SPORTS TECHNOLOGIES AND PHYSICAL ACTIVITY AT UPC

2023

UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

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UPC

Get to know the Polytechnic University of Catalonia (UPC) and discover some of its indicators.

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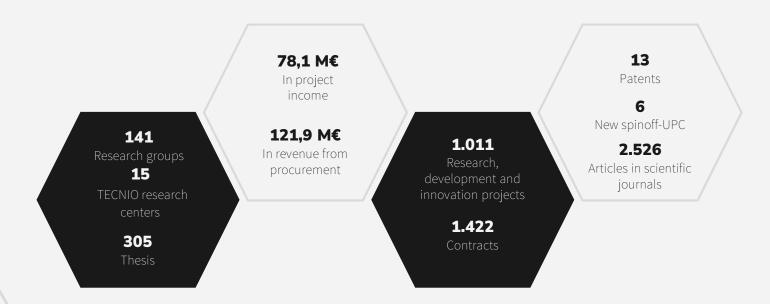
01 THE UPC

The Universitat Politècnica de Catalunya (UPC) is a public institution of research and higher education in the fields of engineering, architecture, sciences and technology, and one of the leading technical universities in Europe.

The UPC participates in the innovation system of Catalonia with projects and contracts for research, development, valorization of knowledge and commercialization of technology.

RESEARCH, DEVELOPMENT AND INNOVATION ACTIVITY AT THE UPC 2022

141
Research groups
15
TECNIO research centers

305
Thesis

78,1 M€
In project income

121,9 M€
In revenue from procurement

1.011
Research, development and innovation projects

1.422
Contracts

13
Patents

6
New spinoff-UPC

2.526
Articles in scientific journals

RESEARCH AND INNOVATION

R&D

Through the research groups distributed by its Schools and Faculties, the UPC has facilities and resources to provide its own services. The most requested services are diagnosis, advice, development, demonstration, training, promotion and support. With special attention to industry and the health sector in the promotion and deployment of sport and physical activity technologies at the UPC.

02 SPORTS AND PHYSICAL ACTIVITY TECHNOLOGIES

The sports sector is currently experiencing a disruptive process in which all procedures and/or management and business models are being transformed.

There are currently multiple technological applications in sports and physical activity technologies, for example the use of recovery and control methods for rehabilitation or injury prevention. Or applications for control, assessment of sports performance, technique, tactics or health progress using sensors, accelerometers or other technologies.

Monitoring   Data Analytics   Sensors

Technical equipment   Wearables   eSports   Apps

APPLIED SPORTS AND PHYSICAL ACTIVITY TECHNOLOGIES

IMATGE MÈDICA

Creation of images of the human body for analysis and clinical diagnosis. The most used techniques in sports are magnetic resonance imaging and ultrasound.

BIOINFORMATICS AND BIOSTATISTICS

Management and analysis of biological data applied to physical activity. How genetics, genomics and other approaches influence the practice of exercises (skills, rehabilitation, injury prevention, etc.).

ARTIFICIAL INTELLIGENCE

Intelligent decision-making technologies performed by machines.

BIOMECHANICS

Study, analysis and description of human motion and its forces, in order to solve anatomical or movement problems.

ROBOTICS

Robots that help or assist humans to practice a sport or recover from an injury.

TEXTILE ENGINEERING

New textile technologies applied to sport.

VIRTUAL REALITY

Simulated experience through sensors and stimuli provided by a computer that applied to physical activity and sport allows gamification, measuring sports performance and training, among others.

BIOMEDICAL INSTRUMENTATION

Instrumentation that can be used to measure and quantify a biophysical function.

BIOMATERIALS

Substances that can be introduced into the body as a medical device or as an organ replacement, for example, surgical staples, meniscus repair devices, bone tissue replacement, etc.

BIOMEDICAL SYSTEMS AND SIGNALS

Signals and systems used to see how the body reacts to training.

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SPORTS TECHNOLOGIES – EXAMPLES OF SCIENTIFIC PRODUCTION

TEXTILE ENGINEERING

New textile technologies applied to sport

A smart shirt for motor rehabilitation of the upper arm.

