



## FEDERICA ZONZINI

### Ph.D candidate

Alma Mater Studiorum – University of Bologna

- Engineering and Information Technology for Structural and Environmental Monitoring and Risk Management (EIT4SEMM) programme
- Advanced Research Centre on Electronic Systems “Eroale de Castro” (ARCES)
- Department of Electrical, Electronic and Information Engineering “Guglielmo Marconi” (DEI)

### Contacts

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## PERSONAL INFORMATION

Date of birth: 07/01/1994 (Cesena, Italy)  
Nationality: Italian  
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47039 Savignano sul Rubicone (FC), Italy

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 LinkedIn: in/federicazonzini

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## PROFESSIONAL EXPERIENCE

- 2021** **Alma Mater Studiorum – University of Bologna**  
**Department of Electrical, Electronic and Information Engineering (DEI)**  
**Tutor of the Master course “Progetto di Circuiti e Sistemi Analogici M”**
- 2017-2018** **Alma Mater Studiorum – University of Bologna**  
**Department of Electrical, Electronic and Information Engineering (DEI)**  
**Tutor of the Master Programme in Electronics Engineering**
- Academic orienteering and consulting
  - Bureaucratic administrator
  - Moderator between students and degree programme director

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## EDUCATION

- September, 2020 – March 2021** **Academic Guest at ETH, Zürich**  
**Structural Mechanics and Monitoring Group**  
Internship abroad under the supervision of Prof. Eleni Chatzi working on the implementation of system identification at the extreme edge for network load reduction on vibration monitoring
- November, 2018- [expected defense date March 2022]** **Ph.D. candidate (XXXIV cycle) - EQFL 8**  
Program Engineering and Information Technology for Structural and Environmental Monitoring and Risk Management (EIT4SEMM)  
University of Bologna, Italy  
Research topic: Integrated Cyber-Physical System for Damage Detection and Diagnosis in SHM applications
- September, 2016- July, 2018** **Collegio Superiore Alumna - Supplementary license**  
Institute of Advanced Studies (ISA) - Centre of excellence Collegio Superiore interdisciplinary programme to selected students enrolled on a degree programme at the University of Bologna, Italy

September, 2016-  
July, 2018

**Master of Science - EQFL 7**  
GPA: 110/110 cum laude  
**Electronics Engineering**  
Thesis title: “Signal processing techniques for SHM applications”  
University of Bologna, Italy

September, 2013-  
July, 2016

**Bachelor of Science - EQFL 6**  
GPA: 110/110 cum laude  
**Electronics Engineering for Energy and Information**  
Thesis title: “Experimental characterization of a localization system based on Ultra-Wide Band technology”  
University of Bologna, Italy

September, 2008-June,  
2013

**Secondary school diploma**  
GPA: 100/100 cum laude  
**Scientific High School** “Marie Curie”, Savignano sul Rubicone, Italy

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### POST-GRADUATE STUDIES

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July, 2021

**Summer School of Information Engineering**  
Summer school on Machine Learning, Energy Efficient Electronics Science and ICT Applications  
University of Padova, Italy

July, 2021

**SIE Ph.D. school**  
Summer school on Electronics for IoT  
University of Trieste, Italy

July, 2019

**12<sup>th</sup> Asia-Pacific-Euro Summer School on Smart Structures**  
Summer school on Structural Health Monitoring  
Sapienza University of Rome, Italy

July-September, 2018

**2<sup>nd</sup> Summer School on Integrated Mobility Systems Engineering**  
Summer school about ICT, Big Data, Signalling, Infrastructures and Project Management  
University of Bologna, Italy

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### TECHNICAL REVIEWER

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IEEE Transaction on Instrumentation and Measurement (TIM)  
IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control (TUFFC)  
IEEE Transactions on Industrial Informatics (TII)  
Elsevier Journal of Building Engineering

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### PERSONAL SKILLS & COMPETENCES

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**Languages**

	READING	SPEAKING	WRITING	LISTENING
Italian	Mother tongue			
English * IELTS	C2	C1	C1	C1
French	B1	A2	B1	A2

**Digital competences**

**Text Processing:** MS Office, LaTeX, Libre Office  
**Programming languages:** C, C++, VHDL, Python,  
**Software applications:** Matlab, Atollic, LT Spice

