ROBÓTICA

4º Grado Ingeniería Informática

2º Cuatrimestre

Teoría y prácticas:

Alberto García

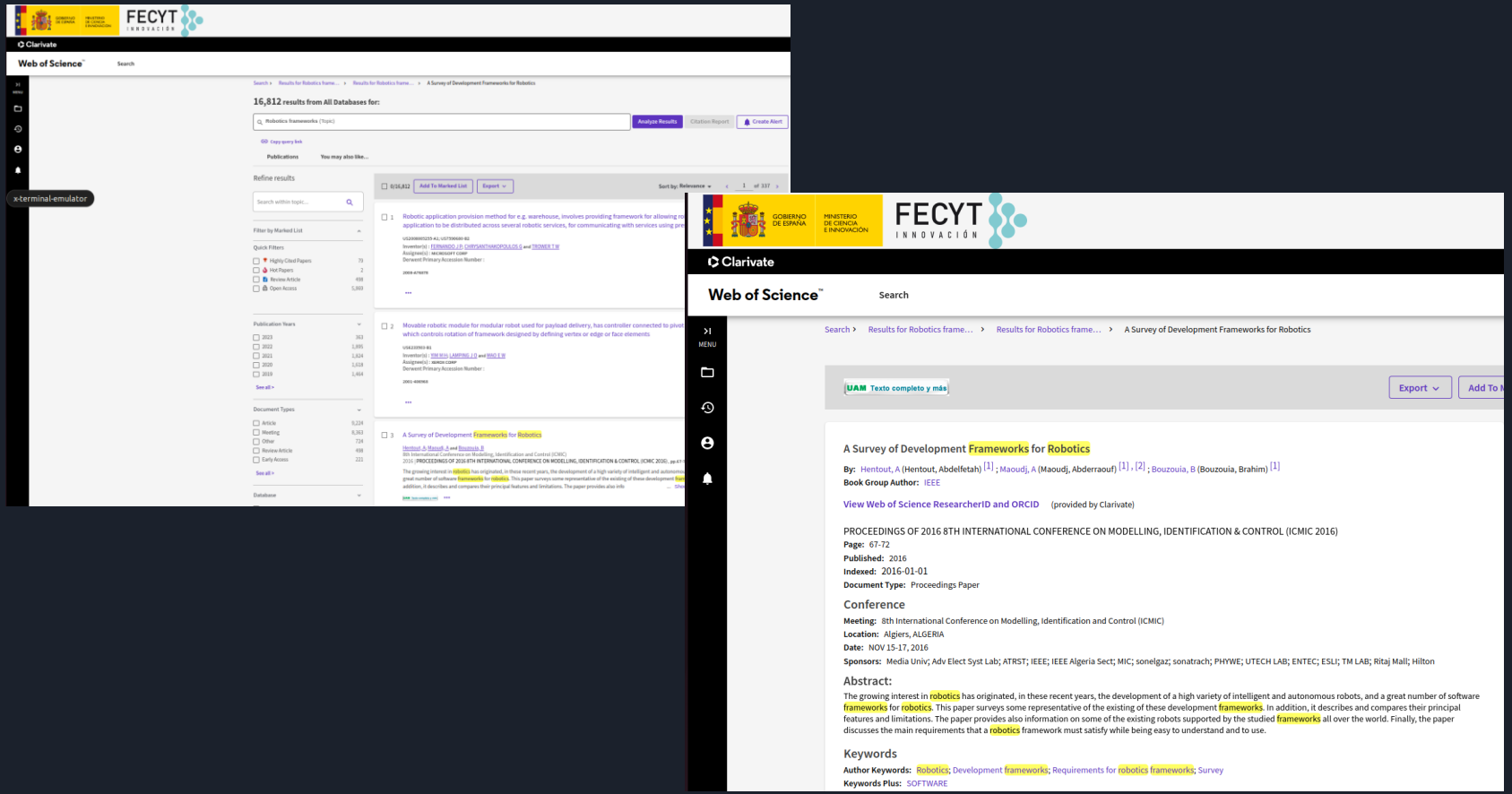
marianoa.garcia@uam.es

Escuela Politécnica Superior

¿De qué va la asignatura?

