Fabrizio Carpi

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Education

New York University — *Brooklyn, NY*

PhD in Electrical and Computer Engineering — *09/2024*

- Thesis: **Learned Task-aware Compression Methods in Communication Systems**. Advisors: Prof. Elza Erkip and Prof. Siddharth Garg.

University of Parma — *Parma, Italy*

MS in Communication Engineering — *10/2018*

- Thesis: **Exploring Machine Learning Algorithms for Decoding Linear Block Codes**, in collaboration with Duke University.

Industrial Experience

Samsung Research America — Standards and Mobility Innovation — *Plano, TX*

Senior Engineer, Research — *09/2024 - Present*

- 6G Team.

Research Intern — *06/2023 - 09/2023*

- Project: **AI-based Pulse Shaping Design** (Python, Pytorch).
  - Implemented simulations and proposed ML-based optimization with custom loss function and domain-knowledge modeling.
  - Published one conference paper [C6] and submitted one patent.

Nokia Bell Labs — Radio Systems Research — *Murray Hill, NJ*

Communication Systems Summer Intern — *06/2022 - 08/2022*

- Project: **Channel state information (CSI) feedback: a semantic communications perspective** (Python, Pytorch).
  - Developed autoencoder-based CSI feedback optimizing the tradeoff between system performance and feedback overhead.
  - Presented project updates to higher management and different divisions within the company.
  - Received the **Outstanding Innovation Award** within the global student program (top 7%) and presented a paper at ICC 2023 [C5].

Intel — Next Generation and Standards — *Remote, USA*

Wireless Standards Research Intern — *05/2021 - 08/2021*

- Project: **AI-assisted channel state information (CSI) feedback for MIMO systems** (Python, Pytorch, MATLAB).
  - Implemented autoencoder-based simulations for beyond-5G use cases and generated channel data using MATLAB 5G toolbox.
  - Analyzed system performance and robustness in wireless scenarios specified by 3GPP models.
  - Evaluated performance-complexity tradeoffs based on neural network pruning and quantization.
  - Regularly presented progress to a broader audience and discussed areas of ML-wireless integration with the AI-related group.

Academic Experience

New York University — Tandon School of Engineering — NYU Wireless — *Brooklyn, NY*

Graduate Research Assistant — *09/2019 - 09/2024*

- Project: **Detection-oriented Neural Compression for the Relay Channel** (Python, Pytorch, JAX).
  - Proposed a compress-and-forward framework for learned neural relays [U1, C7] and submitted one patent.
- Project: **Precoding-oriented CSI Feedback in Multi-Cell MIMO Systems** (Python, Pytorch).
  - Developed multi-cell multi-user MIMO precoding-oriented CSI system for interference managment [U2].
- Project: **Task-aware compression with constrained nodes** (Python, Pytorch).
  - Investigated scalar quantization schemes for binary hypothesis testing.
  - Proposed a compressor scheme based on greedy optimization and analyzed rate-accuracy tradeoffs [C4].
    - Received the **Best Poster Award (1st place) at IEEE CTW 2021**.
    - Received the **Best Student Paper Award (2nd place) at IEEE SPAWC 2021**.
- Received the **2024 David Goodman Award** in recognition of leadership and academic excellence.
- Received the **2022 Dante Youla Award** in recognition of research excellence and knowledge dissemination.
- Received the **2021 Chang Education Award** in recognition of excellence in teaching activities for undergraduate students.

University of Parma — Internet of Things (IoT) Lab
Parma, Italy

Research Associate *11/2018 - 08/2019*

- Project: **Mitigation of NLOS effects in indoor/outdoor localization** (MATLAB).
  - Developed methods to detect non-line-of-sight (NLoS) transmissions based on statistical features of the RSSI.
  - Investigated pre-processing of RSSI data in order to mitigate distance estimation errors due to NLOS conditions.
  - Analyzed performance improvement due to the "NLOS detection + pre-processing" in *agnostic* localization algorithms.
  - Published one conference paper [C2] and one journal paper [J1].

Duke University
Durham, NC

Visiting Student for MS thesis *03/2018 - 08/2018*

- Project: **Optimization of LDPC decoding with supervised learning** (Python, Tensorflow).
  - Optimized belief propagation decoding with supervised learning using a simple parameterization based on weight sharing.
  - Investigated the impact of different loss functions and proposed a new loss for channel coding problems.
- Project: **Reinforcement learning for bit-flipping decoding** (Python, Tensorflow).
  - Proposed a new reinforcement learning-based approach for the decoding of linear block codes.
  - Developed a curriculum learning approach to accelerate convergence by modifying the exploration strategy.
- Published a conference paper at IEEE ISIT 2019 [C1] and presented a conference paper at Allerton 2019 [C3].

