

Ricardo Falcón Pérez

DOCTORAL CANDIDATE · MACHINE LEARNING · SPATIAL AUDIO · ROOM ACOUSTICS

Pyyntitie 1 C 11, 02230, Espoo Finland

☎ (+358) 46 950 4317 | ✉ ricardo.falconperez@aalto.fi | 🏠 rfalcon100.github.io | 📱 rfalcon100 | 🌐 rfp1001

Education

Aalto University

DOCTOR OF SCIENCE (TECHNOLOGY)

- Machine Learning for Audio and Acoustics

Espoo, Finland

(Expected) 2023

Aalto University

M.Sc IN COMPUTER, COMMUNICATIONS AND INFORMATION SCIENCES

- With Honours | GPA 4.3 / 5
- Major: Acoustics and Audio Technology
- Minor: Machine Learning and Data Mining

Espoo, Finland

2018

National Autonomous University of Mexico (UNAM)

B.Sc IN COMPUTER ENGINEERING

- Major: Intelligent Systems and Computer Graphics

Mexico City, Mexico

2011

Music Academy Fermatta

B.A IN CONTEMPORARY POPULAR MUSIC WRITING

- 75% of credits completed

Mexico City, Mexico

2008

Experience

Aalto University

RESEARCH ASSISTANT

- (2019-Present) I am generally interested in deep learning, spatial audio, and room acoustics. My current research focuses two main areas. First, multi-label audio classification tasks such as sound event localization and detection (SELD), especially methods that are robust to acoustically challenging scenarios (for instance high reverberation, low intelligibility, distortion, among others). Secondly, I study multi-modal representation learning for room acoustics, where the goal is to learn a latent space that can encode and decode room acoustics data of different domains, including room geometry, acoustical parameters, room impulse responses, and images. Finally, I am also interested in data augmentation and preprocessing techniques for time domain deep learning models in audio applications.
- (2018) Analyzed and processed a novel dataset of spatial room impulse responses and developed a machine learning based solution to estimate key room acoustic parameters using geometrical information as features, for rooms with multiple conditions including different furniture combinations and acoustical properties. This work was used for a Master Thesis.
- (2017) Worked on music genre classification using deep neural networks, including a literature review and implementation of state of the art methods in MATLAB and Python with Tensorflow. The methods included CNNs with time-frequency domain representation of the input signals, as well as several machine learning classifiers with bag-of-frames inputs from features such as MFCCs.

Espoo, Finland

Jun 2017 - Present

Sony Group Corporation

RESEARCH ASSISTANT (INTERNSHIP)

- Researched methods for data augmentation of spatial audio signals with applications to sound event localization and detection (SELD) deep learning systems. This is relevant to the DCASE challenge.

Tokyo, Japan (remote)

Jun 2021 - Oct 2021

Nokia Bell Labs

SUMMER TRAINEE (RESEARCH ASSISTANT)

- Explored and proposed novel techniques to improve key performance metrics of mobile telecommunications networks using machine learning and signal processing methods. The improvements will be important of the 5g standard.

Espoo, Finland

Jun 2018 - Oct 2018

Hewlett-Packard Enterprise

SOFTWARE DEVELOPER

- Designed and implemented multiple projects related to the DSD (Direct Store Delivery) system for Bimbo Bakeries that controls the company's daily operation of over 1700 sales centers in 22 countries.
- Experience with the full systems development lifecycle: covering requirements, design, development, testing, and deployment to production.
- Key projects include a dynamic system to print diverse fiscal documents using specifics layouts, and a transaction and operational error log module.
- Most applications were developed with Visual Basic .net, C#, Sybase ASE, Oracle, and the .Net framework.

Mexico City, Mexico

Aug 2012 - Sep 2016

Freelance Programming

Mexico City, Mexico

PROGRAMMER

Aug 2011 - Sep 2012

- Designed and implemented a desktop application in C# and a SQL Server Database to manage data for a small Gym. The application handled the customers' personal information, the services and products the Gym provided and payments history. Fingerprint readings were included to keep track of customers' arrivals and departures.
- Designed and implemented a custom orders and inventory management system for a health clinic. Developed as a ASP.net web application with a MySQL database.

Publications

- 2021 **R. Falcón Pérez**, K. Shimada, Y. Koyama, S. Takahashi, en Y. Mitsufuji, "*Spatial mixup: Directional loudness modification as data augmentation for sound event localization and detection*", arXiv: Preprint: submitted to ICASSP 2022
- 2021 **R. Falcón Pérez**, G. Götz, and V. Pulkki, "*Spherical Maps of Acoustic Properties as Feature Vectors in Machine-Learning-Based Estimation of Acoustic Parameters*" J. Audio Eng. Soc., vol. 69, no. 9, pp. 632-643, <https://doi.org/10.17743/jaes.2021.0011>
- 2021 H. Daolang, **R. Falcón Pérez**, "*SSELDNET: A FULLY END-TO-END SAMPLE-LEVEL FRAMEWORK FOR SOUND EVENT LOCALIZATION AND DETECTION*", DCASE2021 Challenge Technical Report
- 2019 **R. Falcón Pérez**, G. Götz, and V. Pulkki, "*Machine-learning-based estimation of reverberation time using room geometry for room effect rendering*", in Proceedings of the 23rd International Congress on Acoustics: integrating 4th EAA Euroregio

