europass

Federica Fuso

WORK EXPERIENCE

[01/06/2024 – Current] **Research Fellow**

Università degli studi di Roma La Sapienza

City: Rome | **Country:** Italy

Design, implementation, and adjustment of mixed GNSS/Total Station survey networks aimed at the georeferencing of the vertices of the new Italian gravimetric network.

[31/10/2021 – Current] **PhD in Data Science**

Università degli studi di Roma La Sapienza

City: Rome | **Country:** Italy

This research aims to extend the study of tsunami detection and forecasting based on ionospheric sounding, using all the available data in real time coming from Global Navigation Satellite Systems (GNSS) and radio occultation satellites, also including social media data.

[02/2023 – 08/2023] **PhD in Data Science - Abroad period**

ETH Zurich

City: Zurich | **Country:** Switzerland

The research at ETH Zurich, supported by the Ermenegildo Zegna scholarship, expanded my investigations, integrating Machine Learning methodologies to detect tsunamis through the analysis of ionospheric Total Electron Content (TEC) data.

[01/2022 – Current] **Superior School of Advanced Studies (SSAS) PhD**

Università degli studi di Roma La Sapienza

City: Roma | **Country:** Italy

SSAS offers students enrolled in Sapienza a complementary course of high qualification, based on courses and activities of a disciplinary and interdisciplinary nature. The school promotes excellence in research and education, aiming to cultivate talents and develop the student's skills and potential.

EDUCATION AND TRAINING

[2022] **Entitled to the Profession of Civil and Environmental Engineer (Section A)**

Università degli studi di Roma La Sapienza

[02/2023 – 08/2023] **Winner of Ermenegildo Zegna scholarship**

Fondazione Zegna https://www.fondazionezegna.org/scholarship/

City: Valdilana (BI) | **Country:** Italy |

[08/2019 – 10/2021] **Master of Science in Environmental Engineering**

Università degli studi di Roma La Sapienza, Italy https://corsidilaurea.uniroma1.it/it/corso/2021/31286/home

City: Rome | **Country:** Italy | **Field(s) of study:** Environmental engineering | **Final grade:** 110/110 con lode | **Thesis:** Forni Glacier volume change monitoring from UAV observations

Field of specialization: Environmental Protection

The course is designed to provide skills on characterization and remediation of contaminated sites, water and waste treatment, environmental impact study and risk analysis, modeling of the fate of pollutants in natural environments, fluid mechanics and environmental modeling and geophysics for environmental monitoring.

[12/2020 – 10/2021] **Path of Excellence**

Università degli studi di Roma La Sapienza

City: Rome | **Country:** Italy |

[08/2020 – 02/2021] **Winner of Erasmus Project**

Università degli studi di Roma La Sapienza

Destination: Seville, Spain

[06/2021 – 09/2021] **Winner of Scholarship for Abroad Thesis**

Fondazione Roma Sapienza

City: Rome | **Country:** Italy |

[08/2016 – 11/2019] **Bachelor's Degree in Environmental Engineering**

Università degli studi di Roma La Sapienza https://corsidilaurea.uniroma1.it/it/corso/2019/29904/home

City: Rome | **Country:** Italy | **Field(s) of study:** Environmetnal engineering | **Final grade:** 110/110 con lode | **Thesis:** Analisi dei parametri di scavo e di condizionamento monitorati durante la realizzazione di una linea metropolitana mediante TBM-EPB

First year: dedicated to general basic training (mathematical analysis, geometry, physics, chemistry, computerized representation of the territory, foreign language);

Second year: dedicated both to the completion of the general basic training (physics, calculation of probability and statistics, numerical calculation and programming, mechanics of the continuous) both to the engineering training in environmental and territorial issues and transport (fluid mechanics, geology, sustainable development and land engineering, locomotion mechanics);

Third year: dedicated to the completion of engineering training in environmental issues and territorial, with particular regard to the areas of soil protection, eco-compatible management of natural and anthropic resources and sustainable land use, interventions and processes of prevention and control of pollution phenomena, planning and management of systems of transport (energy, geotechnics, hydrology, natural resources, health and environmental engineering, fundamentals of surveying and georeferencing of spatial information, transport technology).

