Master's Degree
Robotics

tech global university

Master's Degree
Robotics

- » Modality: **Online**
- » Duration: **12 months.**
- » Certificate: **TECH Global University**
- » Accreditation: **60 ECTS**
- » Schedule: **at your own pace**
- » Exams: **online**

Website: **www.techtitute.com/us/ingeenering/master-degree/master-degree-robotics**

Index

01

Introduction

The progressive and unstoppable robotization and automation of more and more industries and businesses has made robotics one of the most advanced fields of engineering in recent years. From the viral videos of Boston Dynamics to the most cutting-edge drones, robots are part of the popular ideology and daily life of many people. Engineers who wish to specialize in this field must have a high level of expertise, as projects such as autonomous cars or space exploration require the best professionals in the field. This TECH program gathers the knowledge, precisely, of doctors in engineering and professionals specialized in robotics, with experience in the academic and aerospace fields. A great opportunity to give a decisive boost to your professional career with a 100% online teaching, free of face-to-face classes and preset schedules.

Become a specialist in Industry 4.0, industrial process automation, robot planning algorithms and much more content created by robotics experts"

It is undeniable that robotics has driven the advancement of industry to levels that were unimaginable just a few years ago. It is already common to talk about Machine Learning or Artificial Intelligences, fields in which robotics can expand to offer almost futuristic solutions to everyday or even medical problems, with robotic assistants in complex operations.

All this generates an undeniable growth opportunity for professional engineers who dedicate themselves to this field, as they will find a multitude of areas and projects to which they can direct their careers. From the purely industrial field to aerospace technologies and international programs, an appropriate specialization in robotics can mean a quantitative and qualitative leap in quality for the engineers in their own professional career.

For this reason, TECH has assembled for this program a team of leaders in the field of robotics, with extensive experience in numerous international projects of great prestige and an impeccable academic curriculum. Precisely this teaching profile means that the entire content of the program has a unique theoretical-practical approach, where the engineer will not only find the latest developments in robotics, Artificial Intelligence and Communication Systems, but also the practical application of all this knowledge in real working environments.

Through numerous videos in detail, complementary readings, video summaries and self-knowledge exercises, the engineer will obtain a global and specialized vision of the current state of robotics, being able to incorporate to their resume a program that positions them as a valuable asset for any company in the sector. All this, in addition, with the advantage of being able to manage the Master's Degree at your own pace, without having to attend classes or fixed schedules of any kind. In addition, you will have the unique opportunity to take part in 10 exclusive Masterclasses led by an internationally recognized expert in the field of Robotics.

This **Master's Degree in Robotics** contains the most complete and up-to-date scientific program on the market. Its most notable features are:

- Development of case studies presented by experts in robotic engineering
- The graphic, schematic and eminently practical contents with which it is conceived gather scientific and practical information on those disciplines that are indispensable for professional practice
- Practical exercises where self-assessment can be used to improve learning.
- Its special emphasis on innovative methodologies
- Theoretical lessons, questions to the expert, debate forums on controversial topics, and individual reflection assignments
- Content that is accessible from any fixed or portable device with an Internet connection

Boost your professional growth to the maximum with the Masterclasses TECH offers you, guided by a renowned International Guest Director"

Enroll now and don't miss the opportunity to delve into the application of robotics to virtual and augmented reality technologies, with virtual sensors and mixed mobile applications"

The program includes, in its teaching staff, professionals of the sector who pour in this program the experience of their work, in addition to recognized specialists of reference societies and prestigious universities.

The multimedia content, developed with the latest educational technology, will provide the professional with situated and contextual learning, i.e., a simulated environment that will provide immersive education programmed to learn in real situations.

This program is designed around Problem-Based Learning, whereby the professional must try to solve the different professional practice situations that arise during the course. For this purpose, the student will be assisted by an innovative interactive video system created by renowned and experienced experts.

Get the boost your career needs by incorporating this Master's Degree in your value proposal.

Master the most advanced and modern Robotics with topics dedicated exclusively to visual SLAM, computer vision and Visual Servoing.

02

Objectives

The objective of this program could not be other than to offer the engineer the most rigorous and current contents in Robotics. Therefore, throughout the 10 extensive modules of knowledge that make up this Master's Degree, there will be many references to real robotics cases. This casuistry has been created by the teaching team itself, so that the engineer can incorporate the knowledge of the subject to his daily work in the most practical and quickest way possible.

Thanks to TECH's advanced teaching methodology, you will save many hours of study time, which you can invest in the large library of multimedia content created specifically for this program."

General Objectives

- Understand the mathematical foundations for kinematic and dynamic modeling of robots
- Delve into the use of specific technologies for the creation of robot architectures, robot modeling and simulation
- Generate specialized knowledge on Artificial Intelligence
- Develop the technologies and devices most commonly used in industrial automation
- Identify the limits of current techniques to identify bottlenecks in robotic applications

You will have the full support of TECH's technical and teaching team to help you achieve your most ambitious professional goals"

Specific Objectives

Module 1. Robotics: Robot Design and Modeling
- Delve into the use of Gazebo Simulation Technology
- Master the use of the URDF Robot Modeling language
- Develop specialized knowledge in the use of Robot Operating System technology
- Model and simulate manipulator robots, land mobile robots, air mobile robots and model and simulate aquatic mobile robots

Module 2. Intelligent Agents. Applying Artificial Intelligence to Robots and Softbots
- Analyze the biological inspiration of Artificial Intelligence and intelligent agents
- Assess the need for intelligent algorithms in today's society
- Determine the applications of advanced Artificial Intelligence techniques on Intelligent Agents
- Demonstrate the strong connection between Robotics and Artificial Intelligence
- Establish the needs and challenges presented by Robotics that can be solved with Intelligent Algorithms
- Develop concrete implementations of Artificial Intelligence Algorithms
- Identify Artificial Intelligence algorithms that are established in today's society and their impact on daily life

Module 3. Robotics in the Automation of Industrial Processes
- Analyze the use, applications and limitations of industrial communication networks
- Establish machine safety standards for correct design
- Develop clean and efficient programming techniques in PLCs
- Propose new ways of organizing operations using state machines
- Demonstrate the implementation of control paradigms in real PLC applications
- Fundamentalize the design of pneumatic and hydraulic installations in automation
- Identify the main sensors and actuators in robotics and automation

Module 4. Automatic Control Systems in Robotics
- Generate specialized knowledge for the design of nonlinear controllers
- Analyze and study control problems
- Master control models
- Design nonlinear controllers for robotic systems
- Implement controllers and assess them in a simulator.
- Determine the different existing control architectures
- Examine the fundamentals of vision control
- Develop state-of-the-art control techniques such as predictive control or machine learning based control

Module 5. Robot Planning Algorithms

- Establish the different types of planning algorithms
- Analyze the complexity of motion planning in robotics
- Develop techniques for environment modeling
- Examine the pros and cons of different planning techniques
- Analyze centralized and distributed algorithms for robot coordination
- Identify the different elements in decision theory
- Propose learning algorithms for solving decision problems

Module 6. Artificial Vision Techniques in Robotics: Image Processing and Analysis