Skills

Languages: Italian (native), Portuguese (fluent).
Programming: Matlab (advanced), Python (advanced), Tensorflow (advanced), Pytorch (advanced), JAX (basic), Git (proficient).

Awards

2024 **David Goodman Award,** Leadership and Academic Excellence in Electrical Engineering at NYU Tandon.

2022 **Outstanding Innovation Award,** Global Student Internship Program 2022 at Nokia.

2022 **Dante Youla Award,** Graduate Research Excellence in Electrical Engineering at NYU Tandon.

2021 **Best Student Paper Award (2nd place),** IEEE Intl. Workshop on Signal Processing Advances in Wireless Comms (SPAWC).

2021 **Best Poster Award (1st place),** IEEE Communication Theory Workshop (CTW).

2021 **Chang Education Award,** Excellence in Teaching Assistantship in the ECE department at NYU Tandon.

Leadership

- **MyPhDMentor**, *Mentor* for junior PhD students, organized by the Italian Committee for the PhD Enhancement. *06/2023 - Present*
- **ECE PhD Students Organization at NYU Tandon**, *Lead organizer* for peer-support and networking events. *09/2021 - 09/2024*
- **NYU Tandon Graduate Admissions**, *Ambassador* representing NYU graduate programs with prospective students. *02/2020 - 05/2023*
- **Italian Scientists & Scholars in North America Foundation (ISSNAF)**, *Mentee* within the ISSNAF network. *01/2022 - 12/2022*
- **LeadTheFuture**, *Mentee* within an Italian leading non-profit organization for people in STEM (acceptance <20%). *09/2020 - 09/2021*

Publications [fabriziocarpi.github.io/publications]

[U2] **F. Carpi**, S. Venkatesan, J. Du, H. Viswanathan, S. Garg, E. Erkip, *"Learned Precoding-Oriented CSI Feedback in Multi-Cell Multi-User MIMO Systems,"* under review.

[U1] E. Ozyilkan*, **F. Carpi***, S. Garg, E. Erkip, "Learning-Based Compress-and-Forward Schemes for the Relay Channel," under review.

[C7] E. Ozyilkan*, **F. Carpi***, S. Garg, E. Erkip, "Neural Compress-and-Forward for the Relay Channel," IEEE SPAWC 2024.

[C6] **F. Carpi**, S.Rostami,J.Cho,S.Garg,E.Erkip,C.J.Zhang "Learned Pulse Shaping Design for PAPR Reduction in DFT-s-OFDM" IEEE SPAWC 2024.

[C5] **F. Carpi**, S. Venkatesan, J. Du, H. Viswanathan, S. Garg, E. Erkip, *"Precoding-oriented Massive MIMO CSI Feedback Design,"* IEEE ICC 2023.

[J1] **F. Carpi**, L. Davoli, M. Martalò, A. Cilfone, Y. Yu, Y. Wang, G. Ferrari, *"Experimental Analysis of RSSI-based Localization Algorithms with NLOS Pre-Mitigation for IoT Applications,"* Computer Networks, vol. 225, 2023.

[C4] **F. Carpi**, S. Garg, E. Erkip, *"Single-Shot Compression for Hypothesis Testing,"* IEEE SPAWC 2021.
Also presented as a **poster at IEEE CTW 2021 and ITR3 @ ICML 2021**.

[C3] **F. Carpi**, C.Häger,M.Martalò,R.Raheli,H.Pfister *"Reinforcement Learning for Channel Coding: Learned Bit-Flipping Decoding"* Allerton 2019.

[C2] **F. Carpi**, L. Davoli, M. Martalò, A. Cilfone, Y. Yu, Y. Wang, G. Ferrari, *"RSSI-based Methods for LOS/NLOS Channel Identification in Indoor Scenarios,"* IEEE ISWCS 2019.

[C1] M. Lian, **F. Carpi**, C. Häger, H. D. Pfister, *"Learned Belief-Propagation Decoding with Simple Scaling and SNR Adaptation,"* IEEE ISIT 2019.