Massimo Battaglioni

curriculum vitae

October 19, 2023

Citizenship: Italian

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Short Biography

Massimo Battaglioni received a Laurea degree in Electronic Engineering in 2013, a Laurea Magistrale degree in Electronic Engineering (summa cum laude) in 2015 and a PhD in Information Engineering (Doctor Europaeus) in 2019, with a thesis entitled "Design and analysis of spatially coupled LDPC convolutional codes", by Marche Polytechnic University. Since 2019 he is a postdoctoral researcher in Information Engineering at the Department of Information Engineering of Marche Polytechnic University.

His research activity is focused on coding techniques for communications reliability and cryptography, with particular attention to block and convolutional LDPC codes for symmetric and asymmetric channels and their application to cryptography and blockchain. He is also interested in cyber risk assessment methods.

In 2017 he has been a visiting student at the Electrical and Information Technology Department, LTH, Lund University, Sweden. In 2018 he has been a visiting student at the Klipsch School of Electrical and Computer Engineering, New Mexico State University, Las Cruces, New Mexico, USA and at the School of Electrical and Electronic Engineering, University College Dublin, Ireland.

He received the GTTI PhD award for PhD Theses in the field of Communication Technologies for the year 2019.

He serves as Associate Editor for IEEE Communications Letters. He has served and serves as a reviewer for many international journals and conferences. He received the IEEE Communications Letters Exemplary Reviewer award for the years 2018, 2019 and 2020, the IEEE Communication Letters Exemplary Editor award for the year 2021, and the IEEE Transactions on Communications Exemplary Reviewer award for the year 2019.

Training

July 20, 2013: Laurea Degree in Electronic Engineering

Three-year Laurea Degree (equivalent to Bachelor's Degree) in Electronic Engineering obtained with grade 107/110 from Marche Polytechnic University with a thesis entitled "Study of the interaction between cascading filters", advisor Prof. Antonio Morini.

October 20, 2015: Laurea Magistrale Degree in Electronic Engineering

Two-year Laurea Magistrale Degree (equivalent to Master's Degree) in Electronic Engineering obtained with grade 110/110 and honors from Marche Polytechnic University with a thesis entitled "Optimization of the properties of LDPC convolutional codes Tanner graph", advisor Prof. Marco Baldi.

October 31, 2018: PhD

PhD in Information Engineering (curriculum: Biomedical, Electronics and Telecommunications Engineering) from Marche Polytechnic University, designed as Outstanding, with a thesis entitled "Design and Analysis of Spatially Coupled LDPC Convolutional Codes", advisor Prof. Giovanni Cancellieri.

Current Position

Marche Polytechnic University (16/04/2020 - present)

Research Fellow (art. 22, comma 4, Law 240/2010) in the Scientific Sector ING-INF / 03 - Telecommunications, in the Department of Information Engineering, on a project entitled "Cyber risk assessment: algorithms and protocols".

Previous positions

Marche Polytechnic University (01/01/2019 - 15/04/2020)

Research Fellow (art. 22, comma 4, Law 240/2010) in the Scientific Sector ING-INF / 03 - Telecommunications, in the Department of Information Engineering, on a project entitled "Design and analysis of coding schemes for reliability and security of communications".

Language knowledge

English

Good command of spoken and written language. Frequent contacts and speeches delivered in English.

French

Scholastic knowledge of spoken and written language.

Italian

Mother language.

Editorial activity

Editorial activity for Journals and Books   **Associate Editor** for the IEEE Communications Letters since October 2020

Reviewer for international journals, including:
- IEEE Communication Letters since 2015
- IEEE Transactions on Communications since 2015
- IET Communications since 2016
- EURASIP Journal on Wireless Communications and Networking since 2016
- Electronics Letters since 2016
- International Journal of Communication Systems since 2017
- The Journal of Engineering since 2017
- Discrete Applied Mathematics since 2018
- Advances in Mathematics of Communications since 2018
- IEEE Transactions on Circuits and Systems I: Regular Papers since 2018
- IEEE Transactions on Vehicular Technology since 2019
- IEEE Access since 2019
- IEEE Transactions on Information Theory since 2019
- China Communications since 2019
- IEEE Wireless Communications Letters since 2020
- Discrete Mathematics since 2020
- Physical Communications since 2021
- IEEE Transactions on Quantum Engineering since 2022
- IEEE Internet of Things Journal since 2022
- Linear and Multilinear Algebra since 2023
- Concurrency and Computation: Practice and Experience since 2023
- Science China Information Sciences since 2023