- Analyze and understand the importance of vision systems in robotics
- Establish the characteristics of the different perception sensors in order to choose the most appropriate ones according to the application
- Determine the techniques for extracting information from sensor data
- Apply visual information processing tools
- Design digital image processing algorithms
- Analyze and predict the effect of parameter changes on algorithm performance
- Assess and validate the developed algorithms in terms of results

Module 7. Robot Visual Perception Systems with Automatic Learning

- Master the machine learning techniques most widely used today in academia and industry
- Delve into the architectures of neural networks to apply them effectively in real problems
- Reuse existing neural networks in new applications using Transfer Learning
- Identify new fields of application of generative neural networks
- Analyze the use of learning techniques in other fields of robotics such as localization and mapping
- Develop current technologies in the cloud to develop neural network-based technologies
- Examine the deployment of vision learning systems in real and embedded systems

Module 8. Visual SLAM. Robot Localization and Simultaneous Mapping by Computer Vision Techniques

- Specify the basic structure of a Simultaneous Localization and Mapping (SLAM) system
- Identify the basic sensors used in Simultaneous Localization and Mapping (visual SLAM)
- Establish the boundaries and capabilities of visual SLAM
- Compile the basic notions of projective and epipolar geometry to understand imaging projection processes
- Identify the main visual SLAM technologies: Gaussian Filters, Optimization and Loop Closure Detection
- Describe in detail the operation of the main visual SLAM algorithms
- Analyze how to carry out the tuning and parameterization of SLAM algorithms

Module 9. Application of Virtual and Augmented Reality Technologies to

Robotics

- Determine the difference among the different types of realities
- Analyze the current standards for modeling virtual elements
- Examine the most commonly used peripherals in immersive environments
- Define geometric models of robots
- Assess physics engines for dynamic and kinematic modeling of robots
- Develop Virtual Reality and Augmented Reality projects

Module 10. Robot Communication and Interaction Systems

- Analyze current natural language processing strategies: heuristic, stochastic, neural network-based, reinforcement-based learning
- Assess the benefits and weaknesses of developing cross-cutting, or situation-focused, interaction systems
- Identify the environmental problems to be solved in order to achieve effective communication with the robot
- Establish the tools needed to manage the interaction and discern the type of dialogue initiative to be pursued
- Combine pattern recognition strategies to infer the intentions of the interlocutor and respond in the best way to them
- Determine the optimal expressiveness of the robot according to its functionality and environment, and apply emotional analysis techniques to adapt its response
- Propose hybrid strategies for interaction with the robot: vocal, tactile and visual

03

Skills

The skills that the Robotics engineer must develop are multiple, so this Master's Degree focuses on vital issues such as robot planning algorithms, automatic control systems, artificial intelligence applications and advanced robot design. All this in order to gain not only a global understanding of all that modern robotics encompasses, but also to acquire and hone the skills necessary to undertake the most ambitious projects in this field.

You will have a set of skills in Robotics highly sought after in the most important projects and industries internationally"

General Skills

- Master today's most widely used virtualization tools in use today
- Design virtual robotic environments
- Examine the techniques and algorithms underlying any AI algorithm
- Design, develop, implement and validate perceptual systems for robotics

You will hone your strategic, mathematical and analytical determination to take on the creation and definition of complex robotics projects"

Specific Skills

- Identify multimodal interaction systems and their integration with the rest of the robot components
- Implement own virtual and augmented reality projects
- Propose applications in real systems
- Examine, analyze and develop existing methods for path planning by a mobile robot and a manipulator
- Analyze and define strategies for the implementation and maintenance of perception systems
- Determine strategies for integration of a dialog system as part of basic robot behavior
- Analyze programming and device configuration skills
- Examine control strategies used in different robotic systems

04
Course Management

Advances in robotics are unstoppable and professionals in this field are continually renewing their knowledge and acquiring new ones to further advance their careers. For this reason, TECH has called upon active Robotics experts with vast experience in multidisciplinary projects of all kinds. Therefore, all the content provided by the teaching team is based on the latest robotic news, including cutting-edge scientific postulates and a practical approach to the current theoretical framework.

Succeed with the best and acquire the knowledge and skills you need to embark on the robotics industry"

International Guest Director

Seshu Motamarri is an expert in **automation and robotics** with more than **20 years of experience** in various industries such as **e-commerce**, **automotive**, **oil** and **gas**, **food** and **pharmaceutical**. Throughout his career, he has specialized in **engineering management** and innovation and in the implementation of new technologies, always looking for **scalable and efficient** solutions. He has also made important contributions in the introduction of products and solutions that optimize both safety and productivity in **complex industrial environments**.

He has also held key positions, including **Senior Director of Automation and Robotics at 3M**, where he leads cross-functional teams to develop and implement advanced automation solutions. At Amazon, his role as **Technical Lead** led him to manage projects that significantly improved the global supply chain, such as the "SmartPac" semi-automated bagging system and the robotic **smart picking and stowage** solution. His skills in project management, operational planning and product development have enabled him to generate great results in large-scale projects.

Internationally, he is recognized for his achievements in IT. He has been awarded the prestigious **Amazon Door Desk Award** by Jeff Bezos, and has received the **Excellence in Manufacturing Safety Award**, reflecting his hands-on engineering approach. In addition, he has been a **"Bar Raiser"** at Amazon, participating in over **100 interviews** as an objective evaluator in the hiring process.

In addition, he has several patents and publications in **electrical engineering** and functional safety, reinforcing his impact on the **development of advanced technologies**. His projects have been implemented globally, with highlights in regions such as North America, Europe, Japan and India, where he has driven the adoption of sustainable solutions in the industrial and **e-commerce sectors**.

Mr. Motamarri, Seshu

- Senior Director of Global Manufacturing Technology at 3M, Arkansas, United States
- Director of Automation and Robotics at Tyson Foods
- Hardware Development Manager III at Amazon
- Automation Leader at Corning Incorporated
- Founder and member of Quest Automation LLC
- Master of Science (MS), Electrical and Electronics Engineering at University of Houston
- Bachelor of Engineering (B.E.), Electrical and Electronics Engineering, University of Andhra
- Certification in Machinery, TÜV Rheinland Group

Thanks to TECH you will be able to learn with the best professionals in the world"

Management

Dr. Ramón Fabresse, Felipe

- Senior Software Engineer at Acurable
- NLP Software Engineer at Intel Corporation
- Software Engineer in CATEC, Indisys
- Researcher in Aerial Robotics at the University of Seville
- PhD Cum Laude in Robotics, Autonomous Systems and Telerobotics at the University of Seville.
- Degree in Computer Engineering at the University of Seville
- Master's Degree in Robotics, Automation and Telematics at the University of Seville.

Professors

Dr. Íñigo Blasco, Pablo

- Software Engineer at PlainConcepts
- Founder of Intelligent Behavior Robots
- Robotics Engineer at CATEC Advanced Center for Aerospace Technologies
- Developer and Consultant at Syderis
- PhD in Industrial Informatics Engineering at the University of Seville
- Degree in Computer Engineering at the University of Seville
- Master in Software Engineering and Technology

Mr. Campos Ortiz, Roberto

- Software Engineer Quasar Scence Resources
- Software Engineer at the European Space Agency (ESA-ESAC) for the Solar Orbiter mission
- Content creator and Artificial Intelligence expert in the course: "Artificial Intelligence: The technology of the present-future" for the Andalusian Regional Government. Euroformac Group
- Quantum Computing Scientist Zapata Computing Inc
- Graduated in Computer Engineering at Carlos III University
- Master in Computer Science and Technology at Carlos III University

Mr. Rosado Junquera, Pablo J.

