3D Perception

Academic Year: (2021 / 2022) **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

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 (assigments, 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 official 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