TELESPAZIO
a LEONARDO and THALES company

Telespazio Thesis & Internship Topics

2024 Q1





Katwijk, NL | Transinne, BE

2024/02/21

Thesis and internship topics overview

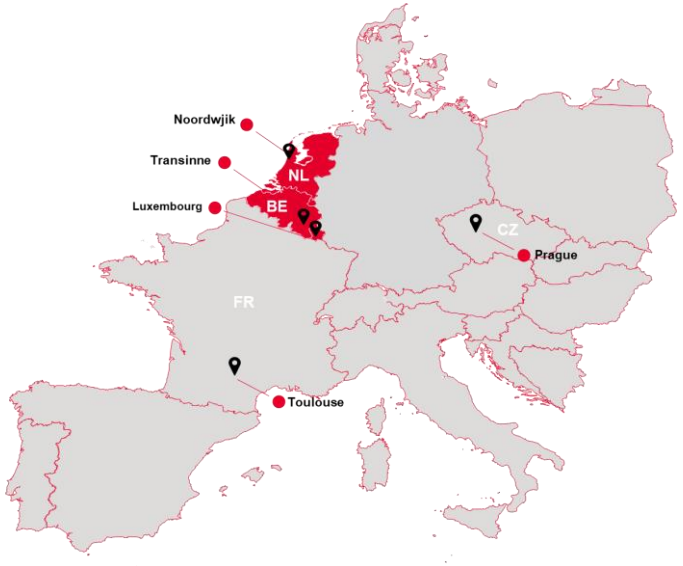
SSO[1]	Geo-Information	SATCOM[2]	MISC
Space Missions modelling and simulation	GNSS Reflectometry Validation	Coming soon	FPGA implementation of interference mitigation algorithms
ML techniques for GNSS spoofing detection	Use of mega constellation for Earth Observation through signal of opportunity		
Satcom as a redundancy link or back-up solution in case of cyberattacks on critical terrestrial infrastructure and services	Quantum Computing logic performances for EO data processing		
Data augmentation applied on multistep-ahead timeseries predictions	Soil Organic Carbon (SOC) monitoring through hyperspectral imaging *NEW!*		
Coming soon	Coming soon		

Other ideas?
Contact us!

 1) SSO: Satellite Systems and Operation | 2) SATCOM: Satellite Communication

We are Telespazio Belgium!

- European leader and a major world actor in **Satellite Space Service and Solutions**
- Subsidiary of Telespazio S.p.A for **BeNeLux**
- More than **4 decades** of expertise
- Providing added value, accessible and cutting-edge services and solutions **bringing Space closer to People**