- Engineer Specialist in Robotics and Automatization
- R&D Automation and Control Engineer at Becton Dickinson & Company
- Amazon Logistic Control Systems Engineer at Dematic
- Automation and Control Engineer at Aries Ingeniería y Sistemas
- Graduate in Energy and Materials Engineering at Rey Juan Carlos University.
- Master's Degree in Robotics and Automation at the Polytechnic University of Madrid
- Master's Degree in Industrial Engineering at the University of Alcalá

Dr. Jiménez Cano, Antonio Enrique

- Engineer at Aeronautical Data Fusion Engineer
- Researcher in European projects (ARCAS, AEROARMS and AEROBI) at the University of Seville
- Researcher in Navigation Systems at CNRS-LAAS
- LAAS MBZIRC2020 System Developer
- Group of Robotics, Vision and Control (GRVC) of the University of Seville
- PhD in Automatics, Electronics and Telecommunications at the University of Seville
- Graduated in Automatic Engineering and Industrial Electronics at the University of Seville
- Degree in Technical Engineering in Computer Systems at the University of Seville

Dr. Alejo Teissière, David

- Telecommunications Engineer.with Specialization in Robotics
- Postdoctoral Researcher in the European projects SIAR and NIx ATEX at Pablo de Olavide University
- Systems Developer at Aertec
- PhD in Automation, Robotics and Telematics at the University of Seville
- Graduated in Telecommunication Engineering at the University of Seville
- Master's Degree in Automation, Robotics and Telematics from the University of Seville

Dr. Pérez Grau, Francisco Javier

- Head of the Perception and Software Unit at CATEC
- R&D Project Manager at CATEC
- R&D Project Engineer at CATEC
- Associate Professor at the University of Cadiz.
- Associate Professor at the University International of Andalucia
- Researcher in the Robotics and Perception group at the University of Zurich
- Researcher at the Australian Centre for Field Robotics at the University of Sydney
- PhD in Robotics and Autonomous Systems from the University of Seville.
- Graduate in Telecommunications Engineering and Computer and Network Engineering from the University of Seville

Dr. Caballero Benítez, Fernando

- Researcher in the European projects COMETS, AWARE, ARCAS and SIAR
- Degree in Telecommunications Engineering from the University of Seville
- PhD in Telecommunications Engineering at the University of Seville
- Full Professor of Systems Engineering and Automatics at the University of Seville
- Associate editor of the journal Robotics and Automation Letters

Dr. Lucas Cuesta, Juan Manuel

- Senior Software Engineer and Analyst at Indizen– Believe in Talent
- Senior Software Engineer and Analyst at Krell Consulting and IMAGiNA Artificial Intelligence
- Software Engineer at Intel Corporation
- Software Engineer at Intelligent Dialog Systems
- Doctorate in Electronic Systems Engineering for Intelligent Environments at the Polytechnic University of Madrid
- Graduate in Telecommunications Engineering at the Polytechnic University of Madrid
- Master's Degree in Electronic Systems Engineering for Intelligent Environments at the Polytechnic University of Madrid

Mr. Márquez Ruiz de Lacanal, Juan Antonio

- Software Developer at GTD Defense & Security Solutions
- Software Developer at Solera Inc
- Development and Research Engineer at GRVC Sevilla
- Co-founder of Unmute
- Co-founder of VR Educa
- Academic Exchange in Engineering and Entrepreneurship at UC Berkeley, California
- Degree in Industrial Engineering from the University of Seville

Take the opportunity to learn about the latest advances in this field in order to apply it to your daily practice"

05
Structure and Content

The teaching team involved in the design of the entire syllabus has used the Relearning methodology, favoring a progressive and natural teaching for the whole program. This is achieved through a reiteration of the most important key concepts in robotics and advanced engineering, so that the student does not have to spend long hours of study to acquire this knowledge.

You have within your reach the key to direct your engineering career towards the field of robotics. Don't waste this opportunity and enroll now"

Module 1. Robotics: Robot Design and Modeling

1.1. Robotics and Industry 4.0
  1.1.1. Robotics and Industry 4.0
  1.1.2. Application Fields and Use Cases
  1.1.3. Sub-Areas of Specialization in Robotics
1.2. Robot Hardware and Software Architectures
  1.2.1. Hardware Architectures and Real-Time
  1.2.2. Robot Software Architectures
  1.2.3. Communication Models and Middleware Technologies
  1.2.4. Robot Operating System (ROS) Software Integration
1.3. Mathematical Modeling of Robots
  1.3.1. Mathematical Representation of Rigid Solids
  1.3.2. Rotations and Translations
  1.3.3. Hierarchical State Representation
  1.3.4. Distributed Representation of the State in ROS (TF Library)
1.4. Robot Kinematics and Dynamics
  1.4.1. Kinematics
  1.4.2. Dynamics
  1.4.3. Underactuated Robots
  1.4.4. Redundant Robots
1.5. Robot Modeling and Simulation
  1.5.1. Robot Modeling Technologies
  1.5.2. Robot Modeling with URDF
  1.5.3. Robot Simulation
  1.5.4. Modeling with Gazebo Simulator
1.6. Robot Manipulators
  1.6.1. Types of Manipulator Robots
  1.6.2. Kinematics
  1.6.3. Dynamics
  1.6.4. Simulation
1.7. Terrestrial Mobile Robots
  1.7.1. Types of Terrestrial Mobile Robots
  1.7.2. Kinematics
  1.7.3. Dynamics
  1.7.4. Simulation
1.8. Aerial Mobile Robots
  1.8.1. Types of Aerial Mobile Robots
  1.8.2. Kinematics
  1.8.3. Dynamics
  1.8.4. Simulation
1.9. Aquatic Mobile Robots
  1.9.1. Types of Aquatic Mobile Robots
  1.9.2. Kinematics
  1.9.3. Dynamics
  1.9.4. Simulation
1.10. Bioinspired Robots
  1.10.1. Humanoids
  1.10.2. Robots with Four or More Legs
  1.10.3. Modular Robots
  1.10.4. Robots with Flexible Parts (Soft-Robotics)

Module 2. Intelligent Agents. Application of Artificial Intelligence to Robots and Softbots

2.1. Intelligent Agents and Artificial Intelligence
  2.1.1. Intelligent Robots. Artificial Intelligence
  2.1.2. Intelligent Agents
    2.1.2.1. Hardware Agents. Robots
    2.1.2.2. Software Agents. Softbots
  2.1.3. Robotics Applications
2.2. Brain-Algorithm Connection
  2.2.1. Biological Inspiration of Artificial Intelligence
  2.2.2. Reasoning Implemented in Algorithms. Typology
  2.2.3. Explainability of Results in Artificial Intelligence Algorithms
  2.2.4. Evolution of Algorithms up to Deep Learning

