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### REALIZAÇÃO

Grupo de Pesquisa MusMat  
Programa de Pós-Graduação em Música da UFRJ | Universidade Federal do Rio de Janeiro

### COMISSÃO ORGANIZADORA

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UNIVERSIDADE FEDERAL DO RIO DE JANEIRO | ESCOLA DE MÚSICA | PROGRAMA DE PÓS-GRADUAÇÃO EM MÚSICA

8-12 DEZ 2020  
V CONGRESSO INTERNACIONAL DE  
MÚSICA E MATEMÁTICA • MUSMAT 2020

PERSPECTIVAS E APLICAÇÕES DA MATEMÁTICA NAS TEORIAS PÓS-TONAIAS

*Homenagem a Jamary Oliveira*

8-12 DEC 2020  
5<sup>TH</sup> INTERNATIONAL CONGRESS OF  
MUSIC AND MATHEMATICS • MUSMAT 2020

PERSPECTIVES AND APPLICATIONS OF MATHEMATICS IN POST-TONAL THEORIES

*Hommage to Jamary Oliveira*

GRUPO DE PESQUISA MUSMAT  
[www.musmat.org](http://www.musmat.org)

Ilustração a partir da obra Sonológico, Day 13, de Raphael Sousa Santos e o Planispharium coeleste, 1670, de Frederik de Wit.

**V CONGRESSO INTERNACIONAL MUSMAT (2020)**  
**Perspectivas e Aplicações da Matemática nas**  
**Teorias Pós-tonais**  
« Homenagem a Jmary Oliveira »

8-12 de dezembro de 2020  
EDIÇÃO ONLINE

O Congresso Internacional de Música e Matemática, MUSMAT 2020, promovido pelo grupo de pesquisa MusMat, chega este ano à sua quinta edição, contendo com a presença de um número bastante expressivo de pesquisadores estrangeiros de renome mundial, convidados para importantes conferências sobre suas pesquisas mais recentes. Diante da situação pandêmica atual, pela primeira vez o congresso será realizado inteiramente em formato online, através de videoconferências e debates virtuais. A lista dos convidados internacionais conta com os nomes de Dmitri Tymoczko (Princeton University, EUA), David Temperley (Eastman School of Music, EUA), Scott Murphy (University of Kansas, EUA), Moreno Andreatta (Université de Strasbourg, França), Martín Rocamora (Universidad de la República, Uruguai), Robert Peck (Louisiana State University, EUA), Fabian Moss (École Polytechnique Fédérale de Lausanne, Suíça), François Pachet (Spotify) e Jean-Pierre Briot (Centre National de la Recherche Scientifique – CNRS, França). O congresso conta ainda com diversos pesquisadores nacionais de reconhecida atuação na confluência entre as áreas da Matemática e da Música, que apresentarão e debaterão seus trabalhos em mesas redondas e conferências. Destacamos ainda a presença de importantes comunicações e discussões em painéis sobre pesquisas e, especialmente, as condições em que estão sendo realizadas no contexto da pandemia. Cinco concertos (um em cada dia do evento), envolvendo instrumentações e intérpretes diversos, contemplarão a dimensão artística do congresso. Desejo a todos um excelente proveito.

Carlos Almada  
Líder do Grupo MusMat

The International Congress of Music and Mathematics, MUSMAT 2020, promoted by the research group MusMat, reaches its fifth edition this year, with the presence of a very significant number of researchers of world renown, invited to present conferences on their most important recent research. In view of the current pandemic situation, for the first time the congress will be held entirely in an online format, through video conferences and virtual debates. The list of international guests includes the names of Dmitri Tymoczko (Princeton University, USA), David Temperley (Eastman School of Music, USA), Scott Murphy (University of Kansas, USA), Moreno Andreatta (Université de Strasbourg, France), Martín Rocamora (Universidad de la República, Uruguay), Robert Peck (Louisiana State University - USA), Fabian Moss (École Polytechnique Fédérale de Lausanne, Switzerland), François Pachet (Spotify), and Jean-Pierre Briot (Center National de la Recherche Scientifique - CNRS, France). The congress also has several Brazilian researchers of recognized actuation in the confluence between the areas of Mathematics and Music, who will present and discuss their work in round tables and conferences. We also highlight the presence of important communications and discussions in panels on research and, especially, the conditions in which they are being carried out in the context of the pandemic. Five concerts (one on each day of the event), involving different instruments and interpreters, will contemplate the artistic dimension of the congress. I wish you all an excellent benefit.