La asignatura está orientada a lo que los ingenieros informáticos deben saber para trabajar en robótica.

Diferentes plataformas de desarrollo



8th International Conference on Modelling, Identification and Control (ICMIC-2016)
Algiers, Algeria- November 15-17, 2016

A Survey of Development Frameworks for Robotics

Abdelfetah Hentout[1], Abderraouf Maoudj[2] and Brahim Bouzouia[3]
[1,2,3]Centre de Développement des Technologies Avancées (CDTA)
Division Productique et Robotique (DPR)
BP 17, Baba Hassen, Algiers 16303, Algeria
[2]University of Sciences and Technology Houari Boumediene (USTHB)
Laboratory of Robotics, Parallelism and Electro-energy (LRPE)
BP32 El Alia, Bab Ezzouar, Algiers 16111, Algeria
Email: [1]ahentout@cdta.dz, [2]amaoudj@cdta.dz, [3]bbouzouia@cdta.dz

***Abstract*—The growing interest in robotics has originated, in these recent years, the development of a high variety of intelligent and autonomous robots, and a great number of software frameworks for robotics. This paper surveys some representative of the existing of these development frameworks. In addition, it describes and compares their principal features and limitations. The paper provides also information on some of the existing robots supported by the studied frameworks all over the world. Finally, the paper discusses the main requirements that a robotics framework must satisfy while being easy to understand and to use.**

***Index Terms*—Robotics, Development frameworks, Requirements for robotics frameworks, Survey.**

I. Introduction

Robotics is the set of sciences and technologies that deals with the development of autonomous and intelligent robots. It is based on various disciplines and technologies such as electronics, mechanics, mechatronics, computer science, wireless communication and automation [1] [2].

Over the years, research in robotics has moved from a very limited capability robot(s) to very sophisticated robot(s). In addition, current robots are equipped with heterogeneous interconnected hardware components, a large variety of sensors (cameras, encoders, effort sensors, laser and ultrasonic sensors, GPS, temperature and humidity sensors, etc.) and actuators (DC servomotor, pneumatic motor, gripper, etc.). These components are controlled by software modules, developed by different manufacturers using various programming languages and tools. Software modules are also required to process sensors information and control actuators for performing vision processing, mapping, navigation, trajectory planning, user interaction, etc. [1].

Depending on their types, current robots must be able to accomplish new applications inside their environments. *Field robots* carry out tasks in hazardous, harsh or dangerous environments or inaccessible terrains to save and preserve human lives. *Service robots* perform human-assistance for the elderly or physical-disability persons, medical or surgical tasks, etc. to support human daily life in unstructured dynamic environments. *Industrial robots* accomplish tedious, painful and dirty tasks in manufacturing environments. Current researches in robotics aim to endow robots more skills. Consequently, next generation robots should be modular for easy and rapid implementation, flexible, customizable, self-configuring, and able to interact with other systems such as senor networks, enterprise information systems, etc. [1].

Industrial robots are extensively used in industrial manufacturing environments. However, few of *service robots* became commercially available, and *field robots* are not widely used [3]. This is due, in large part, to the long development process times and high costs for such systems that are generally designed for specific tasks (ad-hoc solutions) [4]. Furthermore, each manufacturer develops and uses its own operating systems, middlewares and development tools (low-level communication libraries, etc.), which further complicate the development process for such robots. The process of developing and programming current robots is not a simple task for engineers. It requires, per contra, knowledge, effort and expertise. To support developing new intelligent and autonomous robots, numerous common open source and commercial robotics frameworks (operating systems, middlewares, programming languages, etc.) have been developed all over the world.