2.3. Search Algorithms in the Solution Space
- 2.3.1. Elements in Solution Space Searches
- 2.3.2. Solution Search Algorithms in Artificial Intelligence Problems
- 2.3.3. Applications of Search and Optimization Algorithms
- 2.3.4. Search Algorithms Applied to Machine Learning

2.4. Machine Learning
- 2.4.1. Machine Learning
- 2.4.2. Supervised Learning Algorithms
- 2.4.3. Unsupervised Learning Algorithms
- 2.4.4. Reinforcement Learning Algorithms

2.5. Supervised Learning
- 2.5.1. Supervised Learning Methods
- 2.5.2. Decision Trees for Classification
- 2.5.3. Support Vector Machines
- 2.5.4. Artificial Neural Networks
- 2.5.5. Applications of Supervised Learning

2.6. Unsupervised Learning
- 2.6.1. Unsupervised Learning
- 2.6.2. Kohonen Networks
- 2.6.3. Self-Organizing Maps
- 2.6.4. K-Means Algorithm

2.7. Reinforcement Learning
- 2.7.1. Reinforcement Learning
- 2.7.2. Agents Based on Markov Processes
- 2.7.3. Reinforcement Learning Algorithms
- 2.7.4. Reinforcement Learning Applied to Robotics

2.8. Artificial Neural Networks and Deep Learning
- 2.8.1. Artificial Neural Networks. Typology
- 2.8.2. Applications of Neural Networks
- 2.8.3. Transformation from Machine Learning to Deep Learning
- 2.8.4. Deep Learning Applications

2.9. Probabilistic Inference
- 2.9.1. Probabilistic Inference
- 2.9.2. Types of Inference and Method Definition
- 2.9.3. Bayesian Inference as a Case Study
- 2.9.4. Nonparametric Inference Techniques
- 2.9.5. Gaussian Filters

2.10. From Theory to Practice: Developing an Intelligent Robotic Agent
- 2.10.1. Inclusion of Supervised Learning Modules in a Robotic Agent
- 2.10.2. Inclusion of Reinforcement Learning Modules in a Robotic Agent
- 2.10.3. Architecture of a Robotic Agent Controlled by Artificial Intelligence
- 2.10.4. Professional Tools for the Implementation of the Intelligent Agent
- 2.10.5. Phases of the Implementation of AI Algorithms in Robotic Agents

Module 3. Robotics in the Automation of Industrial Processes

3.1. Design of Automated Systems
- 3.1.1. Hardware Architectures
- 3.1.2. Programmable Logic Controllers
- 3.1.3. Industrial Communication Networks

3.2. Advanced Electrical Design I: Automation
- 3.2.1. Design of Electrical Panels and Symbology
- 3.2.2. Power and Control Circuits. Harmonics
- 3.2.3. Protection and Grounding Elements

3.3. Advanced Electrical Design II: Determinism and Safety
- 3.3.1. Machine Safety and Redundancy
- 3.3.2. Safety Relays and Triggers
- 3.3.3. Safety PLCs
- 3.3.4. Safe Networks

3.4. Electrical Actuation
- 3.4.1. Motors and Servomotors
- 3.4.2. Frequency Inverters and Controllers
- 3.4.3. Electrically Actuated Industrial Robotics

3.5. Hydraulic and Pneumatic Actuation
- 3.5.1. Hydraulic Design and Symbology
- 3.5.2. Pneumatic Design and Symbology
- 3.5.3. ATEX Environments in Automation

3.6. Transducers in Robotics and Automation
- 3.6.1. Position and Velocity Measurement
- 3.6.2. Force and Temperature Measurement
- 3.6.3. Presence Measurement
- 3.6.4. Vision Sensors

3.7. Programming and Configuration of Programmable Logic Controllers PLCs
- 3.7.1. PLC Programming: LD
- 3.7.2. PLC Programming: ST
- 3.7.3. PLC Programming: FBD and CFC
- 3.7.4. PLC Programming: SFC

3.8. Programming and Configuration of Equipment in Industrial Plants
- 3.8.1. Programming of Drives and Controllers
- 3.8.2. HMI Programming
- 3.8.3. Programming of Manipulator Robots

3.9. Programming and Configuration of Industrial Computer Equipment
- 3.9.1. Programming of Vision Systems
- 3.9.2. SCADA/Software Programming
- 3.9.3. Network Configuration

3.10. Automation Implementation
- 3.10.1. State Machine Design
- 3.10.2. Implementation of State Machines in PLCs
- 3.10.3. Implementation of Analog PID Control Systems in PLCs
- 3.10.4. Automation Maintenance and Code Hygiene
- 3.10.5. Automation and Plant Simulation

Module 4. Automatic Control Systems in Robotics

4.1. Analysis and Design of Nonlinear Systems
- 4.1.1. Analysis and Modeling of Nonlinear Systems
- 4.1.2. Feedback Control
- 4.1.3. Linearization by Feedback

4.10. Predictive Control
- 4.10.1. Models and State Estimation
- 4.10.2. MPC Applied to Mobile Robots
- 4.10.3. MPC Applied to UAVs

Module 5. Robot Planning Algorithms

5.1. Classical Planning Algorithms
- 5.1.1. Discrete Planning: State Space
- 5.1.2. Planning Problems in Robotics. Robotic Systems Models
- 5.1.3. Classification of Planners

5.2. The Trajectory Planning Problem in Mobile Robots
- 5.2.1. Forms of Environment Representation: Graphs
- 5.2.2. Search Algorithms in Graphs
- 5.2.3. Introduction of Costs in Networks
- 5.2.4. Search Algorithms in Heavy Networks
- 5.2.5. Algorithms with any Angle Approach

5.3. Planning in High Dimensional Robotic Systems
- 5.3.1. High Dimensionality Robotics Problems: Manipulators
- 5.3.2. Direct/Inverse Kinematic Model
- 5.3.3. Sampling Planning Algorithms PRM and RRT
- 5.3.4. Planning Under Dynamic Constraints

5.4. Optimal Sampling Planning
- 5.4.1. Problem of Sampling-Based Planners
- 5.4.2. RRT Probabilistic Optimality Concept
- 5.4.3. Reconnection Step: Dynamic Constraints
- 5.4.4. CForest. Parallelizing Planning

5.5. Real Implementation of a Motion Planning System
- 5.5.1. Global Planning Problem. Dynamic Environments
- 5.5.2. Cycle of Action, Sensorization. Acquisition of Information from the Environment
- 5.5.3. Local and Global Planning

5.6. Coordination in Multi-Robot Systems I: Centralized System
- 5.6.1. Multirobot Coordination Problem
- 5.6.2. Collision Detection and Resolution: Trajectory Modification with Genetic Algorithms
- 5.6.3. Other Bio-Inspired Algorithms: Particle Swarm and Fireworks
- 5.6.4. Collision Avoidance by Choice of Maneuver Algorithm

5.7. Coordination in Multi-Robot Systems II: Distributed Approaches I
- 5.7.1. Use of Complex Objective Functions
- 5.7.2. Pareto Front
- 5.7.3. Multi-Objective Evolutionary Algorithms

