

3D Perception

Academic Year: (2023 / 2024)

Review date: 28-07-2020

Department assigned to the subject: Systems Engineering and Automation Department

Coordinating teacher: CASTILLO MONTOYA, JOSE CARLOS

Type: Electives ECTS Credits : 3.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Programming (C, C++, Python, Matlab, etc.)

OBJECTIVES

The main goal of this course is to give the students an overview of the state-of-the-art sensors, techniques and applications for 3D perception related to robotics. The practical component will play a key role, where students will work with 3D point clouds, applying techniques that allow a robot to perceive its surrounding environment.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction
 - What is 3D perception?
 - Why is 3D perception useful in robotics?
2. Sensors in 3D perception in robotics
 - 3D laser scans
 - Stereo information
 - Time-of-flight sensors
 - Sensors based on infrared meshes (Kinect)
 - Acoustic 3D sensors (3D sonars)
3. Techniques for 3D point clouds processing
 - Filtering
 - Segmentation
 - Recognition
 - 3D reconstruction (environment mapping)
4. Robotic applications of 3D perception
 - Smart vehicles
 - Drones
 - Robotic arms
 - Human-Robot Interaction

LEARNING ACTIVITIES AND METHODOLOGY

Magistral classes, laboratory practical sessions, individual tutorials, and personal work from the students

ASSESSMENT SYSTEM

% end-of-term-examination:	70
% of continuous assessment (assignments, laboratory, practicals...):	30

The assessment system in this course will follow the continuous evaluation model, where participation in the classroom, laboratory performance and a final test for assessing the knowledge obtained will be combined.

% end-of-term-examination:	70
% of continuous assessment (assignments, laboratory, practicals...):	30

BASIC BIBLIOGRAPHY

- Geoffrey Taylor, Lindsay Kleeman Visual Perception and Robotic Manipulation: 3D Object Recognition, Tracking and Hand-Eye Coordination, Springer Tracts in Advanced Robotics, 2006
- Kanatani, Kenichi, Sugaya, Yasuyuki, Kanazawa, Yasush Guide to 3D Vision Computation. Geometric Analysis and Implementation, Springer , 2016
- Rudolph Triebel dimensional Perception for Mobile Robots: Concepts and Approaches for the Acquisition, Efficient Representation, and Semantic Interpretation of Three-dimensional Range Data for Mobile Robots , VDM Verlag, 2008

ADDITIONAL BIBLIOGRAPHY

- Apolloni, Bruno, et al. Machine learning and robot perception, Springer Science & Business Media, 2005
- Malik, Aamir Saeed Depth Map and 3D Imaging Applications: Algorithms and Technologies, IGI Global, 2011

BASIC ELECTRONIC RESOURCES

- . Sitio web oficial de Point Cloud Library: <http://pointclouds.org/>
- . What is 3D data capture? : <http://www.ucl.ac.uk/slade/know/wp-content/uploads/What-is-3D-Data-Capture1.pdf>