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### DISTINCTIONS & AWARDS

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June, 2020

Research Fellowship “Ermenegildo Zegna Founders’ scholarship” supporting abroad internship

July, 2019

Best Paper Young Author Award “Nicola Pitrone” at the 2019 IEEE International Symposium on Measurements and Networking

<b>June, 2019</b>	Best Student for the Master program in Electronics Engineering “Guido Paulucci”, XXIX edition (year 2019), awarded by Rotary Club, Bologna division
<b>July, 2016</b>	Academic scholarship for excellence among the best students at the University of Bologna, A.Y. 2015-2016
<b>July, 2015</b>	Academic scholarship for excellence among the best students at the University of Bologna, A.Y. 2014-2015
<b>June, 2014</b>	“Gino Vendemini” scholarship sponsored every year by the Rubiconia Accademia of Filopatridi” (Italy) to the best graduation score at secondary school

## RESEARCH TOPICS

<p><b><u>Data Compression</u></b> Analysis, application and development of Signal processing techniques for data compression applied to vibration-based structural assessment</p>	<ul style="list-style-type: none"> <li>▪ Compressed sensing</li> <li>▪ Adapted CS: Model Assisted Rakeness-based Compressed Sensing</li> <li>▪ Wavelet Packet Transform</li> <li>▪ Autoregressive models</li> </ul>
<p><b><u>System Identification</u></b> Analysis, application and development of strategies for the reconstruction of structural properties for structures in dynamic regime</p>	<ul style="list-style-type: none"> <li>▪ Time-domain analysis</li> <li>▪ Frequency-domain analysis: parametric and non-parametric methods</li> <li>▪ Operational Modal Analysis</li> <li>▪ Modal features reconstruction</li> </ul>
<p><b><u>Graph Signal Processing</u></b> Adoption of graph-based signal representation for mode shapes retrieval in multiple, non-simultaneous measurements in vibration-based monitoring</p>	<ul style="list-style-type: none"> <li>▪ Mode shape pairing</li> </ul>
<p><b><u>Edge Computing</u></b> Implementation of machine learning models, CS techniques and autoregressive models at the extreme edge for sensor-near data inference</p>	<ul style="list-style-type: none"> <li>▪ Tiny Machine Learning</li> <li>▪ Parametric system identification @edge</li> <li>▪ Compressed Sensing @edge</li> </ul>
<p><b><u>Guided Wave-based Data Communication</u></b> Application of standard communication schemes to acoustic data communication exploiting the mechanical wave as a form of communication content and the mechanical channel as a form of communication medium</p>	<ul style="list-style-type: none"> <li>▪ CDMA modulation scheme</li> <li>▪ FDM and OFDM modulation scheme</li> <li>▪ Time Reversal, Pulse Position Modulation</li> </ul>
<p><b><u>Acoustic Emission-based Monitoring</u></b> Application of artificial intelligence model to the estimation of acoustic features for the damage detection and localization of cracking phenomena</p>	<ul style="list-style-type: none"> <li>▪ Time of Arrival localization with ML/DL architectures</li> </ul>

## PUBLICATION

### JOURNALS

- [9] Zonzini, F., Dertimanis, V., Chatzi, E., De Marchi, L. **System Identification at the Extreme Edge for Network Load Reduction in Vibration Monitoring**. *Submitted to IEEE Internet of Things Journal*, 2021.
- [8] Zonzini, F., Carbone, A., Romano, F., Zauli, M., De Marchi, L. **Machine Learning Meets Compressed Sensing in Vibration-based Structural Health Monitoring**. *Submitted to IEEE Transactions on Instrumentation and Measurements*, 2021.
- [7] Zonzini, F., Zauli, M., Mangia, M., Testoni, N., and De Marchi, L. **Model-assisted Compressive Sensing for Vibration-based Structural Health Monitoring**. *IEEE Transactions on Industrial Informatics*, 2021.