Participation in the Technical Program Committee (TPC) of international conferences

- AEIT 2021 International Annual Conference
- AEIT International Conference of Electrical and Electronic Technologies for Automotive 2023 (AEIT AUTOMOTIVE 2023)
- AEIT 2023 International Annual Conference

Chairing sessions of international conferences

- Chair of the special session "Recent Advances in Coding Theory and its Applications" at AEIT 2019 International Annual Conference
- Chair of the session "Statistics and Information Theory I" at IEEE Information Theory Workshop (ITW) 2020

Organization of special sessions

- **Co-chair** of a special session, entitled "Recent Advances in Coding Theory and its Applications", at AEIT 2019 International Annual Conference, held in Florence, Italy, in September 2019

Reviewer of many contributions submitted for presentation at international conferences.

Awards

PhD thesis

- GTTI PhD award for PhD Theses in the field of Communication Technologies.

Distinctions for reviewer activities

- IEEE Communications Letters 2018 Exemplary Reviewer Award.
- IEEE Communications Letters 2019 Exemplary Reviewer Award.
- IEEE Transactions on Communications 2019 Exemplary Reviewer Award.
- IEEE Communications Letters 2020 Exemplary Reviewer Award.

Distinctions for editorial activities

- IEEE Communications Letters 2021 Exemplary Editor Award.

Invited talks

Seminar at the Polytechnic University of Tirana

Title: Spatially Coupled LDPC codes: error correction up to the Shannon limit.
Place: Polytechnic University of Tirana, Albania.
Date: November 2021.

Participation in research projects

CTE SQUARE
Funded by Ministero delle Imprese e del Made in Italy

Role: Collaborator
The goal of the CTE SQUARE project is to create an ecosystem that can facilitate and promote the surrounding community and its actors. The innovative environment will have the function of contaminating the territory with emerging technologies and the continuous transfer of them to the entrepreneurial fabric of the Marche region. The activities will follow the development of the three strongly characterizing verticals, Culture, Tourism and Engagement, along three lines of research that are based on the expertise of the universities and research centers involved and make use of the emerging technologies deployed: Proof of Attendance, Real-time digital twin, Interactive Multimedia Environments. Partners: UNIURB, Tiscali, Marche Polytechnic University, et al. Period: Undergoing.

Multiple access sequences for satellite constellations without centralised management *Funded by the European Space Agency (ESA/ESTEC)*	**Role: Collaborator** The Project involves the development of a simulation and test environment to design and verify the uncoordinated Telemetry Tracking & Command (TT&C) access and control scenarios, and the realization of a breadboard of the digital part of a receiver, to evaluate the cross-correlation properties and to demonstrate the performance through hardware emulation. Partners: Thales Alenia Space, Polytechnic of Turin, Marche Polytechnic University. Period: Undergoing.
Telemetry randomizer for high data rates *Funded by the European Space Agency (ESA/ESOC)*	**Role: Collaborator** The Project has the aim to study some issues concerning the presence of spurious frequencies in satellite transmissions towards the Earth. In more detail, the study is focused on transmission randomization systems included in the CCSDS, CNES and NASA recommendations, and some new possible solutions have been proposed, for such components, in order to reduce the presence of spurious frequencies in randomized transmissions. Partners: Polytechnic of Turin, Marche Polytechnic University. Period: 2019.
CYBER Risk Assessment Models and Algorithms (CYBERAMA) *Funded by the Fondazione Cassa di Risparmio di Verona Vicenza Belluno e Ancona*	**Role: Collaborator** The Project has the aim to study, design and implement new methods and instruments for the cyber risk assessment, which is a necessary tool to apply the General Data Protection Regulation (GDPR) and the NIS 2016/1148 guideline on the security of networks and information systems. Partners: Marche Polytechnic University, Filippetti S.p.A. Period: 2020-2022.

