# Metadata template for Training Actions (V1.0)

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| Collector: Angela Aragon-Angel  Revision Date: 25/09/2024  Version: v1.0 |
| Title  GNSS Data Processing: Theory & Practical Exercises |
| Subject  Global Navigation Satellite Systems (GNSS), Positioning, Navigation and Timing (PNT) |
| Description  A 3-day in-person professional training for upskilling and reskilling in GNSS Training includes lectures followed by practical sessions and workshops focusing on:   * The concepts and techniques used in the positioning by means of the GNSS. * Standard and Precise Point Positioning (SPP, PPP) with the focus on the instrumental use of the concepts and techniques of GNSS navigation, intended to include all the elements need to understand how the system works and how to work with it. * The processing algorithms implemented through guided exercises in laboratory sessions. * The different terms involved in modelling the pseudoranges (relativistic effects, atmospheric troposphere/ ionosphere and instrumental delays, clock synchronism, etc.), arise and navigation equations are solved by Least Squares estimation and by Kalman filtering.   The practical sessions are made with different programs designed specifically for the course to implement different processing modules.  Theoretical topics:   * Fundamentals of GNSS Positioning   + GNSS Architecture: segments   + GNSS Positioning Concept   + GNSS Signals and Applications * Overview of GNSS Positioning techniques   + GNSS Standalone positioning   + Code based differential positioning (DGNSS)   + Carrier based differential positioning (RTK, PPP) * Code Pseudorange Modelling   + Linear model and prefit-residuals   + Example of computation of modelled pseudorange. * Solving Navigation Equations   + Navigation equations system   + Predicted accuracy (DOP)   + Parameter estimation: Least Squares and Kalman Filter * Precise Point Positioning (PPP)   + Precise Satellite Orbits and Clocks   + Precise modelling for PPP   + Carrier phase ambiguities: Floating vs Fixing   + GNSS Data Processing: Theory & Practical Exercises   Practical lectures:   * GNSS Data Processing Laboratory Exercises: the gLAB tool suite * Model components Detailed Analysis * Solving Navigation Equations: Kinematic satellite LEO orbit estimation |
| Abstract  In this trainins action, the participant will be able to grasp the concepts and techniques used in the positioning by means of the GNSS. Specific emphasis will be made to Standard and Precise Point Positioning (SPP, PPP) techniques with the focus on the instrumental use of the, including all the elements needed to understand how the system works and how to work with it. The different terms involved in modelling the pseudoranges (relativistic effects, atmospheric troposphere/ ionosphere and instrumental delays, clock synchronism, etc.) will be individually analysed, deriving the navigation equations and solving them by means of the Least Squares estimation and by using Kalman filtering. |
| Learning Outcomes  After the training, the participant should be able to:   * Understands basic principles of GNSS (knowledge of terminology) * Execute commands using the gLAB software tool to infer characteristics of the GNSS signal being analysed * Differentiate between different error contributions to the received GNSS signal (knowledge of specific details and elements) * Be able to position using several techniques (knowledge of subject-specific skills and algorithms). |
| Target audience  Professionals working in GNSS and related fields of science and engineering. |
| Start / End dates  June 25th / June 27th, 2024. |
| Organizer  Universitat Politècnica de Catalunya. |
| Location  Universitat Politècnica de Catalunya, Campus Nord, Barcelona, Spain. |
| Language  English |
| Duration  25 hours |
| EQF level  EQF-4 |
| Delivery Mode  In-person. |
| Learning methodologies  Lectures, laboratory sessions, group discussion, problem-analysing activities, motivational speeches from reputed speakers |
| Structure  First day: 4 theoretical sessions followed by the introduction of the software package that will be used to analyse the GNSS data. In the first day, the theory has a heavy weight since fundamental grounds are needed to build positioning methods.  Second and third days: 2 theoretical sessions followed by 2 laboratory sessions. Each day, an invited speaker presents the international organization where he works, giving details of the technical work he does. Attendees are encouraged to ask questions and interact with them through social gatherings promoted by the training action. |
| Instructor(s)   * Jaume Sanz Subirana. Full Professor at the Department of Mathematics at the UPC in Barcelona, * Adrià Rovira García. Serra Hunter Associate professor with the Department of Physics at the Universitat Politecnica de Catalunya (Barcelona, Spain). * Miquel Garcia Fernadez. Co-founder and Chief Technology Officer of Rokubun. * Deimos Ibañez. Maintenance engineer at the Galileo Service Centre. * Matteo Paonni. Team Leader within the Directorate for Space, Security, and Migration with the Joint Research Centre of the European Commission, Ispra, Italy. * Dr. Raül Orús Pérez. Responsible for radio propagation aspects on ESA missions. |
| Workload  1 ECTS |
| Training Program  NA |
| Price  The participation is free of charge (coffee breaks and lunches are included). |
| Maximum number of participants  20 places available. |
| Prerequisites  Some mathematics background is required (Linear Algebra) |
| Registration process  The request for registration was handled from the official website of the SpaceSUITE project, specifically a devoted link could be opened from the GNSS training action announcement:  Apart from name and job title, it was requested to add a short bio (250 words), a motivation paragraph (250 words) and the expected outcome (250 words) from attending this course. |
| Contact information  Adrià Rovira-Garcia, adria.rovira@upc.edu |
| Type of assessment  Exercises were posed during the training action. It was required to be able to do them to continue with the GNSS data analysis. Students not able to follow such instructions, could always follow instructor’s computer screen displayed on the white board. |
| Certification  At present the participants have only received a certification of attendance to the training.  UPC is currently pursuing with the Government of Catalonia the potential assignment of microcrodentials to this training action to those participants over 25 years old (this is a specific requirement from the call by the Catalan government). |
| Title of the micro-credential  Pending (please check previous item). |
| Microcredential awarding body  Pending (please check two previus items). |
| Relation/s (BoK)  Position, Navigation and Timing (PNT), GNSS Signals, Global systems, Galileo, GPS, Beidou, Glonass, orbits, antennas, Frequencies, Messages, Codes and Modulations, High Accuracy Service (HAS) |
| BoK Links  NA |