5.8. Coordination in Multi-Robot Systems III: Distributed Approaches II
- 5.8.1. Order 1 Planning Systems
- 5.8.2. ORCA Algorithm
- 5.8.3. Addition of Kinematic and Dynamic Constraints in ORCA

5.9. Decision Planning Theory
- 5.9.1. Decision Theory
- 5.9.2. Sequential Decision Systems
- 5.9.3. Sensors and Information Spaces
- 5.9.4. Planning for Uncertainty in Sensing and Actuation

5.10. Reinforcement Learning Planning Systems
- 5.10.1. Obtaining the Expected Reward of a System
- 5.10.2. Mean Reward Learning Techniques
- 5.10.3. Inverse Reinforcement Learning

Module 6. Artificial Vision Techniques in Robotics: Image Processing and Analysis

6.1. Computer Vision
- 6.1.1. Computer Vision
- 6.1.2. Elements of a Computer Vision System
- 6.1.3. Mathematical Tools

6.2. Optical Sensors for Robotics
- 6.2.1. Passive Optical Sensors
- 6.2.2. Active Optical Sensors
- 6.2.3. Non-Optical Sensors

6.3. Image Acquisition

6.3.1. Image Representation
6.3.2. Color Space
6.3.3. Digitizing Process

6.4. Image Geometry
6.4.1. Lens Models
6.4.2. Camera Models
6.4.3. Camera Calibration

6.5. Mathematical Tools
6.5.1. Histogram of an Image
6.5.2. Convolution
6.5.3. Fourier Transform

6.6. Image Preprocessing
6.6.1. Noise Analysis
6.6.2. Image Smoothing
6.6.3. Image Enhancement

6.7. Image Segmentation
6.7.1. Contour-Based Techniques
6.7.2. Histogram-Based Techniques
6.7.3. Morphological Operations

6.8. Image Feature Detection
6.8.1. Point of Interest Detection
6.8.2. Feature Descriptors
6.8.3. Feature Matching

6.9. 3D Vision Systems
6.9.1. 3D Perception
6.9.2. Feature Matching between Images
6.9.3. Multiple View Geometry

6.10. Computer Vision based Localization
6.10.1. The Robot Localization Problem
6.10.2. Visual Odometry
6.10.3. Sensory Fusion

Module 7. Robot Visual Perception Systems with Automatic Learning

7.1. Unsupervised Learning Methods applied to Computer Vision
7.1.1. *Clustering*
7.1.2. PCA
7.1.3. *Nearest Neighbors*
7.1.4. *Similarity and Matrix Decomposition*

7.2. Supervised Learning Methods Applied to Artificial Vision
7.2.1. "Bag of Words" Concept
7.2.2. Support Vector Machine
7.2.3. *Latent Dirichlet Allocation*
7.2.4. Neural Networks

7.3. Deep Neural Networks: Structures, Backbones and Transfer Learning
7.3.1. Feature Generating Layers
7.3.3.1. VGG
7.3.3.2. Densenet
7.3.3.3. ResNet
7.3.3.4. Inception
7.3.3.5. GoogLeNet
7.3.2. *Transfer Learning*
7.3.3. The Data. Preparation for Training

7.4. Artificial Vision with Deep Learning I: Detection and Segmentation.
7.4.1. YOLO and SSD Differences and Similarities
7.4.2. Unet
7.4.3. Other Structures

7.5. Computer Vision with Deep Learning II: *Generative Adversarial Networks*
7.5.1. Image Super-Resolution Using GAN
7.5.2. Creation of Realistic Images
7.5.3. *Scene Understanding*

7.6. Learning Techniques for Localization and Mapping in Mobile Robotics
7.6.1. Loop Closure Detection and Relocation
7.6.2. Magic Leap. *Super Point and Super Glue*
7.6.3. Depth from Monocular

7.7. Bayesian Inference and 3D Modeling
- 7.7.1. Bayesian Models and "Classical" Learning
- 7.7.2. Implicit Surfaces with Gaussian Processes (GPIS)
- 7.7.3. 3D Segmentation Using GPIS
- 7.7.4. Neural Networks for 3D Surface Modeling

7.8. End-to-End Applications of Deep Neural Networks
- 7.8.1. End-to-End System. Example of Person Identification
- 7.8.2. Object Manipulation with Visual Sensors
- 7.8.3. Motion Generation and Planning with Visual Sensors

7.9. Cloud Technologies to Accelerate the Development of Deep Learning Algorithms
- 7.9.1. Use of GPUs for Deep Learning
- 7.9.2. Agile Development with Google Colab
- 7.9.3. Remote GPUs, Google Cloud and AWS

7.10. Deployment of Neural Networks in Real Applications
- 7.10.1. Embedded Systems
- 7.10.2. Deployment of Neural Networks. Use
- 7.10.3. Network Optimizations in Deployment, Example with TensorRT

Module 8. Visual SLAM. Robot Localization and Simultaneous Mapping by Artificial Vision Techniques

8.1. Simultaneous Localization and Mapping (SLAM)
- 8.1.1. Simultaneous Localization and Mapping. SLAM
- 8.1.2. SLAM Applications
- 8.1.3. SLAM Operation

8.2. Projective Geometry
- 8.2.1. Pin-Hole Model
- 8.2.2. Estimation of Intrinsic Parameters of a Chamber
- 8.2.3. Homography, Basic Principles and Estimation
- 8.2.4. Fundamental Matrix, Principles and Estimation

8.3. Gaussian Filters
- 8.3.1. Kalman Filter
- 8.3.2. Information Filter
- 8.3.3. Adjustment and Parameterization of Gaussian Filters

8.4. Stereo EKF-SLAM
- 8.4.1. Stereo Camera Geometry
- 8.4.2. Feature Extraction and Search
- 8.4.3. Kalman Filter for Stereo SLAM
- 8.4.4. Stereo EKF-SLAM Parameter Setting

8.5. Monocular EKF-SLAM
- 8.5.1. EKF-SLAM Landmark Parameterization
- 8.5.2. Kalman Filter for Monocular SLAM
- 8.5.3. Monocular EKF-SLAM Parameter Tuning

8.6. Loop Closure Detection
- 8.6.1. Brute Force Algorithm
- 8.6.2. FABMAP
- 8.6.3. Abstraction Using GIST and HOG
- 8.6.4. Deep Learning Detection

8.7. Graph-SLAM
- 8.7.1. Graph-SLAM
- 8.7.2. RGBD-SLAM
- 8.7.3. ORB-SLAM

8.8. Direct Visual SLAM
- 8.8.1. Analysis of the Direct Visual SLAM Algorithm
- 8.8.2. LSD-SLAM
- 8.8.3. SVO

8.9. Visual Inertial SLAM
- 8.9.1. Integration of Inertial Measurements
- 8.9.2. Low Coupling: SOFT-SLAM
- 8.9.3. High Coupling: Vins-Mono

