Course guide
300284 - GNSS - Global Navigation Satellite Systems (Gnss) Data Processing

Last modified: 06/06/2024

Unit in charge: Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: MASTER'S DEGREE IN AERONAUTICAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN AEROSPACE SCIENCE AND TECHNOLOGY (Syllabus 2021). (Optional subject).

Academic year: 2024 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: Defined in the course webpage at the EETAC website.

Others: Defined in the course webpage at the EETAC website.

PRIOR SKILLS

Operativity with the concepts, magnitudes and basic laws of Physics preferably with some knowledge of astrodynamics.
Operationality with algebraic and statistical data functions.
Ability to perform application programs in Matlab / Octave or C # language or similar.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE3 MAST. (ENG) CE3: Aplicar los métodos numéricos para ingeniería aeroespacial con especial énfasis en sus aplicaciones, y en especial en la dinámica de fluidos.
CE3 MAST21. Carry out, present and publicly defend a research work carried out in a group, on a research topic in the aerospace field.

Generical:
CG2 MAST. Identify and apply the fundamental theoretical, experimental and numerical analyzes currently used in aerospace engineering.

Transversal:
CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Basic:
CB9. Students will be able to communicate their conclusions and the knowledge and ultimate reasons that support them to specialized and non-specialized audiences in a clear and unambiguous manner.
CB7. Students will be able to apply the acquired knowledge and their ability to solve problems in new or little explored environments in broader (or multidisciplinary) contexts related to their study area.
CB8. Students will be able to integrate knowledge and face the complexity of formulating judgments based on information that, while being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and opinions.
CB10. Students will acquire learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

TEACHING METHODOLOGY

The classes of the subject will be presential and expositive. Teaching material will be composed of PowerPoint presentations (which can be obtained from the first day) and links to pages and publications of special relevance. A devoted software, the GNSS-Lab Tool suite (gLAB), will be used in assisted laboratory group work supervised by the professors of the subject. Students will have to do a project of one selected topic of the subject, doing their exposition at the end of the course.

In particular, the formative activities applied during the course will be:
A01: Master classes (theory lectures)
A04: Assisted laboratory work (practical exercises)
A06: Project based learning

LEARNING OBJECTIVES OF THE SUBJECT

Theoretical-practical study of the different navigation algorithms for Global Navigation Satellite System System (GNSS) to provide the student with a rigorous knowledge about the GNSS data processing. It is promoted the adquisition of the instrumental use of concepts and techniques in GNSS-based navigation.

STUDY LOAD

Type	Hours	Percentage
Hours large group	45,0	36.00
Self study	80,0	64.00

Total learning time: 125 h

CONTENTS

Theory of Global Navigation Satellite System (GNSS) data processing

Description:
Lecture 0: Introduction
Lecture 1: GNSS measurements and their combinations
Lecture 2: Satellite orbits and clocks computation accuracy
Lecture 3: Position estimation with pseudoranges
Lecture 4: Introduction to DGNSS
Lecture 5: Precise positioning with carrier phase (PPP)
Lecture 6: Differential positioning with code pseudoranges
Lecture 7: Carrier based differential positioning. Ambiguity resolution techniques

Full-or-part-time: 22h 30m
Theory classes: 22h 30m

Laboratory exercises of Global Navigation Satellite System (GNSS) data processing

Description:
Tutorial 0: UNIX enviroment, tools and skills. GNSS standard file formats
Tutorial 1: GNSS data processing laboratory exercises
Tutorial 2: Measurement analysis and error budget
Tutorial 3: Differential positioning with code measurements
Tutorial 4: Differential positioning and carrier ambiguity fixing
Tutorial 5: Analysis of propagation effects from GNSS observables

Related competencies :
CB9. Students will be able to communicate their conclusions and the knowledge and ultimate reasons that support them to specialized and non-specialized audiences in a clear and unambiguous manner.
CB10. Students will acquire learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.
CB7. Students will be able to apply the acquired knowledge and their ability to solve problems in new or little explored environments in broader (or multidisciplinary) contexts related to their study area.
CE3 MAST15. (ENG) CE3: Aplicar los métodos numéricos para ingeniería aeroespacial con especial énfasis en sus aplicaciones, y en especial en la dinámica de fluidos.

Full-or-part-time: 22h 30m
Theory classes: 22h 30m

GRADING SYSTEM

Defined in the course webpage at the EETAC website.

EXAMINATION RULES.

All the evaluation activities proposed are mandatory. An exam, deliverable or project not presented will be scored with a zero note. The examinations will be carried out individually, the project will be carried out in group and the delivery of problems can be both group and individual. The writing exam is open book. Students can bring any material to the assessment except internet/communication devices.

BIBLIOGRAPHY

Basic:
- Sanz Subirana, Jaume; Juan Zornoza, J. Miguel; Hernández Pajares, Manuel. GNSS data processing. Noordwijk: ESA Publications Division, cop. 2013. ISBN 9789292218867.
- Misra, Pratap; Enge, Per. Global positioning system : signals, measurements, and performance. 2nd ed. Lincoln: Ganga-Jamuna, cop. 2006. ISBN 0970954417.
- Hofmann-Wellenhof, Bernhard; Lichtenegger, Herbert; Collins, James. Global positioning system : theory and practice. 4th ed. revised. Wien ; New York: Springer-Verlag, cop. 1997. ISBN 3211828397.

Complementary:
- Hernández Pajares, Manuel; Juan Zornoza, J. Miguel; Sanz Subirana, Jaume. GPS data processing : code and phase : algorithms, techniques and recipes [on line]. 1st ed. (English). Barcelona: Centre de Publicacions del Campus Nord, UPC, DL 2005 [Consultation: 17/04/2020]. Available on: https://gage.upc.edu/sites/default/files/TEACHING_MATERIAL/GPS_BOOK/ENGLISH/PDGPS/BOOK_PDGPS_gAGE_NAV_08.pdf. ISBN 8493223050.

RESOURCES

Audiovisual material:

- Course Slides (Theory & Laboratory). Course Slides (theory & laboratory)

Computer material:
- GNSS-Lab Tool (gLAB). An interactive educational multipurpose package to process and analyse GNSS data.

Other resources:
www.gage.upc.edu/tutorials