Collaborations with companies and research institutions

Company/Institution	Description
CNIT	**Role: Collaborator** Non-conventional error-correcting codes for telecommand space links. Period: November 2018.
CNIT	**Role: Collaborator** Effect of the presence of the tail sequence on the performance of systems for satellite communications Period: November 2022 - January 2023

Professional Memberships and Services

Institute of Electrical and Electronics Engineers (IEEE)	Member since 2015.
National Inter-University Consortium for Telecommunications (CNIT)	Member since 2016.
Italian Group of Telecommunications and Information Technology (GTTI)	Member since 2016.

University Teaching

Digital communications
Master of Science in Electronic Engineering of Marche Polytechnic University.
Academic Years: 2020-2021, 2021-2022, 2022-2023.
Hours: 72, language: Italian.
Role: Professor

Topics:
Digital modulator, optimal receiver for the AWGN channel, colored noise, Viterbi algorithm with soft decision, soft detection, intersymbol interference, power spectra, physical layer security, channels with jamming

Telecommunications network security
Master of Science in Computer and Automation Engineering, Ecampus.
Academic Years: 2020-2021, 2021-2022, 2022-2023.
Hours: 48, language: Italian.
Role: Professor

Topics:
Principles of information security and cryptography, principles of information and coding theory, private key and public-key cryptography (DES, AES, RSA), hash functions, digital signatures, protocols for networks security, blockchain and distributed ledger technologies, physical layer security.

Cybersecurity and blockchain, mod. a
Master of Science in International Marketing and Management of University of Macerata.
Academic year: 2022-2023
Hours: 20, language: Italian.
Role: Professor

Topics:
Cyber risks: threats and countermeasures, analysis and management of cyber risk, elements of symmetric and asymmetric cryptography, security of systems and networks, application cases in economic sciences.

Other
Lectures and tutorials on specific topics for courses of Bachelor and Master of Science of Marche Polytechnic University.

Courses:
- Biomedical Data Protection
- Information Theory and Codes
- Optical Communications
- Digital Communications
- Signal Theory
- Telecommunications

Lectures on specific topics for Advanced Courses

- Advanced Course in Cybersecurity, Cyber Risk and Data Protection

Coordination of the training sessions of the Cyber Challenge 2019 at Marche Polytechnic University.

Supervision of BSc and MSc Dissertations (in Italian)

BSc = three-year Laurea degree, equivalent to BSc.
MSc = two-year post-BSc Laurea degree, equivalent to MSc.
E = Electronic Engineering
B = Biomedical Engineering
I = Computer Engineering

Academic Year	Student	Title	Type	Role
2022-2023	V. Redento	The Web: dangers and suggestions for avoiding them	MSc/I - Ecampus	Supervisor
2021-2022	L. Vanni	Network traffic analysis: from the IPFIX protocol to deep packet inspection	MSc/I - Ecampus	Supervisor