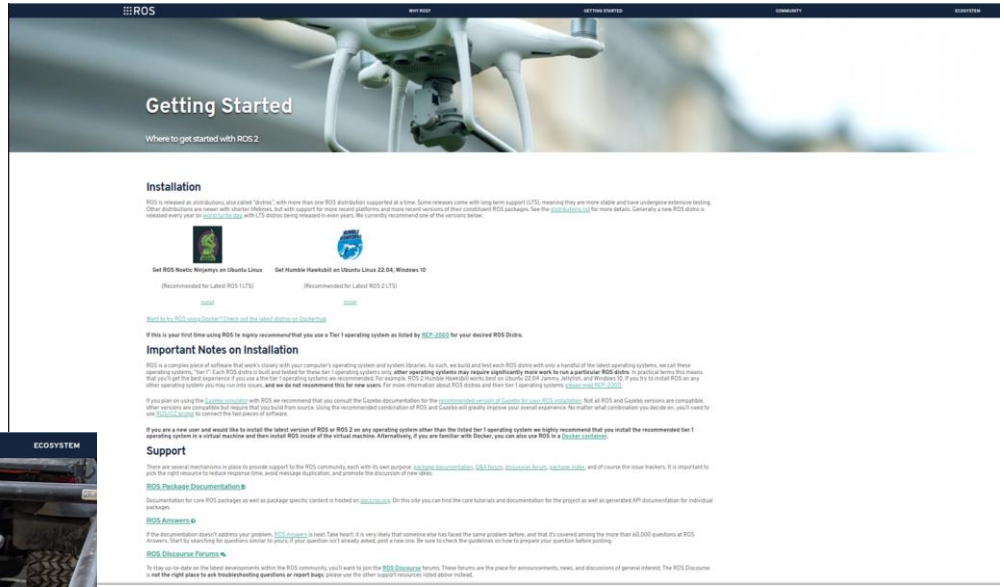
Software frameworks are universal and reusable software environments that attempt to provide integral solutions through a set of generic tools, off-the-shelf libraries, application programming interfaces (APIs) with algorithms and controllers useful to create general-purpose robotic systems [5]. Their main aims consists of (*i*) assisting developers in the design, implementation, debugging and execution of robots [6], (*ii*) significantly decreasing the development time and required resources, (*iii*) making developing robots easier, faster and cheaper [7], and finally, (*iv*) making reuse and sharing of existing software [8]. Some robotic development frameworks include off-the-shelf sub-programs for usual robotic tasks such as trajectory generation, vision processing, mapping, localization, remote control, etc.

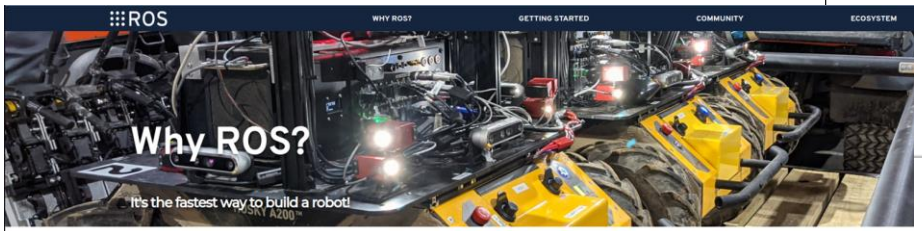
The first robotic applications have been developed using standard real time operating systems such as *VxWorks*, *OS9*, *RTX*, etc. Currently, we note an expanding number of highly competitive development frameworks for robotics. Kramer and Scheutz [9] investigated nine open-source frameworks. They proposed a conceptual evaluation framework based on four categories of criteria (specification, platform support, infrastructure and implementation). Michal and Etzkorn [6] compared

978-0-9567157-6-0 © IEEE 2016

1. Tipo de licencia
2. Instalación
3. Sistema Operativo
4. Lenguaje de programación
5. Simplificación del proceso de desarrollo
6. ...

https://www.ros.org/blog/getting-started/#





ROS (Robot Operating System) is an open source software development kit for robotics applications. ROS offers a standard software platform to developers across industries that will carry them from research and prototyping all the way through to deployment and production.

Don't reinvent the wheel. Create something new and do it faster and better by building on ROS!

Global Community

For over 10+ years the ROS project has produced a vast ecosystem of software for robotics by nurturing a global community of millions of developers and users who contribute to and improve that software. ROS is developed by and for that community, who will be its stewards into the future.

