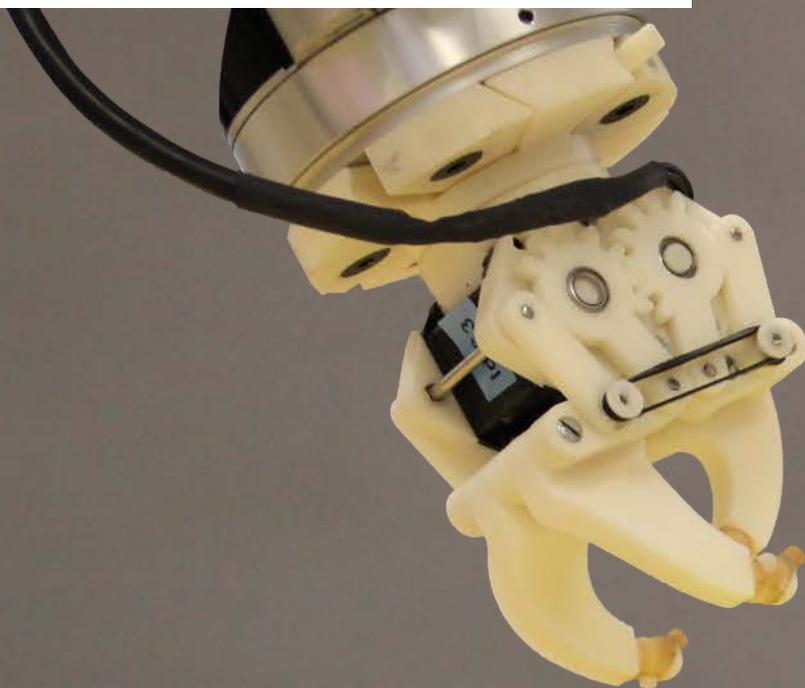Institut de Robòtica
i Informàtica Industrial

CAPACITIES
FOR TECHNOLOGY
TRANSFER

EXCELENCIA
MARÍA
DE MAEZTU
07/2017-06/2021

The **Institut de Robòtica i Informàtica Industrial (IRI)** is a Joint University Research Institute of the Spanish Council for Scientific Research (CSIC) and the Technical University of Catalonia (UPC).

EXCELLENCE IN RESEARCH AT THE SERVICE OF INDUSTRY

IRI is a scientific leader in the fields of robotics and automatic control in Spain. It is recognized with the **María de Maeztu Unit of Excellence** seal by the Spanish State Research Agency.

Our research lines tackle various aspects of robotics research, including indoor and outdoor **human-centered human-safe robotics systems,** and the design and construction of **novel robotic mechanisms**. We also conduct research on modeling, supervision and control of complex dynamic systems, such as **energy and water cycle systems**.

IRI has an intense presence in the international research scene, colaborating with some of the best research centers and companies around the world.

IRI's excellence in research is confirmed by the large number of **high-quality scientific publications** at the main journals and conferences in the robotics and control fields.

In 2017, IRI is involved in 11 European H2020 research projects. Other 3 projects and an ERC Advanced Grant will start in 2018.

In 2017, IRI researchers have worked in technology transfer contracts for 10 different companies.

SERVICES OFFERED TO COMPANIES

INNOVATIVE RESEARCH PROJECTS
Answers to singular needs at the state-of-the art, providing solutions with added value.

PARTICIPATION IN PROJECT CONSORTIA
We often take part in collaborative projects and initiatives participated by industrial partners (Horizon 2020, CDTI, ...).

INDUSTRIAL DOCTORATES
Supervision of company-hired or grant-supported industrial PhD students.

USE OF LABORATORY EQUIPMENT
Facilities are open to our industrial collaborators for project development.

CONSULTING
Industrial and technical advice to companies to help them develop new products and services.

PROTOTYPING
Design, rapid prototyping and testing of devices to address specific needs.

FACILITIES AND SERVICES

The Institute hosts 6 laboratories and a mechatronic workshop that provide hands on support to the research activities. **All of them are open to our academic and industrial collaborators**.