8.10. Other SLAM Technologies
- 8.10.1. Applications Beyond Visual SLAM
- 8.10.2. Lidar-SLAM
- 8.10.2. Range-Only SLAM

Module 9. Application of Virtual and Augmented Reality Technologies to Robotics

9.1. Immersive Technologies in Robotics
- 9.1.1. Virtual Reality in Robotics
- 9.1.2. Augmented Reality in Robotics
- 9.1.3. Mixed Reality in Robotics
- 9.1.4. Difference between Realities

9.2. Construction of Virtual Environments
- 9.2.1. Materials and Textures
- 9.2.2. Lighting
- 9.2.3. Virtual Sound and Smell

9.3. Robot Modeling in Virtual Environments
- 9.3.1. Geometric Modeling
- 9.3.2. Physical Modeling
- 9.3.3. Model Standardization

9.4. Modeling of Robot Dynamics and Kinematics Virtual Physical Engines
- 9.4.1. Physical Motors. Typology
- 9.4.2. Configuration of a Physical Engine
- 9.4.3. Physical Motors in the Industry

9.5. Platforms, Peripherals and Tools Most Commonly Used in Virtual Reality
- 9.5.1. Virtual Reality Viewers
- 9.5.2. Interaction Peripherals
- 9.5.3. Virtual Sensors

9.6. Augmented Reality Systems
- 9.6.1. Insertion of Virtual Elements into Reality
- 9.6.2. Types of Visual Markers
- 9.6.3. Augmented Reality Technologies

9.7. Metaverse: Virtual Environments of Intelligent Agents and People
- 9.7.1. Avatar Creation
- 9.7.2. Intelligent Agents in Virtual Environments
- 9.7.3. Construction of Multi-User Environments for VR/AR

9.8. Creation of Virtual Reality Projects for Robotics
- 9.8.1. Phases of Development of a Virtual Reality Project
- 9.8.2. Deployment of Virtual Reality Systems
- 9.8.3. Virtual Reality Resources

9.9. Creating Augmented Reality Projects for Robotics
- 9.9.1. Phases of Development of an Augmented Reality Project
- 9.9.2. Deployment of Augmented Reality Projects
- 9.9.3. Augmented Reality Resources

9.10. Robot Teleoperation with Mobile Devices
- 9.10.1. Mixed Reality on Mobile Devices
- 9.10.2. Immersive Systems using Mobile Device Sensors
- 9.10.3. Examples of Mobile Projects

Module 10. Robot Communication and Interaction Systems

10.1. Speech Recognition: Stochastic Systems
- 10.1.1. Acoustic Speech Modeling
- 10.1.2. Hidden Markov Models
- 10.1.3. Linguistic Speech Modeling: N-Grams, BNF Grammars

10.2. Speech Recognition: *Deep Learning*
- 10.2.1. Deep Neural Networks
- 10.2.2. Recurrent Neural Networks
- 10.2.3. LSTM Cells

10.3. Speech Recognition: Prosody and Environmental Effects
- 10.3.1. Ambient Noise
- 10.3.2. Multi-Speaker Recognition
- 10.3.3. Speech Pathologies

10.4. Natural Language Understanding: Heuristic and Probabilistic Systems
- 10.4.1. Syntactic-Semantic Analysis: Linguistic Rules
- 10.4.2. Comprehension Based on Heuristic Rules
- 10.4.3. Probabilistic Systems: Logistic Regression and SVM
- 10.4.4. Understanding Based on Neural Networks

10.5. Dialog Management: Heuristic/Probabilistic Strategies
- 10.5.1. Interlocutor's Intention
- 10.5.2. Template-Based Dialog
- 10.5.3. Stochastic Dialog Management: Bayesian Networks

10.6. Dialog Management: Advanced Strategies
- 10.6.1. Reinforcement-Based Learning Systems
- 10.6.2. Neural Network-Based Systems
- 10.6.3. From Speech to Intention in a Single Network

10.7. Response Generation and Speech Synthesis
- 10.7.1. Response Generation: From Idea to Coherent Text
- 10.7.2. Speech Synthesis by Concatenation
- 10.7.3. Stochastic Speech Synthesis

10.8. Dialogue Adaptation and Contextualization
- 10.8.1. Dialogue Initiative
- 10.8.2. Adaptation to the Speaker
- 10.8.3. Adaptation to the Context of the Dialogue

10.9. Robots and Social Interactions:Emotion Recognition, Synthesis and Expression
- 10.9.1. Artificial Voice Paradigms: Robotic Voice and Natural Voice
- 10.9.2. Emotion Recognition and Sentiment Analysis
- 10.9.3. Emotional Voice Synthesis

10.10. Robots and Social Interactions: Advanced Multimodal Interfaces
- 10.10.1. Combination of Vocal and Tactile Interfaces
- 10.10.2. Sign Language Recognition and Translation
- 10.10.3. Visual Avatars: Voice to Sign Language Translation

06

Methodology

TECH is the first university in the world to combine case study methodology with Relearning, a 100% online learning system based on guided repetition.

This innovative pedagogical strategy has been conceived to offer professionals the opportunity to update knowledge and develop skills in an intensive and rigorous way. A learning model that places the student at the center of the academic process and gives them the leading role, adapting to their needs and leaving aside the more conventional methodologies.

TECH prepares you to face new challenges in uncertain environments and achieve success in your career"

The student: the priority of all TECH programs.

In TECH's study methodology, the student is the absolute protagonist. The pedagogical tools of each program have been selected taking into account the demands of time, availability and academic rigor that, today, not only students demand but also the most competitive positions in the market.

With TECH's asynchronous educational model, it is the student who chooses the time they spend studying, how they decide to establish their routines and all this from the comfort of the electronic device of their choice. The student will not have to attend live classes, which many times they cannot attend. The learning activities will be done when it is convenient for them. You will always be able to decide when and from where to study.

“At TECH you will NOT have in person classes (which you might not be able to attend)”

The most comprehensive curriculums at the international level

TECH is characterized by offering the most comprehensive academic itineraries in the university environment. This comprehensiveness is achieved through the creation of curriculums that not only cover the essential knowledge, but also the most recent innovations in each area.

By being constantly updated, these programs allow students to keep up with market changes and acquire the skills most valued by employers. In this way, those who complete their studies at TECH receive a comprehensive preparation that provides them with a notable competitive advantage to advance in their careers.

And what's more, they will be able to do so from any device, PC, tablet or smartphone.

TECH's model is asynchronous, so it allows you to study with your PC, tablet or smartphone wherever you want, whenever you want and for as long as you want"

Case Studies or Case Method

The case method has been the learning system most used by the best business schools in the world. Developed in 1912 so that law students would not only learn the law based on theoretical content, its function was also to present them with real complex situations. In this way, they could make informed decisions and value judgments about how to solve them. In 1924 it was established as a standard teaching method at Harvard.

With this teaching model, it is the student who builds their professional competence through strategies such as Learning by Doing or Design Thinking, which are used by other renowned institutions such as Yale or Stanford.

This action-oriented method will be applied throughout the entire academic itinerary that the student undertakes with TECH. Students will be confronted with multiple real-life situations and will have to integrate knowledge, research, argue and defend their ideas and decisions. All this with the premise of answering the question of how they would act when facing specific events of complexity in their daily work.

Relearning Method

At TECH, case studies are enhanced with the best 100% online teaching method: Relearning.