- [6] Zonzini, F., Girolami, A., De Marchi, L., Brunelli, D., and Marzani, A. **Cluster-based Vibration Analysis of Structures with Graph Signal Processing**. *IEEE Transactions in Industrial Electronics*, 2020.
- [5] Zonzini, F., Aguzzi, C., Gigli, L., Sciullo, L., Testoni, N., De Marchi, L., Di Felice, M., Salmon Cinotti, T., Mennuti, C., and Marzani, A. **Structural Health Monitoring and Prognostic of Industrial Sites and Civil Structures: a Sensor-to-Cloud Architecture**, *IEEE Instrumentation and Network Magazine*, IEEE 2020.
- [4] Zonzini, F., Malatesta, M. M., Bogomolov, D., Testoni, N., Marzani, A., and L. De Marchi. **Vibration-based SHM with up-scalable and low-cost Sensor Networks**. *IEEE Transactions on Instrumentation and Measurement*, IEEE 2019.
- [3] Kexel, C., Testoni, N., Zonzini, F., Moll, J., and De Marchi, L. **Low-power MIMO guided-wave communication**. Accepted for publication at *IEEE Access*, 2020.
- [2] Testoni, N., Zonzini, F., Marzani, A., Scarponi, V., and De Marchi, L. **A tilt sensor node embedding a data-fusion algorithm for vibration-based SHM**. *Electronics*, 8:1-14, 2019.
- [1] Testoni, N., Aguzzi, C., Arditi, V., Zonzini, F., De Marchi, L., Marzani, A., and Salmon Cinotti, T. **A sensor network with embedded data processing and data-to-cloud capabilities for vibration-based real-time SHM**. *Journal of Sensors*, 2018:1-12, 2018.

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## CONFERENCE PROCEEDINGS

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- [21] Zonzini F., Zauli, M., Mangia, M., Testoni, N., De Marchi, L. **HW-Oriented Compressed Sensing for Operational Modal Analysis: the Impact of Noise in MEMS Accelerometer Networks**, *IEEE Sensor Application Symposium*, 2021.
- [20] Montori, F., Zyrianoff, I., Gigli, L., Venanzi, R., Sindaco, S., Aguzzi, C., Zonzini, F., Zauli, M., Testoni, N., Alessi, E., Di Felice, M., Bononi, L., Bellavista, P., De Marchi, L., Salmon Cinotti, T. **A Toolchain Architecture for Condition Monitoring Using the Eclipse Arrowhead Framework**, *Accepted at IEEE IECON 2021*.
- [19] Márquez Reyes, O. A., Moll, J., Zonzini, F., Mohammadgholiha, M., De Marchi, L. **Quadrature Amplitude Modulation for Acoustic Data Communication in Ultrasonic Structural Health Monitoring Systems**. *Accepted at 48th Annual Review of Progress in Quantitative Nondestructive Evaluation*, 2021.
- [18] Zonzini, F., Romano, F., Carbone, A., Zauli, M., De Marchi, L. **Enhancing Vibration-based Structural Health Monitoring via Edge Computing: a TinyML perspective**. *Accepted at 48th Annual Review of Progress in Quantitative Nondestructive Evaluation*, 2021.
- [17] Bogomolov, D., Testoni, N., Zonzini, F., Malatesta, M.M., De Marchi, L., Marzani, A. **Acoustic emission structural monitoring through low-cost sensor nodes**. *SHM10 – 10<sup>th</sup> International Conference on Structural Health Monitoring of Intelligent Structures*, June-July, 2021.
- [16] Aguzzi, C., Gigli, L., Sciullo, L., Trotta, A., Zonzini, F., De Marchi, L., Di Felice, M., Marzani, A., Salmon Cinotti, T. **MODRON: A Scalable and Interoperable Web of Things Platform for Structural Health Monitoring**. *2021 IEEE 18th Annual Consumer Communications & Networking Conference*, January 2021.
- [15] Zonzini, F., Zauli, M., Carbone, A., Romano, F., Testoni, N., De Marci, L. **Hardware-oriented data recovery algorithms for compressed sensing-based vibration diagnostics**. *International Conference on Applications in Electronics Pervading Industry, Environment and Society*, November 2020.
- [14] Zonzini, F., Testoni, N., Marzani, A., De Marchi, L. **Low Depth Time Reversal Modulation Technique for Ultrasonic Guided Waves-based Communications**. In *2020 IEEE International Ultrasonics Symposium (IUS)*, September 2020.
- [13] Zonzini, F., De Marchi, L., Kexel, C., Moll, J. **Guided-wave MIMO communication on a composite panel for SHM applications**. *Proceeding of SPIE Smart Structures + Nondestructive Evaluation, 2020, Online Only, California, United States*.

