

Birth date: 09/22/1990

Nationality: Italian

Gender: Male

Address: Menachem Ussishkin 27, Jerusalem, Israel

Telephone: +(972)0508112656

Email: rolandocarbonari@hotmail.com

Work experience

- From 15/11/2021 – to date **Postdoctoral researcher in Data science – Hebrew University of Jerusalem (Israel)**
Main activities:
 - Development and implementation of rock image segmentation tools
 - GPS time series analysis and prediction using Deep Learning
 - Conducting electromagnetic geophysical studies on natural degassing systems
 - Utilization of machine learning techniques to enhance electrical geophysical data analysis
- From 01/03/2020 to 28/09/2021 **Postdoctoral researcher in Geophysics/Data science – Oregon State University (Corvallis, Oregon)**
Main activities:
 - Implementation of data-driven solutions for drilling well optimization
 - Electromagnetic time series analysis and prediction through Deep Learning
- From 07/03/2019 to 01/03/2020 **Business Intelligence Consultant/Data scientist – Porini s.r.l., Milan, Italy**
Main activities:
 - Performing ETL with SQL Service Analysis Services (SSAS) and Azure Databricks
 - Implementation of machine learning solution with Python, Databricks and R
 - Building reports and dashboards

Education

- 15/02/2019 **PhD in Earth, Environmental and Resources Sciences**
University of Naples Federico II, Naples, Italy
Thesis title: *Hydrothermal system monitoring by continuous magnetotelluric time series: sensitivity analysis and data denoising*
Supervisor: Prof. Rosa Di Maio
- 23/10/2015 **Master's degree in Geology and Applied Geology – 110/110 cum laude**
University of Naples Federico II, Naples, Italy
Thesis title: *Development of magnetotelluric data denoising techniques*
Supervisor: Prof. Rosa Di Maio
- 22/11/2012 **Bachelor's degree in Geological Sciences – 110/110 cum laude** **University of Naples Federico II, Naples, Italy**
Thesis title: *Spectral analyses of explosion quakes at Stromboli volcano*
Supervisors: Prof. Alberto Incoronato, Dr Luca D'Auria
- 27/07/2017 – 31/10/2017 **Internship at Oregon State University (Corvallis, Oregon)**
Research topic: *Magnetotelluric imaging of the Earth's crust and mantle*
Supervisor: Prof. Adam Schultz

- 01/03/2015 – 01/07/2015 **Internship at National Institute of Geophysics and Volcanology (INGV) – Section of Naples (Vesuvius Observatory)**
Research topic: *Processing of magnetotelluric data*
Supervisors: Dr Luca D’Auria, Dr Zaccaria Petrillo

Research Activity

- 15/11/2021 – to date: Participation to **GoMed consortium: Safe, Sustainable and Resilient Development of Offshore Reservoirs and Natural Gas Upgrading through Innovative Science and Technology**, scientific coordinator Prof. Simon Emmanuel, Prof. Dan Shantz. Main contribution: development and application of deep learning-based tools for rock image segmentation.
- 01/02/2020 – to date: Collaboration with University of Napoli Federico II and National Institute of Geophysics and Volcanology (Naples’ section) **to the development of new methodologies for GNSS and geoelectrical data in active volcanic areas**. Scientific coordinators: Prof. Rosa Di Maio, Prof. Umberto Riccardi, Dr. Prospero De Martino. Main Contribution: development and application of deep learning techniques to enhance GNSS and electrical geophysics data analysis and interpretation.
- 02/01/2020 – 28/09/2021: Participation to **EDGE project: An International Research Coordination Network for Geothermal Drilling Optimization Supported by Deep Machine Learning and Cloud Based Data Aggregation**, Scientific Coordinator: Prof. A. Schultz, Department of Energy grant DE-EE0008793. Main contribution: i) data cleaning and pre-processing; ii) developing of well optimization solutions through both machine learning and deep learning techniques.
- 15/01/2018 – 15/03/2019: Participation to the research project: ***Development of geophysical data inversion methods and numerical modeling of complex natural phenomena (i.e., landslides, volcanic eruptions, earthquakes)***, Scientific Coordinator: Prof. R. Di Maio, University of Naples Federico II, funded by MIUR grant E61I18001660005. Main contribution: Numerical modelling of volcanic hydrothermal system evolution by electrical resistivity continuous data
- 10/02/2018 – 15/03/2019: Participation to ***multi-methodological geophysical surveys (geoelectrical, self-potential, GPR, FDEM, MT)*** in the framework of research projects finalized to natural hazards, geo-environmental and civil engineering topics, archaeological and Cultural Heritage research and safeguard, funded by University of Naples Federico II (Scientific Coordinator: Prof. R. Di Maio)
- 02/08/2017 – 31/10/2017: Participation to the research project: ***The distribution of magmatic and hydrous fluids beneath Yellowstone: magnetotelluric and seismic investigations***, Scientific Coordinators: Prof. A. Schultz, N. Bennington and C. Thurber, US National Science Foundation grant EAR-1460294. Main contribution: installation of land magnetotelluric stations, analysis and processing of the collected MT data