Carlos Almada  
Leader of MusMat Research Group

**TUESDAY [RIO DE JANEIRO TIME - GMT-3]****08 Dec 20****PROGRAM**

14:30 OPENING  
**Carlos Almada**

**Luís Neto da Costa** *E é sempre melhor o impreciso que embala do que o certo que basta*

15:00 KEYNOTE: *Repeating Contrapuntal Patterns*  
**Dmitri Tymoczko** (Princeton University)

**PandeMúsica Composições e Performances 1'**

16:00 ROUND-TABLE 1:  
*Algorithms and Music*

**Eduardo Frigatti** *Five Canonic Miniatures I - Anxiety. Vertigo*

**Moreno Andreatta** (University of Strasbourg) -  
*Processes and Techniques of 'Mathemusical' Learning:  
How to Teach Maths through Music via Computer  
Science*

**Marisa Rezende** *Impasse*

**Marcos Sampaio** (UFBA) - *Computational  
Musicology, Algorithms, and Dataset.*

**Helder Oliveira** *Kenosis*

**Jônatas Manzolli** (UNICAMP) - *Dialogue between  
Composition and Analysis through Computer Models*

**Alexandre Schubert** *Cadência*

**Rami Levin** *Coronária*

**Liduino Pitombeira** *Canopus*

Moderator: **Liduino Pitombeira** (UFRJ)

**Ivan Simurra** *Ego Ur*

18:00 CONCERT 1: *Works for Clarinet*  
**José Batista Júnior**

**Salatiel Ferreira** *Instante III - b*

**Rodrigo Cicchelli** *Me dê um minuto*

**Carlos Almada** *Uma bossa*

**Rodrigo Camargo** *Aos Pedacos*

**Marcel Castro-Lima** *Interferência* (em colaboração com Batista Jr)



**WEDNESDAY [RIO DE JANEIRO TIME - GMT-3]****09 Dec 20****PROGRAM**

14:00 ROUND-TABLE 2:  
*Probability and Music*

**David Temperley** (Eastman School of Music) - *Two Probabilistic Models of Musical Pleasure*  
**Fabian Moss** (École Polytechnique Fédérale de Lausanne) - *The Importance of Modeling in Computational Musicology*  
**Hugo Carvalho** (UFRJ) - *Statistical Models for Music Emotion Recognition*

Moderator: **Carlos Almada** (UFRJ)

15:30 ORAL COMMUNICATIONS

**Ricardo de Almeida Gonçalves** (UFRJ) - *Ternarization of Binary Structures and Metric Modulation Applied to a Re-working Featuring Jazz Elements of Garoto's Piece Lamentos do morro*  
**Dennis Carvalho** (UFBA) - *Cuboctahedron as an Instrument of Analysis and Visualization of Musical Space in Coltrane and Berg.*  
**Jose Fornari** (UNICAMP)- *Logistic Maps for Illogic Music*  
**Samuel Pereira e Gilberto Bernardes** (University of Porto) - *The Fourier Phase Sphere: A Method for Computer-Assisted Atonal Composition.*

Coordinator: **Hugo Carvalho** (UFRJ)