+200
EMPLOYEES

~56M €
2023 REVENUE

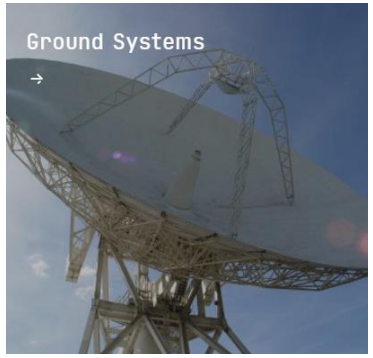
40+
YEARS OF EXPERIENCE

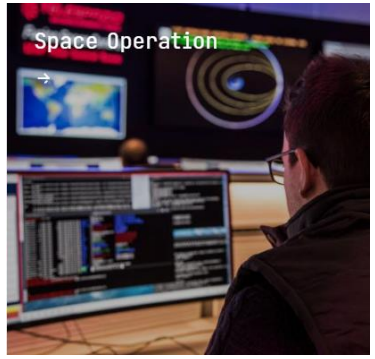
+18
NATIONALITIES

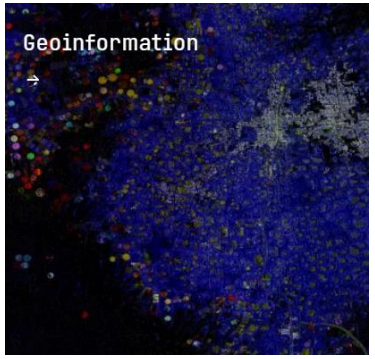
30
% of women in the company

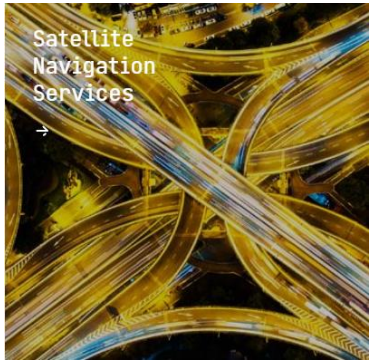
Telespazio Areas of Business

Areas of business









GNSS Ground Systems Deployment & Operations

Space Systems Engineering & Consulting

Secure RF Infrastructure Development

Integrated Downstream Applications

Embedded Systems Design & Implementation

Areas of expertise

Topics

01 SSO

02 Geo-Information

03 SATCOM

04 MISC

Click

Space Missions Modelling and Simulation

TPZB-ITG-RD-INT-23-0006

Description

In the scope of the model based systems engineering approach, software tools could be exploited to provide a quick way to validate a design choice.
One example of such a study is to develop a tool to simulate the network topology of a generic satellite constellation with an inter-satellite link (space to space communication) function enabled. This simulation should also emulate the ground stations as nodes in the topology. Furthermore, the granularity and the level of details could involve simulating each individual packets, including details of the protocol scheme.
Other areas of simulation and modelling could also be addressed, for example data dissemination for telemetry, tracking and control.

Outputs

- The expected outcome of the activity is to produce software tools for simulating and verifying space missions scenarios. In the example given above, a piece of software should be produced that has configurable parameters for inputs(number of satellites, number of ground hubs, etc.) and is able to simulate the behavior of the system(network topology, bandwidth limitations, packet forwarding etc.).

Requirements

- Solid programming background, desirable experience with Matlab, C++, but other language backgrounds are welcome
- General awareness and/or passion of space missions and exploration

Supervisor(s)

D. Dimitrov

Internship

Level

BSc/MSc

Location

NL/BE

Line of Business

- SSO

Domain

- PNT Infrastructures and Solutions

Themes

- System Engineering Tools

ML techniques for GNSS spoofing detection

TPZB-ITG-RD-INT-23-0008

Description

Location-based services require reliable, continuous and precise navigation, positioning and timing information for their successful operation in the market.
GNSS receivers are very sensitive and vulnerable to deliberate interference, which opens the door for attackers who want to compromise a GNSS-based system or infrastructure causing serious impacts. Deliberately attacks on GNSS receivers might act at two different categories: physical attacks on the receiver (nonsignal attacks) or attacks at the GNSS signal-in-space (SIS) level (signal attacks). The focus of this work is on spoofing, which is the transmission of forged GNSS-like signals, with the purpose to produce a false position at the victim's receiver without disrupting GNSS operations, effectively taking control of the receiver. The aim of this work is to:

- Review the state of the art of ML-based spoofing detection techniques
- Select a promising algorithm, implement it and test its performances
- Propose and possibly implement alternative techniques to improve the detection performances.

Outputs

- The expected outcome is a prototype of a spoofing detection algorithm, developed either in Matlab or in Python, together with a test signal generation.
- The algorithm has to be tested against different signal parameters (relative shift in phase/frequency, power etc.) to benchmark the performances.

Requirements

- Understanding of ML techniques applied to DSP
- Background in navigation and GNSS signal processing
- ability to work with Matlab/python

Supervisor(s)

B. Özkaptan

Internship

Level

MSc

Location

NL/BE

Line of Business

- SSO

Domain

- PNT Infrastructures and Solutions

Themes

- PNT Resilience and Security

Satcom as a redundancy link or back-up solution in case of cyberattack on critical terrestrial infrastructure and services

TPZB-ITG-RD-INT-23-0010

Description

Attacks that impact critical terrestrial infrastructures can lead to real-world consequences such us energy outages, flight delays, impact on physical operations. Currently, the number of attacks and the number of affected sites is increasing at a rate of 10x every 2.5 years, which lead to consider alternative (i.e., satellite redundancy links) or back-up solutions in order to ensure que availability of the services. Satellite-based NTN serves as a crucial backup communication when terrestrial networks have been damaged or overwhelmed. In addition, it can be also useful to assess the impact of the terrestrial attack given a satellite redundancy link.

The aim of this activity is to:

- Assess the state of the art of current cyberattacks that affect terrestrial infrastructures and services,
- Design a space system based on MBSE that could enhance the security of sensitive data transmission and storage or provide back-up connectivity in case of terrestrial cyber attacks
- Assess the feasibility, cost, and operation of the proposed system, including the security of the system.

Outputs

- State of the art, preliminary feasibility, and security-by-design processes.

Requirements

- Systems Engineering
- Satellite Communications
- Communication security
- MBSE Tools (e.g. Capella)

Supervisor(s)
E. Mendez

Thesis

Level
BSc/MSc

Location
NL/BE

Line of Business
- SSO

Domain
- PNT Infrastructures and Solutions

Themes
- PNT Resilience and Security

Data augmentation applied on multistep-ahead timeseries predictions

TPZB-ITG-RD-INT-23-0009

Description

Data augmentation is a set of tools and techniques to increase the number of available data. This includes the generation of new data close to the original dataset. The generated data can be synthetics or modified copies of the original dataset. Data augmentation techniques often take place when the available data are scarse and/or with missing values. These issues have significant impacts on the efficiency of deep learning algorithms. Augment the data is therefore crucial when the data are time-related (time-series). In the context of satellite ground station monitoring, the aims of this works are: - literature review of the state of the art data augmentation techniques – test several algorithms and strategies on real data – select the most efficient one and possibly study its integration on a existing time series prediction framework

Outputs

- The expected outcomes are an evaluation of the efficiency of multiple data augmentation algorithms, a set of implemented (in Python) and validated data augmentation algorithms ready to be used on real data.

Requirements

- Ability to work in Python and its scientific libraries (ex: scikit-learn), Underesting ML and its frameworks (Tensorflow or PyTorch), background with time-related data

Supervisor(s)

A. Hubermont

Thesis & Internship

Level

BSc/MSc/PHD

Location

NL/BE

Line of Business

- SSO

Domain

- Moon Exploration and Space Logistics

Themes

- Predictive Maintenance

Topics

01 SSO

02 **Geo-Information**

03 SATCOM

04 MISC

GNSS Reflectometry Validation

TPZB-ITG-RD-2024-GNSSR_Validation

Description

GNSS reflectometry aims at inferring soil properties from the reflections of GNSS signals. Recently, [1] has shown that GNSS receivers on cheap devices such as smartphones are good enough to extract useful information. Specifically, a correlation was found between soil features and the difference between direct and reflected C/N0. On the other hand, Software Defined Radios (SDRs) offer a readily available solution to experiment with, and software GNSS receivers leverage a general purpose computation platform into a full-fledged PNT system. The aim of this study is two-fold: 1. Reproduce the results of [1] with our in-house GNSS-R SDR system; 2. Research, propose and experimentally validate new metrics which can deliver insights on the soil obtained from GNSS signals.

Outputs

- Study report / master thesis on the findings

Requirements

- The student should be familiar with satellite systems (GNSS), basic telecommunication principles and radio propagation phenomena.

Supervisor(s)

J. Crespo, F. Iodice

Internship

Level

MSc

Location

NL

Line of Business

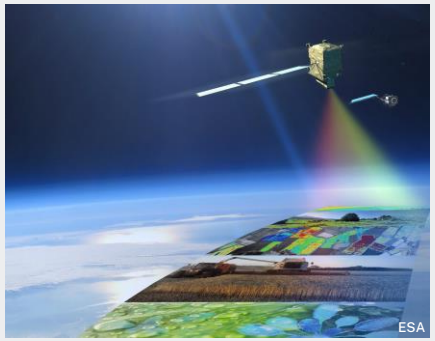
- Geo-Information

Domain

- Earth modelling

Themes

- Telecommunications Engineering
- Signal Processing



Use of megaconstellation for Earth Observation through signal of opportunity

TPZB-ITG-RD-INT-23-0001

Description

Recent years have seen the dramatic increase of small satellites, remarkably for telecommunications, organised in huge formations named mega-constellation. These new systems constituted by thousands of satellites in LEO guarantee low-latency high throughput satellite communication and a global coverage. As a side effect, they provide a global coverage of signals that can be used as signal-of-opportunity for Earth Observation. The thesis will:

- Analyze the currently deployed or under-deployment mega-constellations (Starlink, OneWeb, ...), especially their frequency characteristics
- Assess the potential use for Earth Observation in a bi-static radar configuration
- Evaluate (mathematically and/or through simulation) the potential results for a selected application (e.g. retrieval of soil moisture).

Outputs

- Feasibility analysis
- Trade-off analysis

Requirements

- Remote Sensing
- Signal Processing
- Electromagnetic scattering from surfaces
- Simulations

Supervisor(s)

F. Iodice

Thesis

Level

BSc/MSc

Location

NL

Line of Business

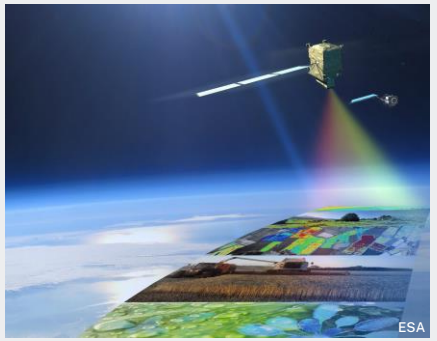
- Geo-Information

Domain

- Digital Twin

Themes

- EO through signal or opportunity



Quantum Computing logic performances for EO data processing

TPZB-ITG-RD-INT-23-0003

Description

Quantum computers have a very high potential of delivering high performances in AI usage. The use of quantum computers in EO data processing might allow faster processing times and a reduction of power consumption. However, a change in the approach to EO data processing might be required.
The purpose of the thesis is to:

- Survey the state of the art of quantum computers architectures and logics
- Choose a study case (an application of a defined sensor's data that requires ML techniques)
- Develop the ML algorithm in quantum logic in order to obtain the same results with comparable accuracy
- Perform a benchmarking to compare QC performances with other architectures (server farm, HPC, edge computing...), using a simulator when appropriate
- Comment the results to establish a list of pros and cons to the use of QC for the specific use case.

Outputs

- State of art report
- ML algorithm
- Performances comparison

Requirements

- The student must be familiar with EO data processing and machine learning techniques, and a good understanding of computer science.
- The student shall have access to a quantum computer simulator

Supervisor(s)

F. Iodice

Thesis & Internship

Level

MSc/PHD

Location

NL/BE

Line of Business

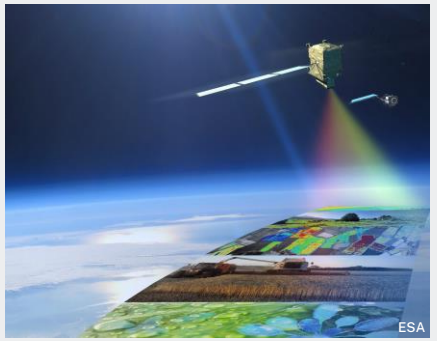
- Geo-Information

Domain

- Earth Modelling

Themes

- Use of QC for EO data processing



Soil Organic Carbon (SOC) monitoring through hyperspectral imaging

TPZB-ITG-RD-INT-24-0001

Description

The aim of this project is to use hyperspectral data acquired from drones and satellites to monitor the soil organic carbon (SOC) content in agricultural fields. This will provide valuable information to farmers and land managers to help optimize soil management practices and improve crop productivity.

The hyperspectral data will provide a detailed spectral signature of the soil and vegetation cover in the agricultural fields. The calibrated hyperspectral data will be used to derive various vegetation indices such as the normalized difference vegetation index (NDVI) and the soil-adjusted vegetation index (SAVI) to estimate vegetation cover and biomass. The hyperspectral data will also be analyzed to identify spectral features that are sensitive to SOC content. This will involve comparing the spectral signature of soils with known SOC content to identify spectral regions that show the strongest correlation with SOC.

Outputs

- Study report / master thesis on the findings, specifically:
  - Correlations between hyperspectral bands and biophysical soil aspects
  - Six-monthly map of SOC trends (in an agricultural area with non-permanent terrains)

Requirements

- The student must be familiar with EO data processing techniques and have a good understanding of computer science
- The student shall experience with remote sensing
- Previous experience with hyperspectral data is a plus

Supervisor(s)
F. Iodice

Thesis & Internship

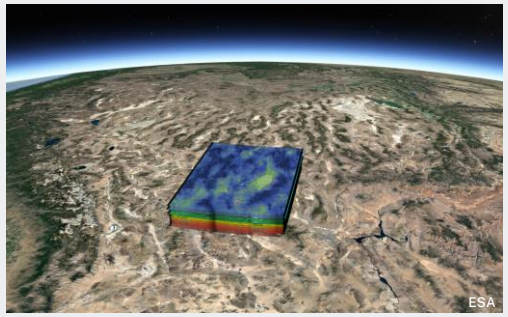
Level
MSc

Location
NL/BE

Line of Business
- Geo-Information

Domain
- Earth Modelling

Themes
- EO through hyperspectral imaging



Topics

01 SSO

02 Geo-Information

03 **SATCOM**

04 MISC

Topics

01 SSO

02 Geo-Information

03 SATCOM

04 **MISC**

FPGA implementation of interference mitigation algorithms

TPZB-ITG-RD-2024-FPGA_Mitigation_Algorithms

Description

Anti-jamming algorithms are crucial in safety-critical GNSS applications. These try and enhance a jammed GNSS signal, so that reception remains largely uncompromised in challenging conditions. Telespazio has developed a prototype of an interference detection and mitigation scheme, that classifies interferences and applies a suitable anti-jamming algorithm. Implemented algorithms include an adaptive (LMS) filter, and transform-based (STFT, Wavelet, time-domain) processing. This study is the evolution of the mentioned prototype, where porting of the algorithms onto an FPGA platform is envisioned. The student will have a Zynq7000 with AD9364 SDR development platform at his/her disposal for the implementation.

Outputs

- Implementation of mitigation algorithms on FPGA, and report

Requirements

- The student should be familiar with signal processing algorithms and experienced with hardware (FPGA) development.

Supervisor(s)

J. Crespo, T. Bouilloc, B. Ozkaptan

Internship

Level

MSc

Location

NL/BE

Line of Business

- MISC

Domain

- Secure Communications
- PNT Infrastructures and Solutions

Themes

- Electronics Engineering
- Signal Processing

TELESPAZIO
a LEONARDO and THALES company

Questions?
Other ideas?

telespazio.com

Matteo Manieri

Open Innovation
Innovation & Technology Governance

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