Impact of training in elite athletes on cardiac function and neural regulation

Study of the characteristics of neural regulation and cardiac function, obtained through the processing and interpretation of cardiac signals.

Development of a parametric system for the customization of pointe shoes

Study of the anatomical parameters, assembly mechanics and materials for the development of the pointe shoe.

Electronic integration in textile substrates for the development of smart fabrics

Design, simulation and characterization of antennas, sensors and circuits using textile materials and techniques to facilitate the development of smart fabrics.

BIOMEDICAL SYSTEMS AND SIGNALS

Signals and systems used to see how the body reacts to training.

Development of methods for measuring the level of effort/recovery in the practice of physical exercise, based on cardiovascular activity, temperature and respiration.

SPORTS TECHNOLOGIES – EXAMPLES OF SCIENTIFIC PRODUCTION

A framework for the analytical and visual interpretation of complex spatiotemporal dynamics in football.

BIOINFORMATICS AND BIOSTATISTICS

Management and analysis of biological data applied to physical activity. For example genetics, genomics and other approaches that influence the practice of exercises (rehabilitation, injury prevention, etc.)

Deep Learning for Video Analytics in Sport Events

Video analysis of sporting events using neural networks.

Validity of neural networks to determine the position of the body in the bicycle

Study that evaluates the validity of certain neural networks trained to estimate body segments from images.

ARTIFICIAL INTELLIGENCE

Intelligent decision-making technologies performed by machines.

Recognition of tactical patterns in football

Project focused on treating and studying the individual behaviors of the players in order to establish models or predictive tactical patterns.

Using GPS to measure external load and estimate the incidence of muscle injuries in men's football

Improving performance and injury prevention in training and recovery by understanding the incidence of muscle injuries from external load measurements in different football teams.

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SPORTS TECHNOLOGIES – EXAMPLES OF SCIENTIFIC PRODUCTION

BIOMECHANICS

Improving performance and injury prevention in training and recovery by understanding the incidence of muscle injuries from external load measurements in different football teams.

Data tracking and predictive simulations of sprint execution

Musculoskeletal modeling and simulation to perform a data tracking simulation.

Marker-free monitoring protocol to analyze biomechanical joint metrics during pedaling

Low cost tracking system combined with inexpensive strength measurement to track or improve cycling training plans.

ArmTracker: A wearable system to assess motor function of the upper limbs during daily life for patients with Duchenne muscular dystrophy and spinal muscular atrophy.

Development of a new system to predict the risk of knee injury in athletes using tools suitable for clinical practice

Comprehensive and portable system for analyzing the risk of knee injury in athletes through jumping.

ROBOTICS

Robots that help or assist humans to practice a sport or recover from an injury.

PosMOFYA-Hybrid Platform Orthosis-Chair to make Mobility, Functionality and Acceptability of application compatible in domestic environments

Equip a wheelchair with the functionality provided by an exoskeleton (stand up, move arms, etc.) without the need to use an exoskeleton.

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SPORTS TECHNOLOGIES – EXAMPLES OF SCIENTIFIC PRODUCTION

VIRTUAL REALITY

Simulated experience through sensors and stimuli provided by a computer that applied to physical activity and sport allows gamification, measuring sports performance and training, among others.

Visualization, modeling, simulation and interaction with 3D models. Applications in life sciences and rural and urban environments.

Estimating player positions from high-angle paddle videos: accuracy comparison of recent computer vision methods.

AvatarGo: plug and play auto avatars through virtual reality

Fast and easy to use and configure system to calculate exact displacement values, unique to each user, leading to improvements in avatar movement.

Virtual Reality for the rehabilitation of patients with physical disabilities

Design of virtual reality applications for people who have suffered a stroke and can use them from home and can send the progress of their treatment to the therapist online.

Design and implementation of a laboratory for the clinical validation of aids for perception and mobility in patients with peripheral field limitation.

Motion estimation and control with event cameras

The goal is to treat the entire cycle of perception-action in an appropriate way in robotic platforms with very demanding dynamics such as humanoids, other legged robots, aerial vehicles or even aerial manipulators.