KINEMATICS AND ROBOT DESIGN LABORATORY

Experimental area to validate the practical interest of parallel robot designs and prototypes. It is equipped with several parallel robots and mechanisms.

BARCELONA ROBOT LABORATORY

Outdoor 10.000 sq m. pedestrian area for urban mobile robotics research, equipped with 21 fixed cameras, full wifi coverage, partial GPS coverage, and computer servers for data processing.

MOBILE ROBOTICS LABORATORY

Facility that includes 3 Pioneer platforms, 2 service robots for urban robotics research, a 4-wheel rough outdoor mobile robot, an autonomous electric vehicle, 3 unmanned aerial robots, and a vast number of sensors and cameras. The laboratory is also equipped with a 12-IR-camera Optitrack positioning system.

PERCEPTION & MANIPULATION LABORATORY

It is equipped with 2 workcells: one with 2 industrial manipulators and an XY positioner, and the other with 2 WAM arms in a reconfigurable arrangement. It also has a 3 fingered hand, a Delta haptic interface, plus all kind of sensors and actuators needed for the cells: force sensors, high speed, high resolution, and 3D cameras.

FUEL CELL CONTROL LABORATORY

Infrastructure consisting in five PEM fuel cell stations for the validation of dymanic models and controllers for the improvement of fuel cell based systems. The in house design and implementation of the test stations makes them very flexible in use and applications.

WATER-CYCLE CONTROL SYSTEMS LABORATORY

Its aim is to test and validate modelling and control developments for dynamic systems associated to the water cycle. To this end, it provides hardware and software tools to test flow, level and volume control in a variety of water systems.

MECHATRONICS WORKSHOP

The Workshop provides support in the design, construction, and maintenance of electric, electronic, and mechanical devices and prototypes for the research projects carried out at IRI. Current rapid prototyping equipment at the workshop include CNC machinery, a number of 3D plastic printers, an electronic design workbench and a ceramic oven.

TECHNOLOGICAL EXPERTISE

MECHANISM DESIGN & ANALYSIS

MECHANISM DESIGN AND CONSTRUCTION

Parallel manipulators
Robotic hands
Reconfigurable robots
Tactile sensors
Cable-driven robots

### MOLECULAR MODELLING

Biomolecule modeling as complex kinematic chains

ANALYSIS AND PLANNING OF MECHANISM MOTION

Software development to determine valid motion and positioning of mechanisms

AERIAL ROBOTICS

AERIAL ROBOT LOCALIZATION, MAPPING AND NAVIGATION

Robust multi-sensor systems
Single and cooperative approaches

AERIAL PERCEPTION AND MANIPULATION

Computer vision methods for scene recognition, object detection, identification and tracking

Hierarchical task control for unmanned aerial manipulators

AERIAL ROBOT CONTROL AND PLANNING STRATEGIES

Fault-tolerant and energy efficient control
Semisupervised planning
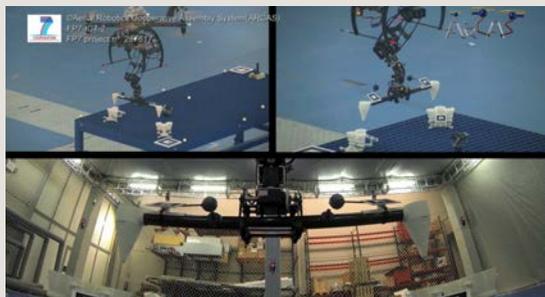
URBAN MOBILITY

AUTONOMOUS NAVIGATION
Localization in GPS denied environments
Vehicle motion, planning and control
3D mapping
Obstacle avoidance
Sensor fusion for robust localization

DRIVER ASSISTANCE (ADAS)
Deep learning methods
Road detection
Multicamera Integration
Object recognition and tracking

URBAN SERVICE ROBOTICS
Urban exploration and mapping
Human guiding and tracking
Human-vehicle interaction
Surveillance tasks
Urban goods transportation (last mile)
Assistance to the mobility of disabled users