18:00 CONFERENCE: **Ricardo Bordini** (UFMA)  
*Hommage to Jarmy Oliveira*

19:30 CONCERT 2: *Works for voice and guitar* - **Duo Adour**

**Jorge Antunes** *Noite Solitária*

**Henderson Rodrigues** *Ciclo I - Passeio*

**Carlos Almada**  
Poema de Petrucio Viana *Fiboema 1\**

**Pedro Proença** *Mozão e eu\**

**Eduardo Frigatti** *Me perdi*

**Daniel Moreira**  
Poema de Stefan Zweig  
Tradução: Manuel Bandeira *Epílogo*

**Carlos dos Santos** *Duas canções simples*

**Leonardo Aldrovandi** *Lâmina da Lua*

**Jorge L. Santos** *Porque sou forte*

**Rodrigo Marconi** *Os Três Rapazes de Viena\**  
(para violão de 8 cordas)  
I - Schoenberg

**Liduíno Pitombeira**  
Poema de Petrucio Viana *Os 4 Elementos\**

\* world premiere

**THURSDAY [RIO DE JANEIRO TIME - GMT-3]****10 Dec 20****PROGRAM**

14:00 ROUND-TABLE 3 :  
*Logic and Music*

**Robert Peck** (Louisiana State University) - *Beat-Class Set Classes and the Power Group Enumeration Theorem.*

**Petrucio Viana** (UFF) - *On the Logicity of Music*

**Francisco Aragão** (UFC) - *Logic and the Logics of Music*

Moderator: **Carlos Mathias** (UFF)

15:30 MUSMAT PANEL I

**Alexandre Ferreira**  
**Max Kühn**  
**Claudia Usai**  
**Pedro Zisels**  
**Rodrigo Furman**  
**Ariane Petri**  
**Érico Bonfim**  
**Ana Miccolis**  
**Pedro Proença**  
**Roberto Macedo**  
**Desirée Mayr**  
**Natanael Luciano**

18:00 CONFERENCE: **Scott Murphy** (Kansas University)  
*Common Musical Sets as Pareto-Optimal Peaks*

19:30 CONCERT 4: Works for Bassoon - **Ariane Petri**

**Angélica Faria**

Kuru

**Carlos dos Santos***Capim Tui Tui*

I – Praia

II – Cidade

III – Sertão

**Daniel Moreira***Alvorada\****Emmanuel Ferreira***Quatro Melodias de Esperança (n. 1 a 3)*

I – Dolce

II – Larghetto Dolce

III – Rubato Grave

**Helder Oliveira***Askesis\**

I – Ária

II – Recitativo

III - Finale

**Micael Antunes***Descontinuum I\****Rodrigo Pascale***Unnest\****Carlos Almada***Rocknária\****Rodrigo Cicchelli***Ei, vamo aí!\**\* *world premiere*

**FRIDAY [RIO DE JANEIRO TIME - GMT-3]**

**11 Dec 20**

**PROGRAM**

14:00 ROUND-TABLE 4:  
*Temporal Organizations in Music*

**Carlos Mathias** (UFF) - *Rhythmic Illusions*  
**Arthur Kampela** (UNIRIO) - *Time Suspended and Metric Grace-Notes: A Cognitive Short-Circuit between the Metronomic, the Metonymic and the Mnemonic*  
**Marcelo Coelho** (Souza Lima) - *Suite I Juca Pirama: Adapting José Eduardo Gramani's Rhythm to Ron Miller's Modal Jazz*

Moderator: **Daniel Moreira de Sousa**

15:30 MUSMAT PANEL II

**Carlos Almada**  
**Liduíno Pitombeira**  
**Daniel Moreira de Sousa**  
**Hugo Tremonte de Carvalho**

18:00 CONFERENCE: **Rodolfo Coelho de Souza** (USP)  
*The Role of Mapping Function in the Algorithmic Musical Composition*

19:30 CONCERT 4: *Enlarge Your Sax: Works for Sax and Electronics*

**Pedro Bittencourt**  
saxes sopranino, soprano, alto, tenor e barítono

**Jack Fortner** *Frammento Cantando* (2006)\*  
Soprano sax

**André Ribeiro** *Linha de sombra* (2014)  
Alto sax

**Gustavo Penha** *Farfalhando* (1983)  
Baritone sax, real-time electronics (MAX MSP)

**Guilherme Bertissolo** *Erupção* (2019-2020) \*\*\*  
Sopranino sax and real-time electronics (PD)  
— *world premiere*  
in collaboration with Pedro Bittencourt (1975)