This method breaks with traditional teaching techniques to put the student at the center of the equation, providing the best content in different formats. In this way, they are able to review and reiterate the key concepts of each subject and learn to apply them in a real environment.

Along the same lines, and according to multiple scientific researches, repetition is the best way to learn. For this reason, TECH offers between 8 and 16 repetitions of each key concept within the same lesson, presented in a different way, with the objective of ensuring that the knowledge is completely consolidated during the study process.

Relearning will allow you to learn with less effort and more performance, involving you more in your specialization, developing a critical spirit, defending arguments and contrasting opinions: a direct equation to success.

A 100% online Virtual Campus with the best teaching resources

To apply its methodology effectively, TECH focuses on providing graduates with teaching materials in different formats: texts, interactive videos, illustrations and knowledge maps, among others. All of them are designed by qualified teachers who focus their work on combining real cases with the resolution of complex situations through simulation, the study of contexts applied to each professional career and learning based on reiteration, through audios, presentations, animations, images, etc.

The latest scientific evidence in the field of Neurosciences points to the importance of taking into account the place and context where the content is accessed before starting a new learning process. Being able to adjust these variables in a personalized way helps people to remember and store knowledge in the hippocampus for long-term retention. This is a model called Neurocognitive Context-Dependent E-Learning that is consciously applied in this university program.

Furthermore, in order to maximize tutor-student contact, a wide range of communication possibilities are provided, both in real time and deferred (internal messaging, discussion forums, telephone answering service, e-mail contact with the technical secretary, chat and videoconferencing).

Likewise, this very complete Virtual Campus will allow TECH students to organize their study schedules according to their personal availability or work obligations. In this way, they will have global control of the academic content and teaching tools, in accordance with their accelerated professional updating.

> *The online mode of study of this program will allow you to organize your time and your learning pace, adapting it to your schedule"*

The effectiveness of the method is justified by four fundamental achievements:

1. Students who follow this method not only achieve the assimilation of concepts, but also a development of their mental capacity, through exercises that assess real situations and the application of knowledge.
2. Learning is solidly translated into practical skills that allow the student to better integrate into the real world.
3. Ideas and concepts are understood more efficiently, given that the example situations are based on real-life.
4. Students like to feel that the effort they put into their studies is worthwhile. This then translates into a greater interest in learning and more time dedicated to working on the course.

The university methodology best rated by its students

The results of this innovative academic model can be seen in the overall satisfaction levels of TECH graduates.

The students' assessment of the quality of teaching, quality of materials, course structure and objectives is excellent. Not surprisingly, the institution became the best-rated university by its students on the Trustpilot review platform, obtaining a 4.9 out of 5.

Access the study contents from any device with an Internet connection (computer, tablet, smartphone) thanks to the fact that TECH is up to date with the technological and pedagogical vanguard.

You will be able to learn with the advantages of access to simulated learning environments and the learning by observation approach, that is, the "Learning from an Expert" approach.

Therefore, the best educational materials, thoroughly prepared, will be available in this program:

Study Material

All teaching material is produced by the specialists who teach the course, specifically for the course, so that the teaching content is highly specific and precise.

This content is then adapted in an audiovisual format that will create our way of working online, with the latest techniques that allow us to offer you high quality in all of the material that we provide you with.

Practicing Skills and Abilities

You will carry out activities to develop specific skills and abilities in each thematic area. Exercises and activities to acquire and develop the skills and abilities that a specialist needs to develop within the context of the globalization in which we live.

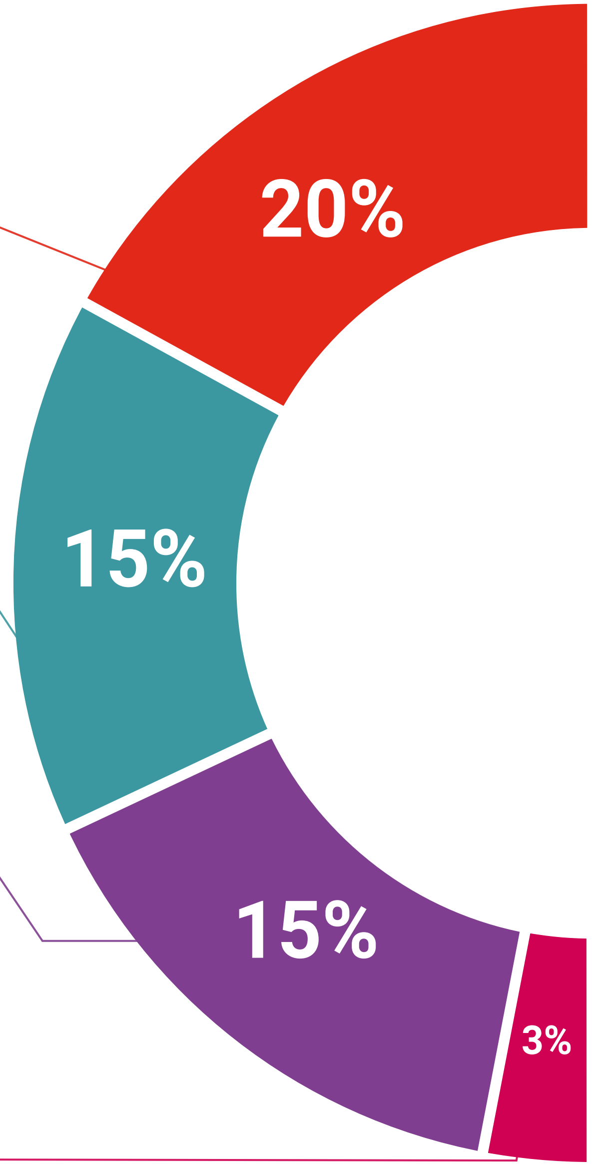
Interactive Summaries

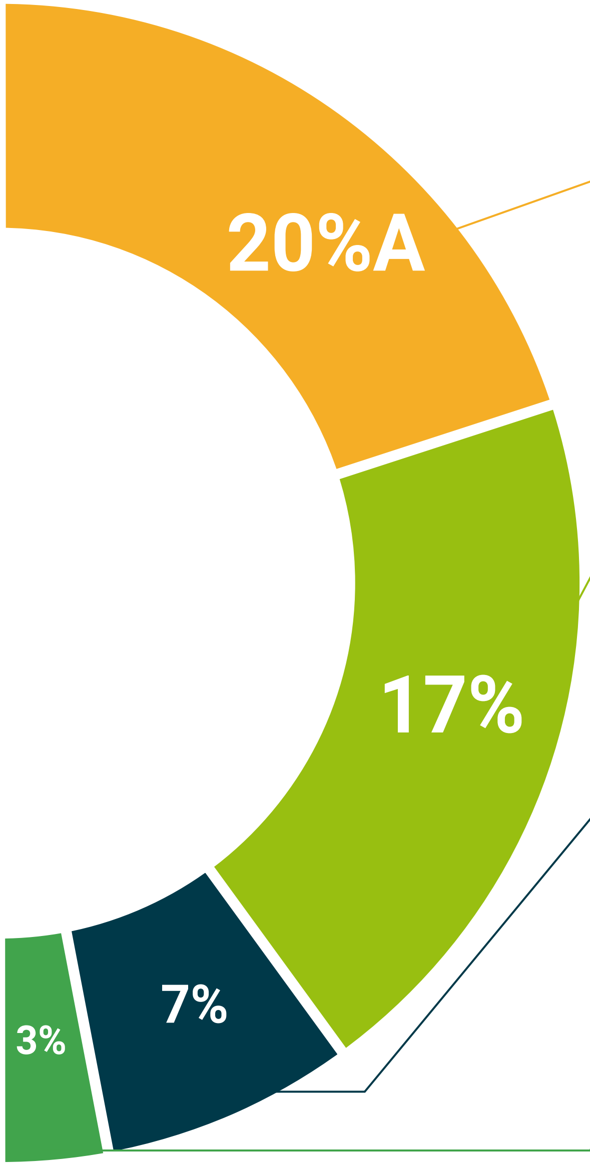
We present the contents in an attractive and dynamic way in multimedia pills that include audio, videos, images, diagrams and concept maps in order to reinforce knowledge.