2021-2022	G. Carra	Analysis of post quantum code-based cryptosystems	MSc/I - Ecampus		Supervisor
2021-2022	M. Pisani	Web3: application of the Zero-Knowledge Proof (ZKP) protocol to the Ethereum blockchain	MSc/I - Ecampus		Supervisor
2021-2022	A. F. P. Cristaldi	Detection and classification of malicious traffic	MSc/I - Ecampus		Supervisor
2021-2022	P. Zuccalà	Physical Layer Security for IoT communications	MSc/I - Ecampus		Supervisor
2021-2022	P. G. Greco	Blockchain and Smart Contracts for Supply Chain Management	MSc/I - Ecampus		Supervisor
2021-2022	A. Pannico	Network security in public administration: the strategic plan of cybersecurity	MSc/I - Ecampus		Supervisor
2021-2022	S. Compagnoni	Cyber risk assessment of complex infrastructures through machine learning-based techniques	MSc/B		Co-Supervisor
2021-2022	A. Bertuccini	Analysis of the tail sequence false alarm probability	MSc/E		Co-supervisor
2021-2022	F. Traini	ATT4S, a knowledge base of Adversaries Tactics and Techniques for Space	MSc/E		Supervisor
2021-2022	E. Baldoni	Optimization of sequences for satellite constellations	BSc/E		Co-supervisor
2021-2022	G. Civitano	Solutions for privacy protection in blockchain	MSc/I - Ecampus		Supervisor
2021-2022	E. Soricelli	Evolution of security in IoT networks	MSc/I - Ecampus		Supervisor
2021-2022	V. Ridolfo	Post-quantum blockchain: how blockchain resists quantum computer attacks	MSc/I - Ecampus		Supervisor
2021-2022	E. Carnevali	Application of the blockchain in the agri-food chain	BSc/E		Co-supervisor
2021-2022	V. Scaraggi	Design and implementation of blockchain protocols for biometric identification	BSc/I		Co-Supervisor
2021-2022	C. Tortomasi	Cryptography and security in banks	MSc/I - Ecampus		Supervisor
2021-2022	A. Baldelli	Error correction codes in quantum communications	BSc/E		Co-Supervisor
2021-2022	T. Maietta	Post quantum cryptography: the future of public key cryptography	MSc/I - Ecampus		Supervisor
2021-2022	F. Clini	M-FSK modulation formats for space applications	BSc/E		Co-Supervisor
2020-2021	M. Pacenti	Trapping set analysis for MDPC codes with applications in cryptography	MSc/E		Co-Supervisor
2020-2021	G. C. Mele	Tools for cyber risk assessment of complex infrastructures	MSc/B		Co-Supervisor
2019-2020	R. Kermenov	LDPC code optimization with Lee metric-based decoding	MSc/E		Co-Supervisor
2019-2020	A. Bertuccini	Spectral properties of telemetry signals in space missions	BSc/I		Co-Supervisor
2018-2019	P. Laddomada	Identification of prime numbers using trigonometric functions for RSA cryptography needs	BSc/E		Co-Supervisor
2018-2019	S. Romandini	Asymptotic performance optimization of LDPC convolutional codes through differential evolution algorithms	BSc/E		Co-Supervisor
2018-2019	O. Di Giuseppe	Cryptanalysis of HQC for post-quantum cryptography	MSc/E		Co-Supervisor
2018-2019	M. Pacenti	Sparse codes in Lee metric and applications in Post-Quantum cryptography	BSc/E		Co-Supervisor
2018-2019	S. Pellegrini	Study and implementation of Linear Feedback Shift Register (LFSR) for Space Applications	BSc/E		Co-Supervisor
2018-2019	M. Di Paolo	Polar codes and criteria for eliminating the rows of their generator matrix	BSc/E		Co-Supervisor
2016-2017	A. Saee	Numerical simulation of the behaviour of LDPC Convolutional Codes in MatLAB	BSc/E		Asst. Supervisor
2016-2017	D. P. D'orio	Functioning simulations of convolutional regular and irregular LDPC codes	BSc/E		Asst. Supervisor
2016-2017	A. Rosati	Simulation of Spatially Coupled LDPC codes behavior. Low weight words and BER curves	BSc/E		Asst. Supervisor
2014-2015	N. A. Travaglini	Optimization of LDPC convolutional codes through cycles in parity-check matrix H	BSc/E		Asst. Supervisor

Presentations given at international conferences

With reference to the list of publications reported below, Massimo Battaglioni has presented the following works at international conferences: [1][5][8, 9][17][20][22][29][31, 32].

Contributions to meetings of the Consultative Committee for Space Data Systems (CCSDS)

- CCSDS Spring 2019 meeting, Mountain View, California, United States, 6-9 May 2019:
    - R. Garello, F. Chiaraluce, M. Battaglioni, M. Baldi, "Telemetry randomizers for high data rates - an ESA analysis".
- CCSDS Fall 2019 meeting, Darmstadt, Germany, 21-24 October 2019:
    - R. Garello, M. Battaglioni, M. Baldi, F. Chiaraluce, M. Bertinelli, G.P. Calzolari, A. Modenini, E. Vassallo, "Telemetry randomizer (high order modulations and random OID)".

Bibliometric Indices

Publications

[1] M. Battaglioni and G. Cancellieri, "A family of binary sequences derived from punctured simplex codes," in *Proc. AEIT International Annual Conference (AEIT)*, Oct. 2023.

[2] M. Battaglioni and G. Cancellieri, "A family of error correcting codes for automotive applications," in *Proc. 2023 AEIT International Conference on Electrical and Electronic Technologies for Automotive (AEIT AUTOMOTIVE)*, pp. 1–6, July 2023.