**Luciano Leite Barbosa** *Poissons rouges* (2020)\*\*\*  
Soprano sax, real-time electronics (MAX MSP 7) and video

**Jaime Reis** *Inverso Sangue: Ambar (B)* (2018)\*\*  
Soprano sax

**Danilo Rossetti** *Proceratophrys boiei* (2016)  
Tenor sax, real-time electronics (MAX MSP)

**Alexandre Lunsqui** *After Telluris II* (2018)  
Baritone sax

\* *world premiere of the sax version*

\*\* *Brazilian premiere*

\*\*\* *world premiere*

**SATURDAY [RIO DE JANEIRO TIME - GMT-3]**

**12 Dec 20**

14:00 ROUND-TABLE 5:  
MUSIC SIGNAL PROCESSING

**Rodrigo Schramm** (UFRGS) - *Improving the Classification of Rare Chords*  
**Martín Rocamora** (Universidad de la República) - *Signal Processing for Music Analysis from Audio Recordings*  
**Bruno Masiero** (UNICAMP) - *Spatial Audio and Object-Oriented Coding*

Moderator: **Luiz Wagner Pereira Biscainho**

15:30 OPEN CONVERSATION: *Challenges for Academic Research in Music/Mathematics*

**Gabriel Pareyon** (Universidad de Guadalajara)  
**Marcos Sampaio** (UFBA)  
**Walter Nery** (Souza Lima)  
**Guilherme Bertissolo** (UFBA)  
**Júlio Herrlein** (UFRGS)  
**Ciro Visconti** (Souza Lima)

Moderation: **MusMat Group**

18:00 CONFERENCE: **François Pachet** (Spotify) and **Jean-Pierre Briot** (CNRS/ Lip6/ PUC-Rio)  
*Some Reflexions about AI-Assisted Music Composition*

19:30 CONCERT 5: *Electroacoustics and Alike*  
Curators: **Marcelo Carneiro, Lilian Campesato, Paulo Dantas**, and **Mariana Carvalho**

**PROGRAM**

**Mariana Carvalho** *Improviso Interior* (2020)

**Paulo Dantas** *tplgy.id3* (2020)

**Marcelo Carneiro** *Prolação* (2020)

**Jéssica Marinhos** *Sui{side}* (2019)

**Daniel Quaranta** *Paisagem Através de Um Vidro Molhado*

**Gabriel Dargains** *Outubro e Fim de Tarde* (2019)

**Lilian Campesato** *Eleonora* (2017-19)

**Nasnuven Paulo** *Reexposição de Panelaço* (2020)

**Marina Mapurunga** *Verde Mar, Ruído Verde, Ventos Invisíveis* (2020)



## ABSTRACTS

### *Repeating Contrapuntal Patterns*

**Dmitri Tymoczko** (Princeton University)

**Abstract:** In my talk I will define a new theoretical tool, the "repeated contrapuntal pattern," which can be found throughout music from the Renaissance to the present day. Repeated contrapuntal patterns unify a host of common devices from sequences to rounds to atonal "wedge" voice leadings to Renaissance idioms having no common name. Musically, they combine a voice leading with a permutation determining how that voice leading is to be reapplied. Geometrically, they are closely related to the parallel transport of vectors. I provide examples from rock music, Palestrina, Beethoven, jazz, Stravinsky, Schoenberg, and Ligeti.

### *Processes and Techniques of 'Mathemusical' Learning: How to Teach Maths through Music via Computer Science*

**Moreno Andreatta** (University of Strasbourg)

**Abstract:** In this short presentation, I will provide an overview of a current ProAppMaMu research project supported by CNRS which constitutes the cognitive component of a larger project entitled SMIR (Structural Music Information Research). The SMIR Project is hosted by IRMA (Institut de recherche mathématique avancée) and is carried out in collaboration with the musicologists of GREAM (Groupe de recherche expérimentale sur l'acte musical) and the computer science researchers from IRCAM Music Representation Team. After discussing the "mathemusical" dynamics underlying the SMIR project, I will offer several music-theoretical examples showing how to approach interesting mathematical problems starting from music representations and computer-aided modelling. I will focus in particular on some computational models of harmonic spaces that have been implemented in the web environment *The Tonnetz* (see <https://guichaoua.gitlab.io/web-hexachord/>) which enables an interactive exploration of a panoply of geometric spaces for music-theoretical, analytical and compositional purposes. Aim of the ProAppMaMu project is to investigate the link between geometric representations and cognitive neurosciences by following some previous work by researchers in neurosciences and experimental psychology - such as Robert Zatorre, Carol L. Krumhansl, Diana Deutsch, Ian Cross, Andrew J. Milne, Pierre Legrain, Alain Letailleur, Erica

Bisesi and many others - and by focusing on the interplay between structural mathematics and computational models.