## HEAVY VEHICLE AUTOMATION
AGVs in shared workspaces
Coordinated navigation
Mixed GNSS-laser-based positioning solutions

ADVANCED TECHNIQUES IN VISUAL PERCEPTION

DEEP LEARNING APPLICATIONS
Automatic scene understanding
Object detection, recognition and tracking
Human activity recognition
E-commerce clothing recognition
Medical imaging
Automatic image captioning
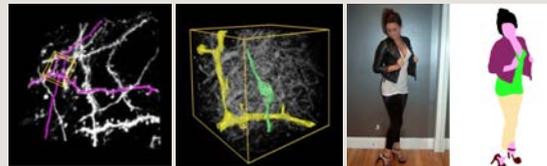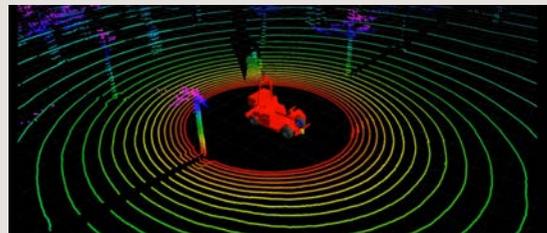
GEOMETRIC COMPUTER VISION
Single and multi-camera pose estimation
Non-rigid 3D object reconstruction
Human motion analysis
Real time augmented reality

TECHNOLOGICAL EXPERTISE

SMART FACTORIES (INDUSTRY 4.0)

HUMAN-ROBOT COOPERATION

Shared workspaces with robots
Object recognition for robot autonomy
Safe robotics approaches
Easy robot programming

FACTORY AUTOMATION

Decision-support tools for constrained systems
Optimization of operations
Redundant and fault tolerant control

SOCIAL ROBOTICS

ROBOT COMPANION

Multimodal interaction
Generation of empathic robot behaviours
Computer vision for social robotics
Robot navigation in crowded environments
Robotics ethics

ASSISTIVE ROBOTICS

PROACTIVE ASSISTANCE TO DISABLED USERS

Improvement of user autonomy
Robot programming by demonstration
Adaptation of robot behaviour
Robotics support for dressing or feeding tasks

### PERCEPTION AND MANIPULATION OF DEFORMABLE OBJECTS

Garment detection, tracking and classification
Detection of grasping points
Garment folding and manipulation

COMPLEX
SYSTEMS CONTROL

MODELLING, CONTROL AND SUPERVISION OF COMPLEX SYSTEMS

Dynamic modeling and paremeter identification
Real-time monitoring and control
Non-linear and large-scale systems
Fault-tolerant control
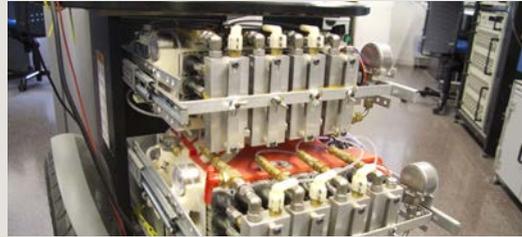
ENERGY
SYSTEMS

FUEL CELL SYSTEMS

Fuel cell modeling and experimental characterization
Fuel cell efficiency and durability analysis
Ethanol reformers for hydrogen production
Fuel cell systems controller design
Fuel cell integration into vehicles

ENERGY MANAGEMENT

Control and integration of renewable energy sources
Energy distribution and efficiency
Enviromental impact
Operation of critical infrastructure systems

