# Pedro Ramoneda

*PhD candidate, Technologist and Pianist*

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My PhD thesis focuses on audio and symbolic music dataset creation and deep learning for performance difficulty analysis. We aim to understand the performance difficulty, through pedagogically motivated representations, to recommend a customised and optimised learning path for each music student. My ML research interests include explainable machine learning, generative models, human-centered AI and curriculum learning.

## Education

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|---|---|
| 2021–Present | **PhD**, Universitat Pompeu Fabra, Barcelona. |
| | Bringing together Music Education and AI under the supervision of Marius Miron and Prof. Xavier Serra at MTG. |
| 2020–2021 | **MRes Sound and Music Computing**, Universitat Pompeu Fabra, Barcelona. |
| | Master's thesis exploring future directions for the PhD thesis. Written under the supervision of. Marius Miron and Prof. Xavier Serra at MTG. |
| 2019–2020 | **Computer Science Engineering**, *(Exchange year)*, Universidade do Porto, Portugal. |
| | Writing the bachelor thesis in computational harmony analysis within the SMClab research group under the supervision of Prof. Gilberto Bernardes. |
| 2015–2020 | **BSc Computer Science Engineering**, Universidad de Zaragoza, Spain. |
| | Major in Computer Science. |
| 2016–2018 | **BMus Piano Performance**, *(Paused)*, CSMA, Zaragoza, Spain. |
| | Piano Teacher: Lluis Rodriguez Salvá. |
| | You can see me playing in this video. |
| 2009–2015 | **Professional Music Degree in Piano Performance**, CPMZ, Zaragoza - Spain. |
| | Piano teacher: Sergio Bernal Bernal. |
| 2009–Present | **Informal Music Education**. |
| | Violin, Composition, Classical Singing and Recording Techniques. |

## Experience

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|---|---|
| 2021–Present | **Early Stage Researcher**, *Music Technology Group (MTG), Universitat Pompeu Fabra, Barcelona.* |
| | I spend 80% of my time on my own research, described at the beginning of this document. Moreover, I devote 20% of my time developing demos and interfaces to use ASPLAB music education research, so called MusicCritic, in educational environments. Xavier Serra's team has invested a lot of effort in the topic for the last few years, with seven researchers working full time on issues related to music assessment and the exploration of large corpora in a pedagogical way. We want to develop interfaces and demos capable of demonstrating how our research can benefit society and music education. In addition, I worked on maintaining and |
| 2020–2021 | **Research Internship**, *Music Technology Group (MTG)* , UPF, Barcelona. |
| | During a full year I worked as a research assistant advised by Marius Miron on the MusicalAI project. My tasks focused on evaluating and making available the MTG datasets. For this purpose, we added in the mirdata library most of the major datasets of the group, building test models, evaluating, making small changes in the datasets and collaborating with NYU and Spotify researchers. It is a very dynamic work that allows me to acquire a general perspective on the Music Information Retrieval field. In addition, I maintained and data curated the Multimodal online database and visualization tool Repovizz |

CLICK HERE FOR THE SHORT RESUME (you can click in most green words)

2015–2020   **Business Information Systems**, Nina Fruits, Zaragoza - Spain.

I developed and maintained part-time a whole staff management and crop productivity systems with NFC cards, weight machines and an Android application, as well as the control of orchard variables with embedded systems, and the management and analysis of all the generated data.

2014–2016   **Piano teacher**, *Colegio El Salvador* , Zaragoza - Spain.

I gave piano lessons as an extracurricular activity to children aged eight to twelve, with a piano level of 2 to 4 years of study. It was an enriching experience that allowed me to understand better how I wanted my career as a musician.

## ⚲ Publications

Ramoneda, P., Tamer, N. C., Eremenko, V., Miron, M. Serra, X. Score difficulty analysis for piano performance education. In Submitted to ICASSP 2022 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP) (2022).

Ramoneda, P., Plaja, G., Miron, M., Caro, R. Serra, X. Understanding the relationship between voice and accompaniment on symbolic music data. Manuscript will be submitted to SMC 2022.

Ramoneda, P., Miron, M. Serra, X. Piano fingering with reinforcement learning. Arxiv.

Bernardes, G., Ramoneda, P. & Miron, M. Unveiling high-level discriminant harmonic descriptors of musical style in the tonal interval space. In Conference: International Conference on Music Perception and Cognition (ICMPC16- ESCOM11) (ICMPC-ESCOM 2021, Azerbaijan, Australia, Colombia, India, Mexico, Lithuania, Poland, UK, South Africa, 2021).

Ramoneda, P. & Bernardes, G. Revisiting harmonic change detection. In 149th AES convention, the Audio Engineering Society, AES149 (2020).