### *Computational Musicology, Algorithms, and Datasets.*

**Marcos Sampaio** (UFBA)

**Abstract:** The purpose of this exhibition is to show an overview of the application of algorithms in recent studies in Computational Musicology and to present currently in use musical datasets.

### *Dialogue between Composition and Analysis through Computer Models*

**Jônatas Manzolli** (UNICAMP)

**Abstract:** The present talk addresses Manzolli's trajectory in which computational models are applied in creative practice and also in musical analysis. The central argument of the lecture is that the use of computational models provides generality, interoperability and malleability in such a way that support a dialogue between musical creation and musicological applications in the field of analysis. It is an interdisciplinary practice, mediated by technology, which can be seen as a synergistic process tied with discoveries and creations among these two fields of musical thinking. In order to develop the theme, it will be presented his research with audio descriptors aligned with the concept of emergence in complex systems that have resulted in creative processes and in the analysis of music of sound masses.

### *Two Probabilistic Models of Musical Pleasure*

**David Temperley** (Eastman School of Music)

**Abstract:** I present two probabilistic models of musical pleasure. The Inferential Musical Pleasure Model (IMPM) predicts that pleasure occurs when uncertainty about the value of a hidden variable shifts to relative certainty: that is, when the maximum of the probability distribution over the hidden variable sharply increases from one moment to the next. In other words, pleasure occurs when structural ambiguity is followed by clarity. The Predictive Musical Pleasure Model (PMPM) states that pleasure occurs when predictions of surface events (e.g. notes) are confirmed following unconfirmed predictions: in other words, when the predictability of the music is high relative to the prior context. Some phenomena, such as the pleasure of

returning to tonal or metrical clarity after ambiguity, are predicted by both theories, since prediction will generally be enhanced when the key and meter are clear. Other phenomena are only predicted by one theory or the other. The IMPM predicts (correctly in my view) that a clarification of the key or meter, in itself, can provide pleasure, even if this was entirely unexpected. On the other hand, the PMPM predicts that expected events after unexpected ones will give pleasure, even when there is no uncertainty about underlying structures. The two theories connect with previous proposals in music theory (Meyer, Huron), experimental aesthetics (Berlyne and followers), and neurophysiology (Zand/Zatorre) regarding the roles of expectation, probability, and ambiguity in musical pleasure, but they provide a more rigorous mathematical foundation for modeling these phenomena.

#### *The Importance of Modeling in Computational Musicology*

**Fabian Moss** (École Polytechnique Fédérale de Lausanne)

**Abstract:** In recent years, the increasing interest of music theorists in algorithmic analysis as well as the growing amount of musical corpora lead to advances in the field of computational musicology.

I present two examples for the application of mathematical and probabilistic models to musical data. Focusing on notes in Western classical music, I introduce a probabilistic model for pitch-class distributions of musical pieces based on the topological structure of the Tonnetz. The model allows for a quantitative comparison between pieces as well as historical comparisons between different composers. Turning to distributions of chords in 19th-century piano compositions, I demonstrate that they can be modeled using power laws and compare several composers under this model. These examples serve to show how explicit modeling not only aids concrete research questions at hand but also exposes which aspects are not yet fully understood and need to be addressed in future research.

#### *Statistical Models for Music Emotion Recognition*

**Hugo Tremonte de Carvalho** (UFRJ)

**Abstract:** Music Emotion Recognition is a sub-area of research within Music Information Retrieval (MIR), which aims to infer the emotion evoked on a listener by a piece of music, usually based on features extracted directly from

the waveform. In this talk we will briefly present and discuss some statistical models to perform this task, also focusing on the computational efficiency of the inference algorithms.