- [12] Zonzini, F., Zauli, M., Testoni, N., Marzani, A., De Marchi, L. **A Structural-aware Frequency Division Multiplexing Technique for Acoustic Data Communication in SHM applications.** To appear in the Proceedings of the 10<sup>th</sup> European Workshop on Structural Health Monitoring (EWSHM), 2020.
- [11] Zauli, M., Zonzini, F., Testoni, N., L. De Marchi and Marzani, A. **Compressive Sensing and On-board Data Recovery for Vibration-based SHM.** To appear in the Proceedings of the 10<sup>th</sup> European Workshop on Structural Health Monitoring (EWSHM), 2020.
- [10] Malatesta, M. M., Zonzini, F., Bogomolov, D., Testoni, N., Marzani, A., and De Marchi, L. **Structural Health Monitoring reliability enhancement by an automated sensor tuning procedure.** To be presented at ESREL 2020/PSAM 15, June 21-26, 2020, Venice.
- [9] Zonzini, F., Girolami, A., Brunelli, D., Testoni, N., Marzani, A and De Marchi, L. **A graph signal processing technique for vibration analysis with clustered sensor networks.** In *International Conference on Applications in Electronics Pervading Industry, Environment and Society* (pp. 355-361). Springer, Cham, 2020.
- [8] Zonzini, F., Testoni, N., L. De Marchi and Marzani, A. **Direct Spread Spectrum Modulation and Dispersion Compensation for Guided Wave-based Communication Systems.** In *2019 IEEE International Ultrasonics Symposium (IUS)*, pages 2500-2503. IEEE, 2019.
- [7] Malatesta, M. M., Zonzini, F., Bogomolov, D., Tarozzi, M, Testoni, N., Agugliaro, G, Mennuti, C., Marzani, A., De Marchi, L., and Benedetti, A. **Structural Health Monitoring of a reinforced concrete beam by means of a miniaturized heterogeneous sensor network.** In *XVIII National Conference on Non-Destructive Testing, Monitoring and Diagnostics, AIPnD, Biennale PND-MD*, Milan, 2019.
- [6] Zonzini, F., Malatesta, M. M., Bogomolov, D., Testoni, N., De Marchi, L., and Marzani, A. **A spectral peak-picking method for on-board operational modal analysis of multi-type vibration-based SHM.** In *ANCRiSST 2019 Procedia*. Sapienza University of Rome, 2019.
- [5] Zonzini, F., Malatesta, M. M., Bogomolov, D., Testoni, N., L. De Marchi and Marzani, A. **Heterogeneous sensor-network for vibration-based SHM.** In *2019 IEEE International Symposium on Measurements & Networking (M&N)*, pages 1-5. IEEE, 2019.
- [4] Testoni, N., Aguzzi, C., Zonzini, F., De Marchi, L., Agugliaro, G., Salmon Cinotti, T, and Marzani, A. **Low-weight sensor networks based on a multi-function sensor node.** In *Sicurezza ed affidabilità delle attrezzature a pressione (SAFAP)*. Bologna, pages 1-10, 2018.
- [3] Zonzini, F., Malatesta, M. M., Aguzzi, C., Testoni, N., Verardi, M., and Scarponi, V. **A sensor network targeted on a novel identification of cracks.** In *FRUCT Oy*, Finland, 2018.
- [2] Girolami, A., Zonzini, F., De Marchi, L., Brunelli, D., and Benini, L. **Modal analysis of structures with low-cost embedded systems.** In *IEEE International Symposium on Circuits and Systems (ISCAS)*, pages 1-4. IEEE, 2018.
- [1] Zonzini, F., De Marchi, L., and Testoni, N. **A small footprint, low power, and light weight sensor node and dedicated processing for modal analysis.** In *Lecture Notes in Electrical Engineering*, volume 539, pages 361-370. Springer Verlag, 2019.