## Talks

2021-Sep   **Seminar**, *"Reproducibilité de la recherche en traitement du signal"*, Title: Mirdata, dataset loaders for reproducible research on Music Information Retrieval.
Speakers: Genis Plaja, Pedro Ramoneda

2021-Jul   **Conference talk**, *ICMPC-ESCOM*, Title: Unveiling High-level Discriminant Harmonic Features of Musical Style in the Tonal Interval Space.
Speakers: Pedro Ramoneda

2020-Oct   **Conference talk**, *AES 149th convention*, Title: Revisiting Harmonic Change Detection Function.
Speakers: Pedro Ramoneda

## Languages

Spanish   Native
English   Upper-intermediate
Portuguese   Intermediate

## Volunteering

2020–present   Helping artists to set up sound installations at Phonos Foundation.

2008–2015  Playing music in various nursing homes for Christmas (in my hometown, Zaragoza).

## Skills

Technologies  Python, C++, C, SQL, Bash, Linux, Javascript

Tech knowledge  Deep Learning, Machine Learning, Sound Synthesis, Data mining, Signal Processing, Computer vision, Algorithms, Embedded systems, music creativity

Music knowledge  Piano performance, Music interpretation, history of music, Formal Analysis, Recording techniques, Violin performance, composition techniques

## Academic dissertations

2020-2021  **Master's thesis**, *MTG, Universitat Pompeu Fabra, Barcelona*.
Title:  *Computational methods to study piano music in education context*

We propose technological approaches to various aspects of Piano Music Education in its most global view, from technique to accompaniment and composition. First, we suggest two automatic piano fingering systems. Second, we depart from one previous generative fingering system to explore the technical difficulty in the new Mikrokosmos dataset. Third, we model the relation-ship between a soloist and piano accompaniment suggesting descriptors in three dimensions: melodic, rhythmic, and harmonic. Lastly, we confirm that automatic composition systems can be biased to generate an individualized repertoire based on difficulty level. The presented work makes a step toward expanding current Music Information Retrieval approaches for Piano Music Education and opening new horizons and challenges for further research.

2019-2020  **Bachelor's thesis - 30 ects credits**, *FEUP, University of Porto*, Porto - Spain.
Title: *Harmonic change detection from musical audio*

Bachelor's thesis at the University of Zaragoza which has been deemed equivalent to the master's thesis in computer science engineering at FEUP. In this project, I wanted to get an in-depth perspective in some aspects of audio signal processing, data mining, music information retrieval and computational musicology. For the full last year, I was conducting research on the field of Music Information Retrieval advised by Gilberto Bernardes head of the SMC group (INESC TEC/FEUP). I was researching how the harmonic change detection function behaves with new tonal spaces, chromograms and other methods that have improved from Christopher Harte proposal 15 years ago. I was reading a lot of papers and books, playing with abundant technology, a lot of data and quiet few datasets. Among other things, I have carried out my final dissertation, and the original research outputs are available on: "Revisiting Harmonic Change Detection" published on AES 149th convention, where I am the main author.

## About me

I like technology, music and dogs. I love to take part in challenging projects that require knowledge of a wide range of topics, with a relatively open-ended goal and discovering little by little what I can do. In the following section, I talk about all these projects in Zaragoza, Porto and Barcelona.

## Music Technology Projects

2020-2021 **Independent Research**, *MTG, Universitat Pompeu Fabra*, Barcelona.

It was related with "Harmonic analysis of large musical audio corpus". My advisors were Gilberto Bernardes (Universidade do Porto) and Marius Miron (Universitat Pompeu Fabra). The idea was, from explainable descriptors, model musical style in large corpus. In particular, we worked on classical historical time recognition, and we have submitted a paper for ICMPC 2021 conference: "Unveiling High-level Discriminant Harmonic Features of Musical Style in the Tonal Interval Space". The supplementary paper material can be found here.

2019 **Sound Synthesis**, *FEUP, University of Porto*, Porto - Portugal.

Four sound projects were developed. The first one explores the use of the modular synthesis with VCV rack. In the second and third project, different sound techniques are explored. And in the fourth project concatenative synthesis is replaced from a fragment of percussive sounds that are replaced with corpus downloaded from freesound. Finally, a mobile augmented instrument has been made thanks to Faust (after taking the Kadenze MOOC Faust course) the idea is that the user can manage the pitch and intensity by moving the mobile as shown here. Then your phone listens to other phones and varies the pitch generated accordingly. Removing its own generated pitch by simple filters and with a filter made with Constant-Q transform. A simple demo is shown here.

2019 **Interactive digital systems**, *FEUP, University of Porto*, Porto - Portugal.

Three audiovisual installations were carried out in teams. The first one talks about the cohesion of people and is made by mixing two songs depending on the cohesion measured with computer vision, as shown here. The second is this one, and it has an educational character: recycling for children. The last one is shown here and talks about the immortality of data when uploaded to the internet.

2021 **Music Information Retrieval Course**, *MTG, Universitat Pompeu Fabra*, Barcelona.