WATER CYCLE
CONTROL SYSTEMS

DRINKING WATER NETWORKS

Modeling of drinking water networks
Real-time monitoring and control

URBAN DRAINAGE SYSTEMS

Real-time control of sewage systems
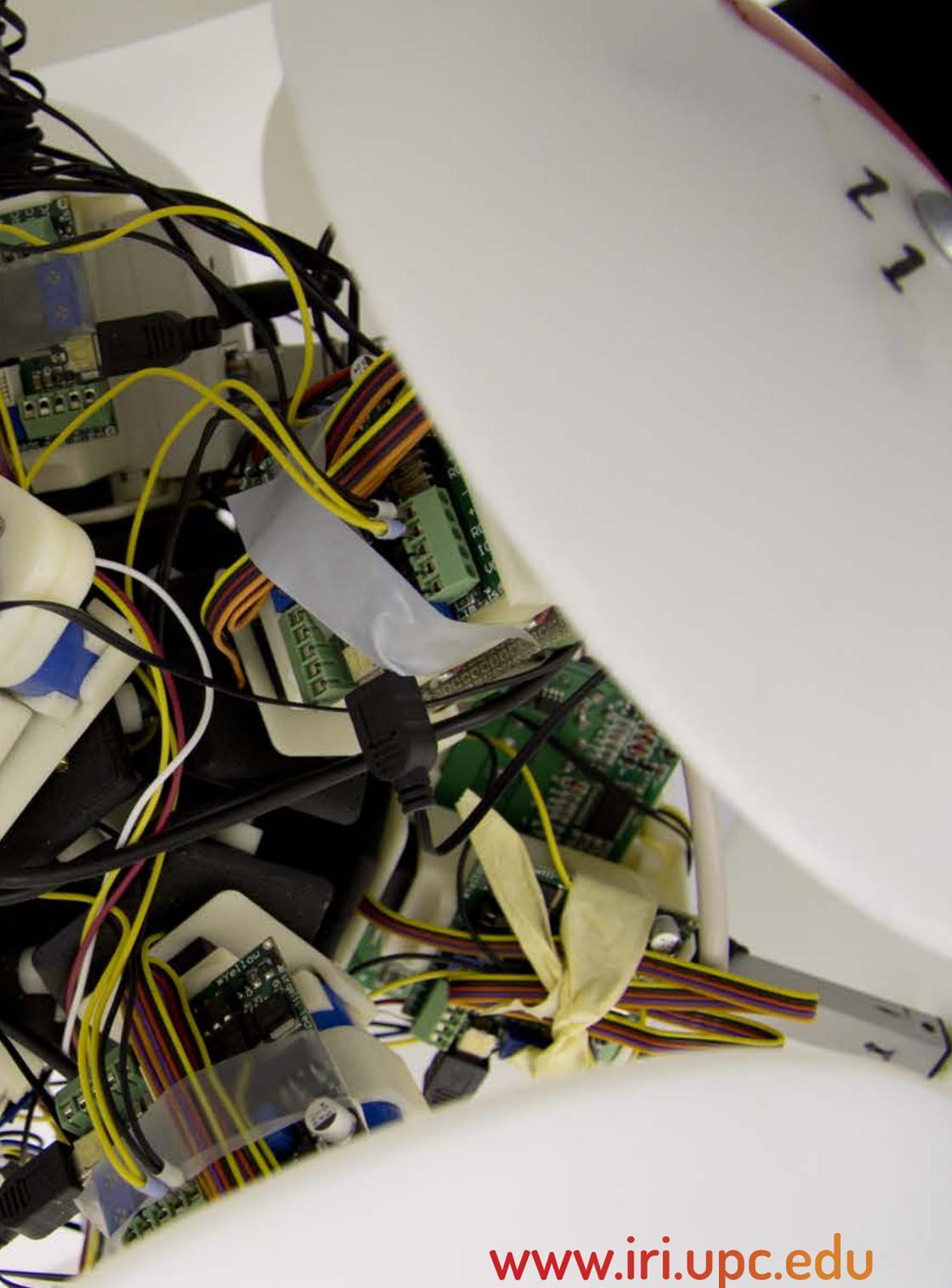Control of wastewater treatment plants

CONTACT WITH US

Do you want to collaborate with us? If you think we can help you by providing a technologic solution to your business, please contact us:

info@iri.upc.edu
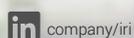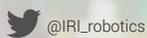
SOME OF OUR COLLABORATORS AND CLIENTS

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