Teaching

Aalto University

Espoo, Finland

TEACHER ASSISTANT

2017 - Present

- 2021 **Seminar on Deep Learning** - Co-organized a deep learning seminar course that included a review of some of the latest publications and trends in deep learning.
- 2021 **Machine Learning Research Project** - Tutored 2 master students on the development of two research projects: an automated audio captioning system (based on DCASE 2021 Task 6); and a multi-modal audio-visual sound scene classification system (based on DCASE 2021 Task 1).
- 2020 **Seminar on Deep Learning** - 2020 Edition of the Deep learning seminar.
- 2020 **Machine Learning Research Project** - Tutored 2 master students on the development of two research projects: a time-domain sound event detection and localization system; and a automated pseudo-song generation in symbolic domain exploring VAE architectures.
- 2020 **Kernel Methods** - Prepared and hosted the computer exercises.
- 2019 **Machine Learning Research Project** - Tutored 2 master students on the development of a research project regarding audio tagging systems, where the students implemented multi-label classification systems based on deep learning.
- 2019 **Recent Advances in Deep Learning** - Co-designed a seminar course that reviews the most recent developments in deep learning. Activities included a thorough overview of the latest publications of top machine learning conferences.
- 2019 **Data Science** - Hosted the demonstration exercise sessions and prepared a term project that includes peer grading a data analysis report.
- 2018 **Data Science** - Hosted the demonstration exercise sessions for the Data Science course with over 300 students. Sessions include a detailed explanation of concepts covered in lectures and additional topics.
- 2017 **Data Science** - Hosted the computer exercise sessions for the Data Science course with over 300 students. Sessions include a demonstration and explanation of key concepts, MATLAB tutorials, as well as providing individual tutoring of students.
- 2017 **Machine Learning: Basic Principles** - Designed, prepared and managed the term project for the Machine Learning: Basic Principles course with over 500 students. Extracted and pre-processed features using a custom dataset. The task required to classify music into genres.

Academic Projects

SSELDNET: A FULLY END-TO-END SAMPLE-LEVEL FRAMEWORK FOR SOUND EVENT LOCALIZATION AND DETECTION

Finland

DCASE CHALLENGE 2021 SUBMISSION

2021

- Our submission to the DCASE 2021 Challenge, task 3. This challenge consists of a sound event localization and detection task, where the goal is to classify sound events as well as to estimate their direction of arrival, based on a spatial soundfield recording.
- Our system explored a time-domain model based on a SampleCNN instead of relying on spectrograms for input features, which dominates most systems currently.
- We achieve moderate performance, improving significantly over the baseline, but not reaching the top teams.

Machine-learning-based estimation of room acoustic parameters

Finland

MASTER THESIS

2018

- Presented a proof of concept for a novel machine learning method to estimate a set of typical room acoustics parameters using geometrical information and limited absorption coefficients as input features. First, a room acoustics dataset composed of real world acoustical measurements is analyzed and processed using microphone array encoding techniques to extract room impulse responses and acoustical absorption area for multiple directions. The dataset is explored to identify correlation between features and general properties, including a low dimensionality representation for visualization.
- The proposed feature extraction and neural network model estimates room acoustics parameters, such as reverberation time (T60), and early decay time (EDT). For reverberation time, this model is evaluated against the Sabine method and the results show much higher accuracy, especially at low frequencies. The method is then expanded to include input features for the locations of the source and microphone, where the results also achieve high performance.

Image texture synthesis with deep neural networks

Finland

CLASS PROJECT

2018

- Implemented a multi scale texture synthesis application for high resolution images using deep neural networks. Developed in Python and Tensorflow.
- The project was later expanded to include multi scale image style transfer.

Parametric audio equalization using genetic algorithms

Finland

CLASS PROJECT

2017

- Implemented an application that matches a hand drawn equalization curve using a parametric equalizer with limited number of bands. The parameters of the equalizer are selected automatically using a genetic algorithm. Developed in MATLAB.

Virtual Analog Phaser: Demonstration

Finland

CLASS PROJECT

2017

- Implemented an offline phaser effect for audio signals using cascaded all pass filters and a feedback loop based on the famous MXR Phase 100 pedal. Developed in MATLAB.

Lectures, Certifications & Courses

- 2019 **Guest Lecture** , Aalto University, "Data Science for Music and Sound II"
- 2018 **Guest Lecture** , Aalto University, "Data Science for Music and Sound"
- 2015 **Videogames Design and Programming** , National Autonomous University of Mexico (UNAM)
- 2013 **Programming in C# Specialist (70-483)** , Microsoft

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Mexico

Music

Yuniper – Divide and Conquer EP

Mexico City, Mexico

CORE MEMBER

2011

- Participated in a 2 man collaboration in the writing, performance and production of an electronic music EP.

Music Recording and Production

Mexico City, Mexico

PRODUCER AND ENGINEER

2010 - 2013

- Recorded, produced and mixed multiple demos and EPs for local rock bands including: o Edgardo Macias o Far Beyond Hell – Untitled o Gothem – Gothem EP

Skills

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|-------------------------------|---|
| Knowledge | Machine Learning, Audio Signal Processing, Microphone Signal Processing, Music Production |
| Programming (Advanced) | Python, Numpy, PyTorch, MATLAB, C#, .Net |
| Programming (Familiar) | Tensorflow, Keras, Unity, Visual Basic, JQuery, Ajax, HTML, PHP, CSS |
| Databases | MySQL, Microsoft SQL Server (TSQL), Sybase ASE (TSQL) |
| Languages | Spanish (<i>native</i>), English (<i>fluent</i>), French (<i>basic</i>) |
| Music | Guitar (<i>Advanced</i>), Bass, Drums, Drums Programming |