[3] M. Battaglioni, F. Chiaraluce, M. Baldi, M. Pacenti, and D. Mitchell, "Optimizing quasi-cyclic spatially coupled LDPC codes by eliminating harmful objects," *EURASIP Journal on Wireless Communications and Networking*, Jul. 2023.

[4] G. Rafaiani, M. Battaglioni, S. Compagnoni, L. Senigagliesi, F. Chiaraluce, and M. Baldi, "A machine learning-based method for cyber risk assessment," in *2023 IEEE 36th International Symposium on Computer-Based Medical Systems (CBMS)*, pp. 263–268, June 2023.

[5] M. Battaglioni, M. Baldi, F. Chiaraluce, and G. Cancellieri, "Rate-adaptive LDPC codes obtained from simplex codes," in *Proc. of 2023 IEEE International Conference on Communications (ICC)*, pp. 1–6, May 2023.

[6] M. Battaglioni and G. Cancellieri, "Punctured binary simplex codes as LDPC codes," in *Proceedings of the 61st FITCE International Congress Future Telecommunications: Infrastructure and Sustainability (FITCE)*, pp. 1–6, Sept. 2022.

[7] M. Battaglioni, G. Rafaiani, F. Chiaraluce, and M. Baldi, "MAGIC: A method for assessing cyber incidents occurrence," *IEEE Access*, vol. 10, pp. 73458–73473, July 2022.

[8] M. Battaglioni, P. Santini, G. Rafaiani, F. Chiaraluce, and M. Baldi, "Analysis of a blockchain protocol based on LDPC codes," in *CEUR Workshop Proceedings, 4th Distributed Ledger Technology Workshop (DLT 2022)*, pp. 7–17, June 2022.

[9] P. Santini, G. Rafaiani, M. Battaglioni, F. Chiaraluce, and M. Baldi, "Optimization of a Reed-Solomon code-based protocol against blockchain data availability attacks," in *Proceedings of IEEE International Conference on Communications (ICC) Workshops*, May 2022.

[10] V. Weger, K. Khathuria, A.-L. Horlemann, M. Battaglioni, P. Santini, and E. Persichetti, "On the hardness of the Lee syndrome decoding problem," *Advances in Mathematics of Communications*, Apr. 2022.

[11] M. Battaglioni, G. Cancellieri, and P. Santini, "On the use of code-based cryptography in automotive applications," in *Proc. AEIT Int. Conf. of Electrical and Electronic Technologies for Automotive (AEIT AUTOMOTIVE)*, pp. 1–6, Nov. 2021.

[12] G. Rafaiani, M. Battaglioni, M. Baldi, and F. Chiaraluce, "Cyber risk assessment: a pragmatic approach," in *Proc. of the 1st International Conference on Information Technologies and Educational Engineering (ICITEE21)*, Nov. 2021.

[13] G. Rafaiani, M. Battaglioni, M. Baldi, F. Chiaraluce, G. Libertini, L. Spalazzi, and G. Cancellieri, "A functional approach to cyber risk assessment," in *Proc. AEIT International Annual Conference 2021*, Sept. 2021.

[14] M. Battaglioni, M. Baldi, F. Chiaraluce, R. Garello, G. P. Calzolari, and E. Vassallo, "Effect of randomizers on the power spectrum excess of space telemetry signals," *International Journal of Satellite Communications and Networking*, vol. 40, pp. 67–82, July 2021.

[15] M. Battaglioni, F. Chiaraluce, M. Baldi, and M. Lentmaier, "Girth analysis and design of periodically time-varying SC-LDPC codes," *IEEE Trans. Inf. Theory*, vol. 67, pp. 2217–2235, Apr. 2021.

[16] G. Cancellieri and M. Battaglioni, "Data transmission in automotive applications and security/safety requirements," in *Proc. AEIT Int. Conf. of Electrical and Electronic Technologies for Automotive (AEIT AUTOMOTIVE)*, pp. 1–6, Nov. 2020.

[17] M. Battaglioni, M. Baldi, and G. Cancellieri, "Improving the minimum distance of QC-LDPC codes by removing cycles," in *Proc. AEIT International Annual Conference (AEIT)*, pp. 1–5, Sept. 2020.