This unique educational system for the presentation of multimedia content was awarded by Microsoft as "Successful Case in Europe."

Additional Reading

Recent articles, consensus documents, international guidelines... In our virtual library you will have access to everything you need to complete your course.





Case Studies

You will complete a selection of the best case studies in the field. Cases presented, analyzed and tutored by the best specialists in the world.

Testing & Retesting

We periodically evaluate and re-evaluate your knowledge throughout the program. We do this on 3 of the 4 levels of Miller's Pyramid.

Masterclasses

There is scientific evidence suggesting that observing third-party experts can be useful.

Learning from an expert strengthens knowledge and recall, and generates confidence in our future difficult decisions.

Quick Action Guides

TECH offers the most relevant contents of the course in the form of worksheets or quick action guides. A synthetic, practical and effective way to help students progress in their learning.

07

Certificate

The Master's Degree in Robotics guarantees students, in addition to the most rigorous and up-to-date education, access to a Master's Degree diploma issued by TECH Global University.

Successfully complete this program and receive your university qualification without having to travel or fill out laborious paperwork"

This private qualification will allow you to obtain a **Master's Degree diploma in Robotics** endorsed by **TECH Global University**, the world's largest online university.

TECH Global University, is an official European University publicly recognized by the Government of Andorra (***official bulletin***). Andorra is part of the European Higher Education Area (EHEA) since 2003. The EHEA is an initiative promoted by the European Union that aims to organize the international training framework and harmonize the higher education systems of the member countries of this space. The project promotes common values, the implementation of collaborative tools and strengthening its quality assurance mechanisms to enhance collaboration and mobility among students, researchers and academics.

This **TECH Global University private qualification**, is a European program of continuing education and professional updating that guarantees the acquisition of competencies in its area of knowledge, providing a high curricular value to the student who completes the program.

Title: **Master's Degree in Robotics**

Modality: **Online**

Duration: **12 months.**

Accreditation: **60 ECTS**


tech global university

Mr./Ms. _________________ with identification document ___________
has successfully passed and obtained the title of:

Master's Degree in Robotics

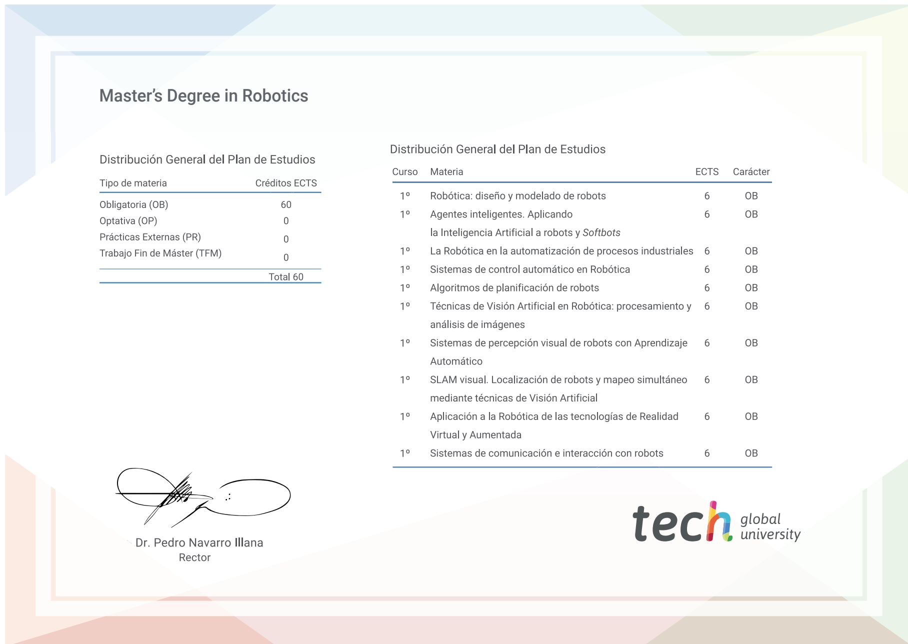
This is a private qualification of 1,800 hours of duration equivalent to 60 ECTS, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

TECH Global University is a university officially recognized by the Government of Andorra on the 31st of January of 2024, which belongs to the European Higher Education Area (EHEA).

In Andorra la Vella, on the 28th of February of 2024

Dr. Pedro Navarro Illana
Dean

This qualification must always be accompanied by the university degree issued by the competent authority to practice professionally in each country. Unique TECH Code: AFWORD23S techtitute.com/certificates


Master's Degree in Robotics

Distribución General del Plan de Estudios

Tipo de materia	Créditos ECTS
Obligatoria (OB)	60
Optativa (OP)	0
Prácticas Externas (PR)	0
Trabajo Fin de Máster (TFM)	0
	Total 60

Distribución General del Plan de Estudios

Curso	Materia	ECTS	Carácter
1º	Robótica: diseño y modelado de robots	6	OB
1º	Agentes inteligentes. Aplicando la Inteligencia Artificial a robots y *Softbots*	6	OB
1º	La Robótica en la automatización de procesos industriales	6	OB
1º	Sistemas de control automático en Robótica	6	OB
1º	Algoritmos de planificación de robots	6	OB
1º	Técnicas de Visión Artificial en Robótica: procesamiento y análisis de imágenes	6	OB
1º	Sistemas de percepción visual de robots con Aprendizaje Automático	6	OB
1º	SLAM visual. Localización de robots y mapeo simultáneo mediante técnicas de Visión Artificial	6	OB
1º	Aplicación a la Robótica de las tecnologías de Realidad Virtual y Aumentada	6	OB
1º	Sistemas de comunicación e interacción con robots	6	OB

Dr. Pedro Navarro Illana
Rector

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*Apostille Convention. In the event that the student wishes to have their paper diploma issued with an apostille, TECH Global University will make the necessary arrangements to obtain it, at an additional cost.

Master's Degree
Robotics

» Modality: **Online**
» Duration: **12 months.**
» Certificate: **TECH Global University**
» Accreditation: **60 ECTS**
» Schedule: **at your own pace**
» Exams: **online**

Master's Degree
Robotics

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