[08/2011 – 07/2016] **High School Diploma (Scientific Studies)**

Liceo Scientifico Statale Gaetano De Sanctis

City: Rome | **Country:** Italy |

LANGUAGE SKILLS

Mother tongue(s): Italian

Other language(s):

English

LISTENING C1 **READING** C1 **WRITING** C1

SPOKEN PRODUCTION B2 **SPOKEN INTERACTION** B2

Spanish

LISTENING B1 **READING** A2 **WRITING** A2

SPOKEN PRODUCTION A2 **SPOKEN INTERACTION** A2

Levels: A1 and A2: Basic user; B1 and B2: Independent user; C1 and C2: Proficient user

DIGITAL SKILLS

My Digital Skills

Python Programming | MATLAB Programming | Machine Learning Algorithms | Microsoft Office User | Team-work oriented | Responsibility | Decision-making | Organizational and planning skills | Written and Verbal skills | Problem-solving | Ability to Work Under Pressure | Efficient multi-tasking

PUBLICATIONS

[2024] **Machine learning-based detection of TEC signatures related to earthquakes and tsunamis: the 2015 Illapel case study**

Reference: F Fuso, L Crocetti, M Ravanelli, B Soja (submitted: 10/2023, minor review: 03/2024), GPS solutions

Earthquakes and tsunamis can trigger acoustic and gravity waves (AGWs) that could reach the ionosphere, generating electron density disturbances, known as Travelling Ionospheric Disturbances (TIDs). These perturbations can be investigated as variations in ionospheric Total Electron Content (TEC) estimated through Global Navigation Satellite Systems (GNSS) receivers. The VARION (Variometric Approach for Real-Time Ionosphere Observation) algorithm is a well-known real-time tool for estimating TEC variations. In this context, the high amount of data allows the exploration of a VARION-based machine learning classification approach for TEC perturbation detection. For this purpose, we analyzed the 2015 Illapel earthquake and tsunami for its strength and high impact on both humans and the environment. We use the VARION-generated core observations (i.e., dsTEC/dt) provided by 115 GNSS stations as input features for the machine learning algorithms, namely Random Forest and XGBoost. We manually label time frames of TEC perturbations as the target variable. We consider two elevation cut-off time series, namely 15° and 25°, to which we apply the classifier. XGBoost with a 15° elevation cut-off dsTEC/dt time series reaches the best performance, achieving an F1 score of 0.77, recall of 0.74, and precision of 0.80 on the test data. Furthermore, XGBoost presents an average difference between the labeled and predicted middle epochs of TEC perturbation of 75 seconds. It can be easily integrated into a real-time early warning system and presents a low computational time. Finally, the model could be seamlessy integrated into a real-time early warning system, due to its low computational time. This work demonstrates high-probability TEC signature detection by machine learning for earthquakes and tsunamis, that can be used to enhance tsunami early warning systems.

[2024] **Probing the ionospheric effects of the 2020 Aegean Sea earthquake: leveraging GNSS observations for tsunami early warning in the Mediterranean**

Reference: F Fuso, M Ravanelli (review: 07/2024), Journal of Geophysical Research: Space Physics

On October 30th, 2020, a Mw 7.0 earthquake occurred in the eastern Aegean Sea area north of Samos island (Greece), causing tsunami waves up to 3m. In this work, we analyze Global Navigation Satellite System (GNSS) observations to investigate the induced ionospheric perturbation in total electron content (TEC) estimates. We observe TEC variations (up to 0.3 TECU), linked to the propagation of the internal gravity waves (IGWs) caused by the small tsunami. Comparison between IGWs arrival times in the ionosphere and the tsunami wave arrival at tide gauges reveals that the optimal observation geometries of ionospheric TEC detected the tsunami's arrival before it reached Kos and Hraklreio coastlines. We show that TEC variations, though slight, can be used to complement existing tsunami early warning systems, particularly in the Mediterranean region where such phenomena are not deeply investigated. Integrating TEC data alongside traditional seismic sensors and sea level measurements can ensure a more robust early warning system capable of detecting and mitigating the effects of also small but impactful tsunamis.