and connections in areas still under-explored, such as in interdisciplinarity with sport. The idea of the Kinase installation came from the possibility of giving users an opportunity to experience between music and bodybuilding arts through a practical experience. This installation focuses on the design of an interactive system for musical creation controlled by a choreographic performance, in which the user, besides interacting with the creative process and with the music generation itself during his/her performance, can also change the musical structure and redefine parameters driving the sound generation. Using a motion sensor, users act in real time, reorganizing the execution of previously elaborated sound materials and manipulating effect and dynamics processors. An interactive modular composition was performed to experience the system, adopting a modular musical structure in tones. By providing the user with functions previously exclusive to the professional niche of the performer and / or composer, the system provides access to music creation processes for people that do not necessarily have knowledge about traditional musical composition, as well as providing information about a still little spread sport. The results expose new forms of mediation and open boundaries of applications untouched by both areas, creating a new experience for the public.

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## Black Lives Matter

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- Avner Paulo (Federal University of São João del-Rei - Brazil)
- Carlos Eduardo Oliveira de Souza (Federal University of São João del-Rei - Brazil)
- Bruna Guimarães Lima e Silva (Federal University of São João del-Rei - Brazil)
- Flávio Schiavoni (Federal University of São João del-Rei - Brazil)
- Adilson Siqueira (Federal University of São João del-Rei - Brazil)

**Keywords:** Computer Music and Creative process ; Music, Emotion and Communication ; Music, Society and Technology

The Brazilian police killed 16 people per day in 2017 and 3/4 of the victims were black people. Recently, a Brazilian called Evaldo Rosa dos Santos, father, worker, musician, and black, was killed in Rio de Janeiro with 80 rifle bullets shot by the police. Everyday, the statistics and the news show that the police uses more force when dealing with black people and it seems obvious that, in Brazil, the state bullet uses to find a black skin to rest. Unfortunately, the brutal force and violence by the state and the police to black people is not a problem only in this country. It is a global reality that led to the creation of an international movement called Black Lives Matter (BLM), a movement against all types of racism towards the black people specially by the police and the state. The BLM movement also aims to connect black people of the entire world against the violence and for justice. In our work, we try to establish a link between the reality of black people in Brazil with the culture of black people around the world, connecting people and artists to perform a tribute to the black lives harved by the state force. For this, the piece uses web content, news, pictures, YouTube's videos, and more, to create a collage of visual and musical environment merged with expressive movements of a

dance, combining technology and gestures. Black culture beyond violence because we believe that black lives matter.

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## Iterative Meditations: The use of audio feature extraction tools on acousmatic composition

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- Aluizio Oliveira (Federal University of Minas Gerais - Brazil)

**Keywords:** Computer Music and Creative process ; Music Analysis and Synthesis ; Sound Analysis and Synthesis

This piece explores the possibilities of using Music Information Retrieval and Signal Processing techniques to extract acoustic features from the recorded material and use this information on the decision making process that is intrinsic to music composition. By trying to identify or create sound descriptors that could represent the composer's subjective sensations of listening it was possible to compare and manipulate samples on the basis of this information, bridging the gap between the imagined acoustic targets and the actions required to achieve it. "Iterative Meditations" was created through an iterative process of listening, analyzing, acting and refining the analysis techniques used, having as end product the musical piece itself as well as a set of tools for writing musical pieces.





# Workshops

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## Introduction to automatic audio classification

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- Tiago Tavares (State University of Campinas - Brazil)

**Keywords:** Music Analysis and Synthesis ; Music Information Retrieval

This hands-on workshop comprises essential techniques for digital signal processing and machine learning. Participants will use the Python libraries librosa and scikit-learn as support to build an automatic audio classification system. The workshop will use explorations in toy problems to approach theoretical aspects. Later, it will discuss practical issues for building a scientific applications in the field.

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## Procedural Music in Games

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- José Eduardo Ayres (National Institute of Pure and Applied Mathematics - Brazil)
- Pedro Arthur (National Institute of Pure and Applied Mathematics - Brazil)
- Vitor Rolla (National Institute of Pure and Applied Mathematics - Brazil)
- Luiz Velho (National Institute of Pure and Applied Mathematics - Brazil)

**Keywords:** Computer Music and Creative process ; Software Systems and Languages for Sound and Music

This workshop will bring to the audience an introduction to the Chuck audio programming language, to the Unity game engine within a hands-on experience how one can use such technologies to achieve a new level of immersion through procedurally generated sounds responding to game events and visual effects. The workshop is intended to a broad audience ranging from programmers to ones with little to no knowledge in the field.

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# Keywords

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## Acknowledgments:

