Master 2 project: GNSS Interference detection and characterization through Machine Learning/Deep Learning approach

Place: in the offices of University Gustave Eiffel, Campus de Lille, in Villeneuve d'Ascq (North of France).
Duration : 5 or 6 months.

Intelligent mobility is the growing trend in next-generation transportation systems. It aims to bring more autonomy, connectivity and coordination to improve road mobility. These services would certainly need high-level performance requirements to ensure accuracy, availability, precision and safety at the position level. Global Navigation Satellite System (GNSS) is considered a key enabler to reach the positioning performance requirements. However, the satellite signals are vulnerable to several disturbances (threats) as they become very weak due to the large travel distance between the satellites and the receiver. One of the major threats to GNSS receivers is radio frequency interference from man-made devices. They are mainly classified as non-intentional or intentional interference also known as jamming. The jamming signal impacts significantly on the receiver functionality at the acquisition, tracking and navigation level. In such a situation, the role of interference mitigation strategy becomes very crucial to counter disturbances induced by malicious signals. However, devising any mitigation strategy requires a better understanding of interference signal characteristics, in particular . A proper interference signal characterization (bandwidth, sweeping rate, sweeping period etc.) would allow tuning of the mitigation filter to achieve optimal performance. [Qin et al., 2020] discussed ANF parameter selection and disclosed that inappropriate ANF filter parameters could have an adverse impact more than the interference itself.

In this internship, we would like to address automated/optimal parameter selection aided by machine learning techniques for the mitigation filters (e.g. ANF). We have all the necessary tools at our disposal in the laboratory to conduct this work. This includes a GNSS simulator with additional interference capabilities (Stella HIL-ITF), a Record and Playback system (Stella RP) to record and replay the signal in the lab, a customized jammer with the capabilities of transmitting several kinds of interference signals (monotone AM, chirp, frequency hopping, pulse and others). This is the complementary work for the Ph.D. topic ***Identification and mitigation of GNSS interferences in a multi-sensor localization system*** currently under progress (in 3rd year) in the framework of a national project LOCSP. In this context, any contributive outcome would be highly encouraged for a scientific publication.

Don't wait any further and reach out to us in case this internship call catches your intention and you are eager to learn and explore the scientific world (ecosystem)!
We will be happy to have you onboard our research group.

Requirements

The candidate must be in a master 2 degree. This work would require some knowledge of machine learning techniques (SVM, CNN, KNN and others), digital signal processing and filtering techniques. Moreover, some programming skills in either Matlab or Python would be very beneficial. English is expected for scientific exchanges with the PhD associated.

References and additional ressources

You will find some recommended articles related to this topic that would give you an insight view of this work. You are free to include other sources that you find interesting and can help for a better understanding of the topic.

Ferre, R. M., Fuente, A. D. La, & Lohan, E. S. (2019). Jammer classification in GNSS bands via machine learning algorithms. *Sensors (Switzerland)*, *19*(22). https://doi.org/10.3390/s19224841

Mehr, I. E., & Dovis, F. (2022). Detection and Classification of GNSS Jammers Using Convolutional Neural Networks. *2022 International Conference on Localization and GNSS, ICL-GNSS 2022 - Proceedings*. https://doi.org/10.1109/ICL-GNSS54081.2022.9797030

Qin, W., & Dovis, F. (2022). Situational Awareness of Chirp Jamming Threats to GNSS Based on Supervised Machine Learning. *IEEE Transactions on Aerospace and Electronic Systems*, *58*(3), 1707–1720. https://doi.org/10.1109/TAES.2021.3135014

Qin, W., Gamba, M. T., Falletti, E., & Dovis, F. (2020). An Assessment of Impact of Adaptive Notch Filters for Interference Removal on the Signal Processing Stages of a GNSS Receiver. *IEEE Transactions on Aerospace and Electronic Systems*, *56*(5), 4067–4082. https://doi.org/10.1109/TAES.2020.2990148

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