#### *Ternarization of Binary Structures and Metric Modulation Applied to a Re-working Featuring Jazz Elements of Garoto's Piece Lamentos do morro*

**Ricardo de Almeida Gonçalves** (UFRJ)

**Abstract:** The present study originates from concepts concerning the jazz influence on the works of Aníbal Augusto Sardinha, Garoto, published in researches by Delneri (2009), Junqueira (2010) and Severo (2017), pointing out, specifically, elements found latent on the piece Lamentos do Morro. Understanding them as manifestations of an intertextual character, we aim to explicit how the usage of metric modulations and ternarizations of binary structures in a musical re-working can value and extend the limits of the intertextual elements originally found on the piece.

#### *Cuboctahedron as an Instrument of Analysis and Visualization of Musical Space in Coltrane and Berg*

**Dennis Carvalho** (UFBA)

**Abstract:** In the present work, we will approach subjects related to concepts of applied geometry in music, analyzing excerpts of some works structured from the use of symmetrical micro and/or macrostructures. We will also investigate, through the cuboctahedron, some existing relationships between inversely symmetrical structures of different cardinalities exploring subjects such as Modes of Limited Transposition (MTL), Interval Cycles (CI) and Neo-Riemannian Theory (TNR).

#### *Logistic Maps for Illogic Music*

**Jose Fornari** (UNICAMP)

**Abstract:** Logistic map is a simple non-linear polynomial equations with chaotic behavior. Here is presented a dynamic computer model programmed in Pure Data (Pd) that generates melodic sequences using two Logistic maps. Although this is a simple music model, there seems to be a myriad of possible sound generational structuring and parameterizations capable of delivering indeterministic (illogic) music that is unpredictable while retaining an

auditory similarity. This paper describes this so called illogical music model, presents its algorithm and discusses its sound and musical results.

*The Fourier Phase Sphere: A Method for Computer-Assisted Atonal Composition*

**Samuel Pereira, Gilberto Bernardes** (University of Porto)

**Abstract:** In post-tonal music since the early 20th century, harmonic syntax evolved to almost as many theories and compositional systems as the number of composers. In this context, it is important to assist them in their creative process as intended by the tool proposed in this paper. To this end, we extended recent methods by Yust on adopting the phase information from the discrete Fourier transform of pitch-class sets resulting in the creation of a spherical space of harmonic representation that ultimately helps the composer establishing a harmonic syntax for his pieces.

*Jamary! The solo!*

**Ricardo Bordini** (UFMA)

**Abstract:** Things may be said and heard, some of them good, others not so much. Many parentheses are used with something. Jamary, music, and mathematics are said to be immanent things; they are not separated from each other nor from him. Some music is heard, eyes and ears are seen and, suddenly, an unusual discovery. More stuff and stuff within parentheses. It ends without answers or references. Just a solo, nothing more.

*Beat-Class Set Classes and the Power Group Enumeration Theorem*

**Robert W. Peck** (Louisiana State University)

**Abstract:** The theory of beat-class sets originated in the work of Milton Babbitt, who demonstrated a correspondence between modular pitch-class spaces and metric spaces in the framework of total serialism. Later authors, particularly Richard Cohn, John Roeder, and Robert Morris, applied similar concepts to a variety of analytical situations, such as the phase music of Steve Reich and of Indian ragas. These conceptions of beat-class sets incorporate two states: one in which an event happens in a particular metric context and one in which no such event happens. Accordingly, the universe of beat-class sets for a given modulus may be partitioned into equivalence classes similar to the pitch-class set classes of post-tonal theory.

In this study, we consider extensions to the theory of beat-class sets by including additional rhythmic groupings, resulting in the possibility of more than two states. The theory of these beat-class sets ultimately becomes a question of partitions. Specifically, we examine equivalence classes of multi-state beat-class sets using the Power Group Enumeration Theorem (PGET) of Frank Harary and Edgar M. Palmer. The PGET allows us to determine the numbers of set classes of beat-class sets as determined by various groups of transformations: cyclic shift, retrogradation, and permutation, among others. Our results have implications for further applications as well, in pitch-class set theory, serial theory, and transformational theory.

*On the Logicity of Music*

**Petrucio Viana** (UFF)

**Abstract:** Since the pioneering work by S. Langer, some authors have proposed logic tools for analyzing the structure of music. In my speech, I intend to explain what it means to make a logical analysis of a subject and, based on that, make a survey of those that I consider the best works in this area. With this, I intend to contribute to a better understanding of the question: can musical thought be the object of a logical analysis?