Research Interests

- **Machine Learning and data processing:** research and development of predictive Machine Learning models for geophysical problems, with a specific focus in data denoising, time series analysis and image processing
- **Geothermal, hydrothermal, and volcanic systems modeling:** numerical simulation of hydrothermal, geothermal and systems evolution. Imaging of geothermal, hydrothermal and volcanic systems by using electrical and electromagnetic methods (e.g., electrical resistivity tomography, self-potential and magnetotellurics)

- **Geophysical exploration with electric and electromagnetic methods:** use of self-potential, electrical resistivity tomography, FDEM and magnetotelluric methods to define the Earth models from shallow to deep crustal geological structures

Teaching Activity

- From 2015 to 2019: Lectures on Magnetotelluric Method in the framework of “*Electromagnetic methods of geophysical exploration*” course taken by Prof. Rosa Di Maio at University of Naples Federico II
- 01/03/2017 – 30/06/2017 Short tutoring course of physics for undergraduate students at the Department of Earth, Environment and Resources Sciences, University of Naples Federico II
- 04/09/2022 – 11/09/2022 Short course “From Matlab to Python” for graduate students on switching from Matlab to Python programming language. Institute of Earth Sciences, Hebrew University of Jerusalem.

Professional Skills

- **Data modelling through machine learning and deep learning:** implementation of data-driven solutions to different problems. Good experience with the following algorithms: **Random Forest, Self-Organizing Maps, Support Vector Machine, Feed-Forward Neural Networks, Recurrent Neural Networks, Convolutional Neural Networks, Autoencoders**
- Data cleaning and pre-processing: **outlier detection, dimensionality reduction, feature selection**
- Time series analysis and modelling with both standard and Deep Learning techniques, e.g. **ARIMA, Gaussian processes, Recurrent Neural Network (Echo-State Network, LSTM)**
- Development of **reports** and **dashboards**
- **Wavelet Analysis**
- Acquisition, processing, and inversion of **magnetotelluric, FDEM, geoelectrical, GPR and Self-Potential data**
- Very good knowledge of basic statistics, e.g., **Principal Component Analysis, robust and linear regression**

Computer Skills

- Scientific programming: **Python (scikit-learn, scipy, Pandas, Keras, TensorFlow, Cartopy, XGBoost), MATLAB (Neural Network Toolbox, Wavelab 850, Wavelet toolbox), Excel, R**
- Database querying: **MySQL, T-SQL**
- Data visualization: **Microsoft Power BI**
- Numerical modelling: **TOUGH2, PetraSim**
- Magnetotelluric data processing: **EMTF processing code**
- Geophysical interpretation: **WinGLink**

Language Skills

- **Italian:** mother
- **English:** fluent

Awards

- 17/11/2015 – **Winner of the Italian SEG-EAGE Challenge Bowl**
- 01/12/2016 – **Winner of the “Vittorio Illiceto prize” for the best master thesis in Applied Geophysics, University of Padua and Order of Veneto Region Geologists, Italy**
- 01/02/2022 – **Azrieli International Postdoctoral Fellowship 2022/23 cohort**

Memberships

- 2016 - 2018 – **Society of Exploration Geophysicists (SEG)**
- 2016 - 2018 – **University of Naples Federico II SEG Student Chapter**
- 2016 - 2018 – **European Geosciences Union (EGU)**
- 2017 - **European Association of Geoscientists and Engineers (EAGE)**
- 2022 – **American Geophysical Union (AGU)**

