



Domenico Stefani

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ABOUT ME

Postdoctoral researcher at the Department of Information Engineering and Computer Science of the University of Trento, Italy. I received in 2020 a master's degree (cum laude) in Computer Science from the University of Trento, Italy, and in 2024 a Ph.D. degree from the same institution. My research interests include embedded systems, music information retrieval, and smart musical instruments.

PUBLICATIONS

Real-Time Embedded Deep Learning on Elk Audio OS

[2023]

D. Stefani and L. Turchet, "Real-Time Embedded Deep Learning on Elk Audio OS" in Proceedings of the International Symposium on the Internet of Sounds, Pisa, Italy, Oct 2023

A Comparison of Deep Learning Inference Engines for Embedded Real-Time Audio Classification

[2022]

Stefani, D., Peroni, S., & Turchet, L. (2022, September). A Comparison of Deep Learning Inference Engines for Embedded Real-Time Audio Classification. Proceedings of the 25-Th Int. Conf. on Digital Audio Effects (DAFx20in22), 3, 256–263. Vienna, Austria.

On the Challenges of Embedded Real-Time Music Information Retrieval

[2022]

Stefani, D., & Turchet, L. (2022, September). On the Challenges of Embedded Real-Time Music Information Retrieval. Proceedings of the 25-Th Int. Conf. on Digital Audio Effects (DAFx20in22), 3, 177–184. Vienna, Austria.

Embedded Real-time Expressive Guitar Technique Recognition

[2022]

D. Stefani "Embedded Real-time Expressive Guitar Technique Recognition," in Workshop on Embedded AI for NIME, International Conference on New Interfaces for Musical Expression (NIME),

Bio-Inspired Optimization of Parametric Onset Detectors

[2021]

D. Stefani and L. Turchet, "Bio-Inspired Optimization of Parametric Onset Detectors," in Proceedings of the 24th International Conference on Digital Audio Effects (DAFx20in21), vol. 2, pp. 268–275, Sept. 2021.

Demo of the TimbreID-VST Plugin for Embedded Real-Time Classification of Individual Musical Instrument Timbres

[2020]

D. Stefani and L. Turchet. "Demo of the TimbreID-VST Plugin for Embedded Real-Time Classification of Individual Musical Instrument Timbres", Proceedings of IEEE FRUCT'27 2020

EDUCATION AND TRAINING

Phd in Information and Communication Technology

University of Trento [31/10/2020 – 11/01/2024]

City: Trento

Country: Italy

Field(s) of study: Information and Communication Technologies

Thesis: Embedded Real-time Deep Learning for a Smart Guitar: A Case Study on Expressive Guitar Technique Recognition

Artificial Intelligence for real-time *embedded* Music Information Retrieval.

I obtained my Ph.D. on January 11th 2024

My PhD research focused on bringing AI and Music Information Retrieval (MIR) methods to smart self-contained musical instruments.

These instruments can be designed to recognize certain high-level traits or properties from a music signal, such as the expressive techniques used or the mood of the music.

In turn, smart instruments can be designed to use this high-level property to trigger audio samples during a performance, control the synthesis of accompanying sounds, morph and trigger transitions on live visuals, control stage equipment, lighting, and more. However, the underlying AI methods or algorithms must be lightweight, reliable, and fast, so that they can be used in real-time on tiny resource-constrained devices that can augment the performance of a musician.

The main line of research focused on the acoustic guitar and the recognition of both pitched and percussive expressive techniques (palm-mute, harmonics, hitting different areas of the guitar,...).

In the last part of my Ph.D., I have experimented with emotion recognition from music in embedded platforms.

Technical skills developed:

- Audio Plugin development with C++ and the JUCE framework;
- Deployment of plugins to Embedded devices (RPI 4) with Elk Audio OS (Cross-compilation, remote control);
- Tensorflow+Python programming to train models for Music Information Retrieval tasks.
- Neural network deployment to C++ projects with TFlite, Libtorch/Torchscript (Pytorch), ONNX Runtime, and RTNeural.
- Academic Writing (English, Two C1 Courses attended and passed with full marks).

Courses attended:

- Academic Writing for the Sciences and Engineering
- Research Methodology
- Advanced C++ programming
- Deep Models for Spoken Language Translation

Tutoring/Teaching assistance activities:

- Multisensory Interactive Systems (3 years)
- Computer Science (Programming for Biotechnology students, 3 years)

Visiting Researcher

Centre for Digital Music, Queen Mary University of London [28/02/2023 – 23/08/2023]

City: London

Country: United Kingdom

Website: <https://c4dm.eecs.qmul.ac.uk/>

Six months-long collaboration as a visiting researcher at the Centre for Digital Music at the Queen Mary University of London.

During this, I focused on offline and real-time emotion recognition from musical improvisations on embedded devices.

This allowed me to work on the following different aspects:

- Deployment of audio plugins to *embedded* single-board computers, including deep-learning inference;
- Offline emotion recognition, with framewise classification on seconds-long frames;

- Use of large models (modified MusiCNN);
- Use of the Essentia Library for compatible results between Python (for training) and C++ code (for inference on embedded target);
- Real-time preprocessing of audio for real-world experiments (e.g. Silence detection, resampling);
- Experiments to evaluate systems and test hypotheses with musicians.

Master degree in Computer Science (110/110 Cum Laude)

University of Trento [09/09/2018 – 20/10/2020]

City: Trento

Country: Italy

Final grade: 110/110 cum laude – Level in EQF: EQF level 7

Thesis: Embedded real-time classification of percussive and pitched sounds on a smart guitar

Free-choice credits were allocated with particular interest to courses such as Multisensory Interactive Systems, Machine Learning and Deep Learning.

