COURSE DETAILS

"GUIDANCE AND NAVIGATION"

SSD ING-IND/05 *

DEGREE PROGRAMME: AUTONOMOUS VEHICLE ENGINEERING

ACADEMIC YEAR 2022-2023

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: DOMENICO ACCARDO
PHONE: +39 081 768 2149
EMAIL: DOMENICO.ACCARDO@UNINA.IT

GENERAL INFORMATION ABOUT THE COURSE

YEAR OF THE DEGREE PROGRAMME: I
SEMESTER: II
CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

NONE

PREREQUISITES (IF APPLICABLE)

NONE

LEARNING GOALS

The course aims at providing students with basic/advanced notions related to the following topics:

- *Feasible and optimal discrete path planning*
- *Feasible and optimal differential path planning*
- *Geodesics*
- *Inertial Navigation Systems*
- *Auxiliary Navigation Systems*
- *Integrated Navigation Systems*

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The course is intended to provide the needed knowledge to design and develop efficient guidance and navigation solutions for autonomous vehicles. Guidance is the development of the mission plan, i.e. the 3D or 4D trajectory for the vehicle, depending on the type of transport systems. Guidance can be strategic or tactical depending whether it is realized before the mission is started or not. Navigation is the function that provides information about position, velocity, and orientation for the vehicle. It is accomplished by integrating measurement from different sources, such as sensors and receivers.

Applying knowledge and understanding

The student needs to manage advanced path planning and integrated navigation issues for autonomous vehicles.

COURSE CONTENT/SYLLABUS

- *Introduction.*
- *Definitions and principles.*
- *Reference terms for terrestrial navigation;*
- *System architecture of mission management for autonomous vehicles.*
- *Guidance*
    - *Requirements and constraint for mission planning;*
    - *Discrete path planning;*
    - *Differential path planning. Dubin's paths;*
    - *Geodesics;*
- *Navigation*
    - *Process sensors: inertial systems*
        - *Reference configurations for inertial navigation;*
        - *Advanced inertial sensors;*
        - *Coriolis gyros;*
        - *Fiber optic gyros;*
        - *MEMS inertial sensors;*
        - *Inertial Navigation Equations;*
        - *Error of Inertial Navigation;*
    - *Basic models of measurement sensors;*
    - *Satellite navigation;*
    - *Integrated navigation*
        - *Architecture of integrated navigation systems;*

- *Integrated navigation by Kalman Filtering*
- *Reference model;*
- *Application – GPS/INS integration*

READINGS/BIBLIOGRAPHY

Slides, lecture notes, technical papers. Textbooks:

Lavalle S.M., "Planning Algorithms", Cambridge University Press, Boston MA, USA, 2006.
Groves P.D., "Principles of GNSS, Inertial, and Multisensor Integrated Navigation Systems, Second Edition (GNSS Technology and Applications) 2nd Edition", Artech House, New York NY, USA, 2013.
Farrell J. and Barth M., "The Global Positioning System and Inertial Navigation", McGraw Hill, New York NY, USA, 1999
Savage P.G., Strapdown Analytics, Strapdown Associates Inc., Maple Plain MN, USA, 2000
Rogers R. M., "Applied Mathematics in Integrated Navigation Instruments", AIAA Press, Washington DC, USA, 2000
Titterton, D. H., "Strapdown Inertial Navigation Technology", Peter Peregrinus, New York NY, USA, 1996

TEACHING METHODS

Lectures (approx. 80 % of total hours), exercises (approx. 10 % of total hours), interactive/laboratory activities (approx. 10% of total hours)

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

*For **integrated courses**, there should be one exam.*

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to: (*)	**Multiple choice answers**	
	Open answers	X
	Numerical exercises	X

(*) multiple options are possible

b) Evaluation pattern:

The final grade is formulated by the Examination Committee according to the scores achieved by the student in the discussion of the final project work and of the oral questions. The final evaluation is discussed and highlighted to each student