In this project, I aim to assess whether an instrument quality sound is good or bad. The few available data issues are managed with transfer learning techniques. We wanted to evaluate whether the transfer learning of tone quality is more robust on similar instruments. Four transfer learning strategies have been carried out to conduct the sound quality assessment and can be found here.

2019 **Distributed Systems**, *FEUP, University of Porto*, Porto - Portugal.

A project about state of the art in clock synchronization for audio embedded systems was developed. A report is available here.

2020-2021 **Audio Signal Processing for Musical Applications**, *MTG, Universitat Pompeu Fabra*, Barcelona.

This course teaches a broad set of techniques from a low level to a high level. As a final project, Xavier Serra assigned me a task with an ottoman tambourine as the central axis. From there, as tambourines are based on crotales and membrane parts, I analysed the relationship between tambourines, membrane little percussive instruments and cymbals in timbre domain. This little project can be found here

2020-2021 **Research methods**, *MTG, Universitat Pompeu Fabra*, Barcelona.

As final project, I have carried out, with my mate Genis Plaja, a meta science project about "Biases and faults in MIR datasets: A literature review" (page 133).

2020-2021 **Music Perception and Cognition**, *MTG, Universitat Pompeu Fabra*, Barcelona.

With my team, we carried out a project for studying how emotions based on Music-evoked autobiographical memories are distributed across cultures. This project has had an enormous research design and finally we have had very interesting results

2018 **Embedded Systems II**, *University of Zaragoza*, Zaragoza - Spain.

In this course's project, a Raspberry Pi was used as a MIDI slave taking advantage of the OTG-USB port. From there several prototypes of instruments like this theremin were developed. This project was made thanks in part to The audio programming book written by Victor Lazzarini et al.

2017 **Software project**, *University of Zaragoza*, Zaragoza - Spain.

We created a social network. There, different producers, composers and performers could come together to create content. The central axis of the website was made by me, among other things. It was a service developed in Python and FFmpeg that allowed to manipulate different audio files, mix songs... mix together different tracks and put effects on the tracks. A report of the global project can be found here.

2018 **Information Systems**, *University of Zaragoza*, Zaragoza - Spain.

Two main projects were developed for this course. One part is a theoretical study on the state of the art in sound and music computing. It can be found here. The other one was a questions game about climate change made in the form of a web application with a vue.js framework, as is shown in this report.

2018 **History of Music**, *CSMA*, Zaragoza - Spain.

A project was about Italian polychromy. At the beginning of the Renaissance, this style was the first use of a stereo as we understand it. A summary is here.

2017 **Acoustics**, *CSMA*, Zaragoza - Spain.

I wrote an outstanding document on analyzing piano room acoustics and the psychophysics of the piano, how the sound was generated in an imperfect way, from a theoretical and practical perspective. I recorded with different types of microphones from many different angles.

2015 **History of Music**, *CPMZ*, Zaragoza - Spain.

An essay about how the harmony of the spheres along the history was made to end with generative music beginnings, which along with an excellent performance in the exam, scored the highest award possible, "matrícula de honor".

## Other Projects

2018 **Hardware project**, *University of Zaragoza*, Zaragoza - Spain.

With an old Embest S3CEV40 embedded system, the Reversi game was developed. As is shown here.

2018 **Computer graphics**, *University of Zaragoza*, Zaragoza - Spain.

In this course, two algorithms for rendering from scratch in C++, extended with a lot of improvements were developed. The two algorithms are stochastic path tracing using Monte Carlo methods and photon mapping. As is shown in this presentation. This course was taught by the expert on the field Diego Gutierrez.

2018 **Computer Architecture 2**, *University of Zaragoza*, Zaragoza - Spain.

A MIPS processor was built from scratch with several performance improvements with VHDL. This course was rewarded with a perfect score.

2019 **Computer vision**, *University of Zaragoza*, Zaragoza - Spain.

Many interesting projects were carried out with teachers such as Domingo Tardós and Jose Neira, both boundary-pushing researchers in the field. On the one hand, a system in which moving figures are eliminated from a video and on the other hand to create panoramic photographs in all directions moving a camera, both taking descriptive points. This is the report of these projects.

2019 **Embedded Systems Lab**, *University of Zaragoza*, Zaragoza - Spain.

An Internet of Things project in the field of precision agriculture was made, as shown here. It aims to improve worker productivity in harvesting tasks using an application, embedded sensors and scales. All of this is sent to a server for further processing by means of a web interface. The project is mostly made from Python, vue.js and C++. This course was scored with the highest Spanish award possible, "matrícula de honor".

2019 **Distributed Artificial Intelligence**, *FEUP, University of Porto*, Porto - Portugal.

A simplified stock market simulation has been developed using the JADE multiagent systems framework.

**2018-2019**    **Other relevant computer science courses**, *University of Zaragoza*, Zaragoza - Spain.
Other courses have been completed which are relevant but without free-projects developed in the context of the subjects, but the projects that were made for them are closed and standards, such as Algorithms, Language Processors or Machine learning.