Proven in Use

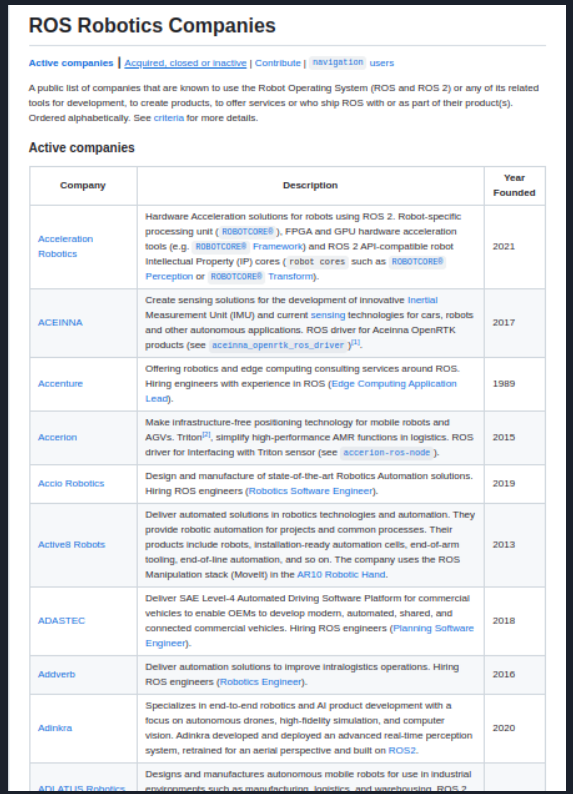
ROS is relied upon throughout the robotics industry. It's the norm for teaching robotics. It's the basis for most robotics research, from single-student projects to multi-institution collaborations and large-scale competitions. And it's inside robots that are running in production all around the world today. In the autonomous mobile robot (AMR) alone, ROS has helped to create billions of dollars in value.

Shorten Time to Market

ROS provides the tools, libraries, and capabilities that you need to develop your robotics applications, allowing you

Empresas que utilizan ROS:

https://github.com/vmayoral/ros-robotics-companies#active-coanies



ROS Robotics Companies

Active companies | Acquired, closed or inactive | Contribute | `navigation` users

A public list of companies that are known to use the Robot Operating System (ROS and ROS 2) or any of its related tools for development, to create products, to offer services or who ship ROS with or as part of their product(s). Ordered alphabetically. See criteria for more details.

Active companies

Company	Description	Year Founded
Acceleration Robotics	Hardware Acceleration solutions for robots using ROS 2. Robot-specific processing unit (`ROBOTCORE®`), FPGA and GPU hardware acceleration tools (e.g. `ROBOTCORE®` Framework) and ROS 2 API-compatible robot Intellectual Property (IP) cores (`robot cores` such as `ROBOTCORE®` Perception or `ROBOTCORE®` Transform).	2021
ACEINNA	Create sensing solutions for the development of innovative Inertial Measurement Unit (IMU) and current sensing technologies for cars, robots and other autonomous applications. ROS driver for Aceinna OpenRTK products (see `aceinna_openrtk_ros_driver`)[1].	2017
Accenture	Offering robotics and edge computing consulting services around ROS. Hiring engineers with experience in ROS (Edge Computing Application Lead).	1989
Accerion	Make infrastructure-free positioning technology for mobile robots and AGVs. Triton[2], simplify high-performance AMR functions in logistics. ROS driver for interfacing with Triton sensor (see `accerion-ros-node`).	2015
Accio Robotics	Design and manufacture of state-of-the-art Robotics Automation solutions. Hiring ROS engineers (Robotics Software Engineer).	2019
Active8 Robots	Deliver automated solutions in robotics technologies and automation. They provide robotic automation for projects and common processes. Their products include robots, installation-ready automation cells, end-of-arm tooling, end-of-line automation, and so on. The company uses the ROS Manipulation stack (MoveIt) in the AR10 Robotic Hand.	2013
ADASTEC	Deliver SAE Level-4 Automated Driving Software Platform for commercial vehicles to enable OEMs to develop modern, automated, shared, and connected commercial vehicles. Hiring ROS engineers (Planning Software Engineer).	2018
Addverb	Deliver automation solutions to improve intralogistics operations. Hiring ROS engineers (Robotics Engineer).	2016
Adinkra	Specializes in end-to-end robotics and AI product development with a focus on autonomous drones, high-fidelity simulation, and computer vision. Adinkra developed and deployed an advanced real-time perception system, retrained for an aerial perspective and built on ROS2.	2020
ADLATUS Robotics	Designs and manufactures autonomous mobile robots for use in industrial environments such as manufacturing, logistics, and warehousing. ROS 2	