Publications

- Carbonari, R.**, Emmanuel, S., & Day-Stirrat, R.J. (2024). *Identification of quartz cement in sandstone through deep learning segmentation of electron microscopy images*. *Geoenergy Science and Engineering*, 233, 212529, <https://doi.org/10.1016/j.geoen.2023.212529>.
- Salone, R., De Paola, C., **Carbonari, R.**, Rufino, F., Avino, R., Caliro, S., Cuoco, E., Santi, A., & Di Maio, R. (2023). *High-resolution geoelectrical characterization and monitoring of natural fluids emission systems to understand possible gas leakages from geological carbon storage reservoirs*. *Scientific Reports*, 13(1), 18585.
- Carbonari, R.**, Riccardi, U., De Martino, P., Cecere, G., & Di Maio, R. (2023). *Wavelet-like denoising of GNSS data through machine learning. Application to the time series of the Campi Flegrei volcanic area (Southern Italy)*. *Geomatics, Natural Hazards and Risk*, 14(1), 2187271.
- Rallo, R., **Carbonari, R.**, Ton, D., Ashari, R., Ashok, P., Bonneville, A., Bour, D., Cladouhos, T., Garrison, G., Horne, R., van Oort, E., Petty, S., Schultz, A., Sørli, C. F., Thorbjornsson, I. O., Uddenberg, M., & Weydt, L. (2022). *A Probabilistic Approach to Model and Optimize Geothermal Drilling*. *Proceedings of the 47th Workshop on Geothermal Reservoir Engineering*, Stanford University, Stanford, California, February 7-9, 2022, SGP-TR-223.
- Carbonari, R.**, Ton, D., Bonneville, A., Bour, D., Cladouhos, T., Garrison, G., Horne, R., Petty, S., Rallo, R., Schultz, A., Sørli, C.F., Thorbjornsson, I., Uddenberg, M., Weydt, L. (2021). *First year report of EDGE project: An International Research Coordination Network for Geothermal Drilling Optimization Supported by Deep Machine Learning and Cloud Based Data Aggregation*. *PROCEEDINGS*, 46th Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, February 15-17, 2021 SGP-TR-218.
- Carbonari, R.**, Di Maio, R., & Piegari, E. (2019). *Feasibility to use continuous magnetotelluric observations for monitoring hydrothermal activity. Numerical modeling applied to Campi Flegrei volcanic system (southern Italy)*. *Frontiers in Earth Science*, 7, 262.
- Di Maio, R., Piegari, E., Rani, P., **Carbonari, R.**, Vitagliano, E., & Milano, L. (2019). *Quantitative interpretation of multiple self-potential anomaly sources by a global optimization approach*. *Journal of Applied Geophysics*.

- Piegari, E., Di Maio, R., **Carbonari, R.**, & Scandone, R. (2019). *Simulations of the emptying of a closed chamber by magma ascent dynamics based on self-organized fracture mechanisms*. Journal of Volcanology and Geothermal Research, 369, 113-120.
- Carbonari, R.**, Di Maio, R., Piegari, E., D'Auria, L., Esposito, A., & Petrillo, Z. (2018). *Filtering of noisy magnetotelluric signals by SOM neural networks*. Physics of the Earth and Planetary Interiors, 285, 12-22.
- Carbonari, R.**, D'Auria, L., Di Maio, R., & Petrillo, Z. (2017a). *SOM Clustering Analysis in the Discrete Wavelet Transform Domain for Filtering Noisy Magnetotelluric Data*. Proceedings of 79th EAGE Conference & Exhibition 2017, Paris, 12 - 15 June 2017, Session: Electromagnetics - Acquisition and Processing, Extended Abstract, 5 pp., doi:10.3997/2214-4609.201700564.
- Carbonari, R.**, D'Auria, L., Di Maio, R., & Petrillo, Z. (2017b). *Denoising of magnetotelluric signals by polarization analysis in the discrete wavelet domain*. Computers & Geosciences, 100, 135-141.
- Carbonari, R.**, Di Maio, R., D'Auria, L., & Petrillo, Z. (2016). *Denoising of magnetotelluric data by polarization analysis in the discrete wavelet transform domain*. SEG Technical Program Expanded Abstracts, 2016, 1034-1038, doi:10.1190/segam2016-13709906.1, 16-21 October 2016, Dallas (USA).