[18] P. Santini, M. Battaglioni, M. Baldi, and F. Chiaraluce, "Analysis of the error correction capability of LDPC and MDPC codes under parallel bit-flipping decoding and application to cryptography," *IEEE Transactions on Communications*, vol. 68, pp. 4648–4660, Aug. 2020.

[19] P. Santini, M. Battaglioni, F. Chiaraluce, M. Baldi, and E. Persichetti, "Low-Lee-density parity-check codes," in *ICC 2020 - 2020 IEEE International Conference on Communications (ICC)*, pp. 1–6, June 2020.

[20] M. Battaglioni, F. Chiaraluce, M. Baldi, and D. Mitchell, "Efficient search and elimination of harmful objects for the optimization of QC-SC-LDPC codes," in *Proc. GLOBECOM 2019 - 2019 IEEE Global Communications Conf.*, Dec. 2019.

[21] M. Battaglioni, P. Santini, M. Baldi, and G. Cancellieri, "Obtaining structured generator matrices for QC-LDPC codes," in *Proc. AEIT International Annual Conference 2019*, Sept. 2019.

[22] M. Battaglioni, M. Baldi, F. Chiaraluce, and M. Lentmaier, "Girth properties of time-varying SC-LDPC convolutional codes," in *Proc. IEEE Int. Symp. Information Theory (ISIT) 2019*, pp. 2599–2603, July 2019.

[23] P. Santini, M. Battaglioni, M. Baldi, and F. Chiaraluce, "Hard-decision iterative decoding of LDPC codes with bounded error rate," in *Proc. ICC 2019 - 2019 IEEE Int. Conf. Communications (ICC)*, pp. 1–6, May 2019.

[24] P. Santini, M. Battaglioni, F. Chiaraluce, and M. Baldi, "Analysis of reaction and timing attacks against cryptosystems based on sparse parity-check codes," *Code-Based Cryptography*, Jan. 2019.

[25] M. Battaglioni, A. Tasdighi, M. Baldi, M. H. Tadayon, and F. Chiaraluce, "Compact QC-LDPC block and SC-LDPC convolutional codes for low-latency communications," in *Proc. Indoor and Mobile Radio Communications (PIMRC) 2018 IEEE 29th Annual Int. Symp. Personal*, pp. 1–5, Sept. 2018.

[26] M. Battaglioni, M. Baldi, and G. Cancellieri, "Connections between low-weight codewords and cycles in spatially coupled LDPC convolutional codes," *IEEE Transactions on Communications*, vol. 66, pp. 3268–3280, Aug. 2018.

[27] M. H. Tadayon, A. Tasdighi, M. Battaglioni, M. Baldi, and F. Chiaraluce, "Efficient search of compact QC-LDPC and SC-LDPC convolutional codes with large girth," *IEEE Commun. Lett.*, vol. 22, pp. 1156–1159, June 2018.

[28] M. Battaglioni, A. Tasdighi, G. Cancellieri, F. Chiaraluce, and M. Baldi, "Design and analysis of time-invariant SC-LDPC convolutional codes with small constraint length," *IEEE Transactions on Communications*, vol. 66, pp. 918–931, Mar. 2018.

[29] M. Battaglioni, F. Chiaraluce, and T. Klove, "On non-linear codes correcting errors of limited size," in *Proc. GLOBECOM 2017 - 2017 IEEE Global Communications Conf.*, pp. 1–7, Dec. 2017.

[30] M. Battaglioni, M. Baldi, and E. Paolini, "Complexity-constrained spatially coupled LDPC codes based on protographs," in *Proc. Int. Symp. Wireless Communication Systems (ISWCS)*, pp. 49–53, Aug. 2017.

[31] M. Battaglioni, M. Baldi, and G. Cancellieri, "Design of spatially coupled LDPC codes based on symbolic hypergraphs," in *Proc. Telecommunications and Computer Networks (SoftCOM) 2016 24th Int. Conf. Software*, pp. 1–5, Sept. 2016.

[32] M. Baldi, M. Battaglioni, F. Chiaraluce, and G. Cancellieri, "Time-invariant spatially coupled low-density parity-check codes with small constraint length," in *Proc. IEEE Int. Black Sea Conf. Communications and Networking (BlackSeaCom)*, pp. 1–5, June 2016.

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