*Logic and the Logics of Music*

**Francisco Aragão** (UFC)

**Abstract:** We will discuss Logic as a descriptive discipline and normative discipline and propose an argument in favor of internal logic and music as a logical activity. We conclude with an example about the logic of tonalism.

*Common Musical Sets as Pareto-Optimal Peaks*

**Scott Murphy** (Kansas University)

**Abstract:** Much music in the Western tradition favors certain sets of pitch classes, especially the perfect fifth, the consonant triad, and the pentatonic, diatonic, and chromatic scales. Music theorists have identified many structural features that these favored sets tend to possess and that unfavored sets tend not to possess, to various degrees of success. For example, near evenness is one fairly successful feature, because it is both a feature of the

perfect fifth, consonant triad, and the pentatonic and diatonic scales, and is not a feature of most other unfavored sets. However, the definition of near evenness requires a superset in which the nearly even set is embedded. The definition of well formedness has no such superset requirement, and thus can be applied to sets with pitches of any frequency, and scales of any tuning or temperament. However, while the pentatonic, diatonic, and chromatic scales are well formed, the consonant triad is not, and well formedness applies to an infinite number of scales larger than the chromatic scale. I propose another, even more successful feature: Pareto optimization of average consonance (as high as possible) and largest step (as small as possible), where consonance is measured using a continuous version of the discrete values assigned to the six interval classes in recent scholarship. The Pareto-optimal scales cluster into seven categories – the perfect fifth, the consonant triad, the minor seventh, the pentatonic, diatonic, and chromatic scales, and the infinite set of pitch classes—that admit a variety of tunings and temperaments.

### *Rhythmic Illusions*

**Carlos Mathias** (UFF)

**Abstract:** I will revisit his geometric approach to rhythms (Mathias/Toussaint) and show how advanced rhythmic transformations such as displacements and modulations can be described and created by the use of rigid transformations on the plane and functions known as *Heavyside modulators*. These advanced rhythmic transformations are perceived as “rhythmic illusions”, small changes to conventional rhythmic patterns that persuade the listener that the tempo, and/or time signature, has momentarily changed. Rhythmic illusions are tensions between what is musically and culturally expected, and an opportunity to explore mathematical moves in music composition.

### *Time Suspended and Metric Grace-Notes: A Cognitive Short-Circuit Between the Metronomic, the Metonymic and the Mnemonic*

**Arthur Kampela** (UNIRIO)

**Abstract:** Traditionally, a grace-note is a fast rhythmic figure that precedes a specific metric/metronomic rhythm. It can also appear as groupings of figures that exhibit the same-note-value preceding or following a metronomic/rhythmic figure. They pluck their inertial energy from an

undisclosed point within the metric span in order to attach themselves to the nearest rhythmic coordinate. Thus, a curious cognitive inversion takes place: in order to calculate the precise point of the grace-note(s) departure it is necessary to lift momentarily the metric grid's regularity, to insert a probabilistic space that would work as a pocket-mechanism to accommodate the gracenotes' grouping. Such rhythmic gymnastics obliges the performer to understand time as a flexible entity, one that is relative to the amount of notes it needs to fit before the next metronomic note as well as keeping the metronomic pulsation constant. This uncanny situation where perception is split between metric precision and 'anticipatory guesswork,' is a very interesting rhythmic space I have been devising for a time. Thus, I created a new concept which I called “metric grace-notes.” It lies at the exact cognitive juncture where the metronomic, the metonymic and the mnemonic perceptions, meet. As they inhabit a 'suspended' space where events are cognitively detached from the main metronome, I felt it was appropriate to charge (or spice it up) such micro-rhythms with similar metric hierarchies used to differentiate gesturally metronomic rhythms. Thus, avoiding treating the grace-notes as same-note-value entities, I started to 'sculpt' their inner geometry with different note-values. That way, the performer reaches the main metronomic note at the end of a certain rhythmic path with an object that exhibits within its inner geometry, an inbuilt metric hierarchy.