Talks (national and international meetings)

- Carbonari, R.**, Di Maio, R., Riccardi, U., De Martino, P., Cecere, G. (2023): GNSS Time-series Denoising and Prediction through a Combined Use of Wavelet and Deep Learning. Testing on data-series from Campi Flegrei, XXVIII General Assembly of the International Union of Geodesy and Geophysics (IUGG) (Berlin 2023). <https://doi.org/10.57757/IUGG23-3058>
- Carbonari, R.**, Emmanuel, S. *Automated Rock Image Analysis Through Machine Learning: A Tool for Carbon Sequestration*. AGU Fall Meeting 2022, Chicago, 12-16 December 2022.
- Carbonari, R.**, Riccardi, U., De Martino, P., Cecere, G., Di Maio, R. *Wavelet Denoising of GNSS Time Series Through Machine Learning. Application to the Campi Flegrei Caldera*. AGU Fall Meeting 2022, Chicago, 12-16 December 2022.
- Carbonari, R.**, Ton, D., Bonneville, A., Bour, D., Cladouhos, T., Garrison, G., Horne, R., Petty, S., Rallo, R., Schultz, A., Sørli, C.F., Thorbjörnsson, I., Uddenberg, M., Weydt, L. *First Year Report of EDGE Project: an International Research Coordination Network for Geothermal Drilling Optimization Supported by Deep Machine Learning and Cloud Based Data Aggregation*. Stanford Geothermal Workshop (46th), 16-18 February 2021.
- Carbonari, R.**, Di Maio, R., Piegari, E., D'Auria, L., Esposito, A., Petrillo, Z. *Improving magnetotelluric impedance tensor estimates by self-organizing maps*. Proceedings of XXXVII Convegno del GNGTS, Bologna (Italy), 19-21 November 2018, 185-189.
- Piegari E., Di Maio R., **Carbonari R.**, Vitagliano E., Milano L. *An innovative global optimization algorithm for identifying the source parameters of potential fields. Application to multiple self-potential anomalies*. Proceedings of XXXVII Convegno del GNGTS, Bologna (Italy), 19-21 November 2018, 211-214.
- Carbonari, R.**, Di Maio, R., & Piegari, E. *Monitoring volcano-hydrothermal systems by continuous magnetotelluric observations: a synthetic study on the Campi Flegrei area (Southern Italy)*. Cities on Volcanoes 10, 2018, Naples, 2 - 7 September 2018.
- Carbonari, R.**, Di Maio, R., & Petrillo, Z. *A novel approach for monitoring hydrothermal systems by continuous magnetotelluric observations*. EGU General Assembly 2018, Vienna, 8 - 13 April 2018.
- Schultz, A., Bennington, N. L., Bowles-Martinez, E., Imamura, N., Cronin, R. A., Miller, D. J., Hart, L., Gurrola, R. M., Neal, B. A., Scholz, K., Fry, B., & **Carbonari, R.** *Controls on Magmatic and Hydrothermal Processes at Yellowstone Supervolcano: The Wideband Magnetotelluric Component of an Integrated MT/Seismic*

Investigation. AGU Fall Meeting 2017, New Orleans, 11-15 December 2017.

Carbonari, R., D'Auria, L., Di Maio, R., & Petrillo, Z. *SOM Clustering Analysis in the Discrete Wavelet Transform Domain for Filtering Noisy Magnetotelluric Data*. 79th EAGE Conference and Exhibition 2017, Paris, 12 – 15 June 2017.

Carbonari, R., Di Maio, R., D'Auria, L., & Petrillo, Z. *Denoising of magnetotelluric data by polarization analysis in the discrete wavelet transform domain*. SEG Annual meeting 2016, Dallas, 16 – 21 October 2016.

Carbonari, R., D'Auria, L., Di Maio, R., & Petrillo, Z. *Magnetotellurics as a multiscale geophysical exploration method*. EGU General Assembly 2016, Vienna, 17 - 22 April 2016.

Carbonari, R., D'Auria, L., Di Maio, R., & Petrillo, Z. *Sviluppo di tecniche di denoising di dati magnetotellurici*. XXXIV Convegno del GNGTS, Trieste (Italy), 17-19 November 2015, 185-189.

Date: 11/02/2024