

# Federico Brunero

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## PROFESSIONAL SUMMARY

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Extremely determined and highly ambitious Italian engineer with strong analytical and time management skills. Standing out for dedication, meticulousness and critical thinking.

## EDUCATION

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**PhD in Computer Science, Telecommunications and Electronics** Expected July 2022  
Sorbonne University, France

**Master of Science in Data Science and Engineering** Expected January 2021  
Institute Mines Télécom and EURECOM, France  
GPA: 4.0/4.0

**Master of Science in Electrical and Computer Engineering** August 2019  
University of Illinois at Chicago, Chicago, US  
GPA: 4.0/4.0

**Thesis title:** Low-Density Parity-Check Code Design for the AWGN Channel with Additive Radar Interference  
**Advisor:** Natasha Devroye (co-advisor in Italy) **Co-advisors:** Daniela Tuninetti, Roberto Garello (advisor in Italy)  
**Description:** Performance analysis of convolutional codes in the AWGN channel with Additive Radar Interference and in-depth study of LDPC codes applied to the same channel model, with final LDPC code design and comparison to LDPC codes optimized for the AWGN channel.

**Master's Degree in Communications and Computer Networks Engineering** July 2019  
Politecnico di Torino, Torino, Italy  
Grade: 110/110 cum laude

The thesis work is the same as the one conducted in the US since it is related to the joint project TOP-UIC between Politecnico di Torino and University of Illinois at Chicago.

**Bachelor's Degree in Telecommunications Engineering** July 2017  
Politecnico di Torino, Torino, Italy  
Grade: 110/110

## COURSEWORK

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### Adaptive Digital Filters

**University:** University of Illinois at Chicago

**Content:** basics of estimation (optimal estimation and linear estimation), basics of optimization, modeling and filter selection, filter optimization and adaptation (steepest-descent, stochastic-gradient, LMS, RLS and Kalman filtering algorithms), performance of adaptive filters.

### Applied Electromagnetics

**University:** Politecnico di Torino

**Content:** transmission lines and distributed parameter components, Maxwell equations, electromagnetic wave propagation in metallic waveguide and in homogeneous media, electromagnetic wave radiation and antennas.

### Devices for Optical and Microwave Communications

**University:** Politecnico di Torino

**Content:** discrete optical devices (waveplates, isolators and circulators, interferential filters), optical fibers and waveguide devices (dielectric waveguides, modes of optical fibers, analysis and characteristics of lasers and photodiodes).

## Digital Transmission

**University:** Politecnico di Torino

**Content:** baseband digital modulation with their bit error probability and spectral properties, Nyquist theorem, geometrical representation of signals and signal spaces, optimal detection theory in Gaussian noise, passband modulation formats with their bit error probability and spectral properties.

## Image and Video Processing

**University:** Politecnico di Torino

**Content:** Huffman coding and data compression, scalar and vector quantization, spatial and frequency domain processing, image restoration, image compression (transforms, predictive coding, JPEG standard), motion estimation and compensation techniques for video compression (H.264/AVC and H.265/HEVC standards), image forensics.

## Information and Communication Theory

**University:** Politecnico di Torino

**Content:** digital modulations for the AWGN channel and basic concepts from information theory (entropy and mutual information, definition of channel codes, discrete channels and their capacity, continuous input-continuous output channels, Shannon capacity formula), introduction to channel coding (focus on block codes and convolutional codes).

## Neural Networks

**University:** University of Illinois at Chicago

**Content:** mathematical model of neurons (perceptron), the gradient descent and LMS algorithms, learning methods (supervised and unsupervised), multilayer networks, the backpropagation algorithm and its implementation, Hopfield networks and support vector machines.

## Signal Processing: Methods and Algorithms

**University:** Politecnico di Torino

**Content:** discrete-time random processes, nonstationary random processes, foundations of estimation theory, spectral estimation and time-frequency analysis.

## Signal Theory and Signal Processing

**University:** Politecnico di Torino

**Content:** signal classification (energy and power), linear and inner-product spaces, Fourier series and transform, LTI systems, energy spectrum and autocorrelation function, random processes, discrete time systems (signals, Fourier transform, FIR and IIR digital filters).

## Stochastic Processes

**University:** Politecnico di Torino

**Content:** Poisson process (equivalent definitions and generalizations), renewal processes (equilibrium distribution and stationary processes), discrete and continuous time Markov chains, Brownian motions.

## COURSE PROJECTS

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### IoT device for fire alarm

Spring 2018

- Developed an IoT device based on the GHI Electronics FEZ Spider II Mainboard in **C#** for fire alarm
- Saved all data taken by sensors in a DynamoDB database, exploiting the MQTT protocol for the communication between the device and the AWS database and a self-designed MQTT broker bridge installed on an EC2 instance
- Developed a Web application in Python with the Dash framework in order to visualize all measurements

### PRNU forensics, image compression and deep learning

Spring 2018

- Investigated topics related to the multimedia signal processing through some experiments in **MATLAB**
- Implemented a camera identification tool based on PRNU fingerprints exploiting correlation and PCE metrics
- Tested an image compression scheme based on transform coding similar to that of JPEG standard and a scheme to perform predictive coding
- Developed deep learning-based classifiers made of both fully connected layers and convolutional layers

## Simulation of telecommunication systems

Spring 2017

- Simulated through the MATLAB software different telecommunication systems to evaluate and compare performances
- Considered 2-PAM systems with different filters at the receiver (matched filter, ILPF, RC filter and  $t^k$  filter), multilevel modulation formats (QPSK, 16-QAM, rectangular 8-QAM, star 8-QAM), FDM system with three channels

## WORK EXPERIENCE

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### MATLAB Student Ambassador, Torino, Italy

October 2017 – July 2018

- Managed a community of students at the Politecnico di Torino through a Facebook group
- Organized seminars/events about the MATLAB software and its toolboxes
- Organized special events about the MATLAB role in image processing applications and in linear algebra field

### Curriculum internship, Venaria Reale, Italy

March 2017 – June 2017

- Analyzed and interpreted data from accelerometers
- Implemented an instrument of data extraction and processing of binary files in C# with the Visual Studio environment
- Exploited digital filters to make statistical analysis on the extracted data with the developed application

## PERSONAL SKILLS

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- *Software/frameworks*: ANSYS HFSS, AWS, Code::Blocks, GNU Emacs, Linux, Microsoft Excel, Microsoft PowerPoint, Microsoft Word, Visual Studio, Wireshark
- *Programming/scripting languages*: Bash, C, C#, CSS, HTML, L<sup>A</sup>T<sub>E</sub>X, MATLAB, Python
- *Languages*: fluent in English, native Italian