### *Suite I Juca Pirama: Adapting José Eduardo Gramani's Rhythm to Ron Miller's Modal Jazz*

**Marcelo Coelho** (Faculdade Souza Lima)

**Abstract:** Description of the compositional process of the Suite I Juca Pirama, composed of ten movements, where literary-musical elements present in the poem I Juca Pirama, by Gonçalves Dias, are adapted to Gramani's rhythmic and modal harmony practiced in jazz systematized by the pianist, American composer and educator Ron Miller. Detailed information about the compositional process of each movement, references to Gramani's studies and their applications, intertextual relations with the text of the poem and harmonic compositional procedures will be presented.

### *The Role of Mapping Function in the Algorithmic Musical Composition*

**Rodolfo Coelho de Souza** (USP)

**Abstract:** In a sense, the idea that computers are already capable of composing music is misleading. A composition made using computers is always the result of the mental operations of a creative human. Nevertheless, the focus of research in this field generally focuses on the aspect of data generation and the various automatic processes that can be used: random, stochastic, genetic, Markovian, etc. Less attention is given to an essential step in the process, which is the mapping function. The purpose of this presentation is to highlight the crucial role that the stage of converting the input data into events of the musical work plays, whether the output is in the form of a score or sound wave. For this purpose, we will show some examples that the same data entry can generate very different musical pieces when using different mapping functions. Another aspect that will be discussed are the points of the process of an algorithmic composition in which human intelligence can intervene. If the project does not take this order into account, the result obtained may be misleading in relation to the intended purpose.

### *Improving The Classification of Rare Chords*

**Rodrigo Schramm** (UFRGS)

**Abstract:** Automatic Chord Recognition is a subject of great interest in the field of Music Information Retrieval. Early research had focused on knowledge-based systems, where specific audio features were developed and planned to be extracted at a preprocessing stage in order to support a following chord classification algorithm. More recently, Automatic Chord Recognition Research has moved towards data-driven methods, where the feature design and feature extraction became part of deep learning models. Despite recent advances, Automatic Chord Recognition still faces issues such as finding a suitable feature representation, temporal coherence over chord sequences, ambiguity and subjectivity, and connection to musical concepts. Furthermore, deep learning models require a huge amount of labeled data for training. Correct annotation of real data is difficult since it requires music experts and it is time-consuming. Moreover, the number of chord classes is big and available datasets usually have an unbalanced quantity of examples for each class. This talk will give an overview of these Automatic Chord Recognition techniques and it will present a set of new deep training

techniques designed to improve the classification performance on rare chord classes.

### *Beat-Class Set Classes and the Power Group Enumeration Theorem Signal Processing for Music Analysis from Audio Recordings*

**Martín Rocamora** (Universidad de la República)

**Abstract:** This brief presentation offers an overview of the research we conducted over the last few years on computational rhythm analysis from audio recordings, considering the Afro-Uruguayan candombe drumming as a case study. It comprises the creation of datasets, the discovery, and analysis of rhythmic patterns, the study of micro-timing, and the development of algorithms for beat and downbeat tracking. Besides, it also discusses our recent efforts to improve and Extend the Methods to Other Music Traditions, in Particular, to Afro-Brazilian Samba.

### *Spatial Audio and Object-Oriented Coding*

**Bruno Masiero** (UNICAMP)

**Abstract:** The technological advances of the last decades resulted in a significant shift in our relation with media. The popularization of the Internet allowed that a huge quantity of audio documents were available at any time and essentially from any place, a condition that was only met thanks to coding techniques which allowed the compaction of audio files, being the MP3 coding the most widely known example. On the other hand, the increasing popularization of surround systems for domestic use and the use of headphones associated with mobile phones with large storage capacity allows the integration of the spatial information as an important element of the process and artistic product. This means that it is necessary to employ coding techniques specially tailored to spatial audio files. In this talk we will discuss a proposal in accordance with these requirements, the object-based coding, and all the required signal processing tools.

### *Some Reflexions about AI-Assisted Music Composition*

**François Pachet** (Spotify), **Jean-Pierre Briot** (CNRS/ Lip6/ PUC-Rio)

**Abstract:** This conference will be a conversation between the speakers about the subject.