A relevant project, developed for the Deep Learning course, revolved around objective music evaluation and automatic generation of music scores using machine learning.

Thesis topic involved real time feature extraction and classification of audio signals and C++ development for audio DSP.

Industrial Technical Institute Diploma - Electrical/Electronic technician (100/100)

Istituto Tecnico Superiore "Silvio De Pretto" [09/09/2010 – 09/06/2015]

City: Schio

Country: Italy

Electronics-specific subjects were studied, with particular attention to C Programming for **embedded devices** and basic desktop application programming.

Computer Science (105/110)

University of Trento [11/09/2015 – 22/07/2018]

City: Trento

Country: Italy

Final grade: 105/110 – Level in EQF: EQF level 6

C/C++ Imperative programming

Object-Oriented Programming

Database management

Software Engineering

Web programming

Algorithms, Machine Learning and Compilers

WORK EXPERIENCE

Postdoctoral Researcher

University Of Trento [15/01/2024 – Current]

City: Trento

Country: Italy

Postdoctoral researcher focusing on embedded spatial audio for networked music performance systems.

University Tutor/ Teaching assistant

University Of Trento [11/2022 – 01/2023]

City: Trento

Country: Italy

Tutor for the courses of Multisensory Interactive Systems for the Computer Science and Human-

Computer Interaction Master students, and Computer Science for Biology bachelor students.
I provided assistance to the students on exam exercises, projects, and technical difficulties with both software and hardware devices (microcontrollers, sensors, electronics, audio equipment).
I autonomously conducted two laboratory lessons and helped the course teacher to conduct several other laboratory classes.
The activity was completed with a positive assessment by the lecturer in charge of the course.

University Tutor

University Of Trento [11/2021 – 02/2022]

Tutor for the courses of Computer Science ("**Informatica**", CIBIO department) and **Multisensory Interactive Systems** for the Computer Science and Human-Computer Interaction master students.
I provided assistance to the students on exam exercises, projects, and technical difficulties with both software and hardware devices (microcontrollers, sensors, electronics, audio equipment).
I helped the course teacher to conduct laboratory classes.
The activity was completed with a positive assessment by the lecturer in charge of the course.

Teaching Assistant for "Multisensory Interactive Systems"

University Of Trento [31/10/2020 – 02/2021]

Teaching assistant for the course of **Multisensory Interactive Systems** for the Computer Science and Human-Computer Interaction master's degrees students.
I provided assistance on projects and technical difficulties with both software and hardware devices (microcontrollers, sensors, electronics).
I helped the course teacher to conduct laboratory classes.
The activity was completed with a positive assessment by the lecturer in charge of the course.

Thesis research Internship

DISI, University of Trento [16/02/2020 – 20/10/2020]

Supervisor: Prof. Luca Turchet

Thesis research involving real time feature extraction and classification of audio signals, performed harnessing C++ development for audio DSP.

Computer programmer

Vivica S.r.l. [03/06/2018 – 13/07/2018]

Address: via Tempesta 9, 36063 Marostica (Italy)

Website: www.vivica.com

Business or sector: Professional, scientific and technical activities

(Internship)

I developed a project on my own for the company.

The product delivered was a complete client-server system that exploited UDP broadcast messages to allow technicians to remotely configure multimedia devices made by the company itself.

C/C++ languages were used in a multiplatform fashion and Java for Android Programming in order to offer a graphical interface to the native library.

Electrical Technician Intern

ACS Controls Ltd [31/05/2014 – 30/06/2014]

City: Londonderry

Country: United Kingdom

(Internship for the european mobility "Leonardo Da Vinci" project, now Erasmus+)

LANGUAGE SKILLS

Mother tongue(s): **Italian**

Other language(s):

English

LISTENING C1 READING C1 WRITING C1

SPOKEN PRODUCTION B2 SPOKEN INTERACTION B2

Levels: A1 and A2: Basic user; B1 and B2: Independent user; C1 and C2: Proficient user

COMMUNICATION AND INTERPERSONAL SKILLS

Communication and interpersonal skills

- good communication and active listening skills gained through various internships in Italy and one in Northern Ireland, UK.

JOB-RELATED SKILLS

Job-related skills

- Good knowledge of C and C++ languages acquired through university courses and research, with emphasis on the JUCE audio programming framework;
- Good knowledge of embedded audio plugin deployment with Elk Audio OS;
- Good knowledge of Deep Learning inference engines (TFLite, Libtorch/Torchscript, ONNX runtime, RTNeural);
- Good knowledge of code versioning principles and the git/GitHub tool.
- Good base knowledge of microcontrollers (Atmel, Arduino boards, Teensy) and basic electronics gained through pre-university studies, personal projects, and the Multisensory Interactive Systems course.
- Good knowledge of Java and Python.
- Good knowledge of web languages: Java for Web, Javascript, and Node.js
- Good knowledge of SQL-based languages and ER database representation.

OTHER SKILLS

Other skills

- music: passionate guitar player and music listener

AWARDS

Awards

- Leonardo Project (now Erasmus+) traineeship in Derry/Londonderry, Northern Ireland (2014)
- Merit Award, University of Trento (2018)
- Stiftelsen C.M Lerici Scholarship to carry out a research project in Sweden (2023)

ORGANIZING ACTIVITIES

Organizing activities

- Publicity Chair of the 2021 Audio Mostly Conference. <https://audiomostly.com/2021/info/committee/>
- Local organization staff member of the IEEE 1st International Workshop on the Internet of Sounds 2020 at University of Trento
- Former Fablab volunteer (UNITN Fablab)