SPORTS TECHNOLOGIES – EXAMPLES OF SCIENTIFIC PRODUCTION

MEDICAL IMAGING
Creation of images of the human body for analysis and clinical diagnosis. The most used techniques in sports are magnetic resonance imaging and ultrasound.

Muscle changes detected by localized bioimpedance and magnetic resonance, after muscle injury and until return to play, in professional sports teams.

Bio-Tune: new multifunctional materials for implants

Development of innovative multifunctional materials to produce a new generation of medical implants with the ability to regulate cellular behavior and increase their antibacterial potential.

BIOMATERIALS
Substances that can be introduced into the body as a medical device or as an organ replacement.

Synthesis and catabolism of type II collagen in marathon runners.
Marathon running increases synthesis and decreases catabolism of type II cartilage joint collagen accompanied by high energy demands and an inflammatory reaction.

BIOMEDICAL INSTRUMENTATION
Instrumentation that can be used to measure and quantify a biophysical function.
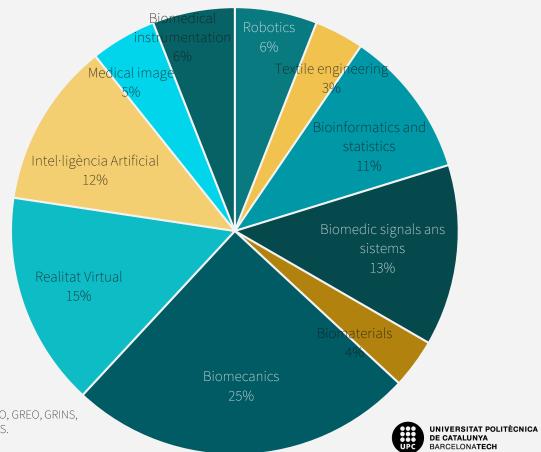
03
RESEARCH & INNOVATION

R&D

Through the research groups distributed by its Schools and Faculties, the UPC has facilities and resources to provide its own services, in the areas of diagnosis, advice, development, demonstration, training, promotion and support to industry, the public sector and civil society in the promotion and deployment of sports and physical activity innovation technologies.

SCIENTIFIC ACTIVITY AT UPC

25 RESEARCH GROUPS

5 SPECIFIC RESEARCH CENTERS **

*ADR&M, ANCORA, B2SLAB, BBT, BIOART, BIOMEC, DISEN, GCEM, GIE, GPI, GRBIO, GREO, GRINS, IEB, IMP, InSup, ISSET, LAM, LARCA, RFEMC, TECTEX, TECNOFAB, ViRVIG, VOS, VIS.
**CREB, TALP, CD6, CRnE, CETpD

Pie chart labels:
- Biomedical instrumentation 6%
- Robotics 6%
- Textile engineering 3%
- Bioinformatics and statistics 11%
- Medical image 5%
- Intel·ligència Artificial 12%
- Biomedic signals ans sistems 13%
- Realitat Virtual 15%
- Biomaterials 4%
- Biomecanics 25%

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BIOMEC - Biomechanical Engineering Lab

The UPC Biomechanical Engineering group develops multicentric biomechanical models to analyze and simulate the dynamics of human movement for clinical and sports applications. It also designs and builds, based on previous models, custom robotic devices that improve human movement and neurorehabilitation.

CETpD - Technical Research Centre for Dependency Care and Autonomous Living

The main research environment of the CETpD is focused on the development of new knowledge in the field of hardware - software technologies with the aim of contributing to the improvement of the quality of life of chronic patients, people with specific needs, related to human movement, mainly in the detection and compensatory action of movement dysfunctions.

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04 UPC EXCELLENCE PROJECTS

In this document are considered excellence projects those in which:

- The scientific process is rigorous and complex with high quality standards.
- They are strategic and tractors.
- They acquire a commitment to both social aspects and to great scientific and socioeconomic impact.
- They have repercussions on the territory.
- They comprise the different entities participating in the quadruple helix, so that the projects remain multidisciplinary.

ALPE Project **- Altitude performance in elite athletes: genetic, metabolic and neurocardiovascular analysis in training and competition**

The project aims for the understanding of the differences in performance between sea level and moderate altitude training.
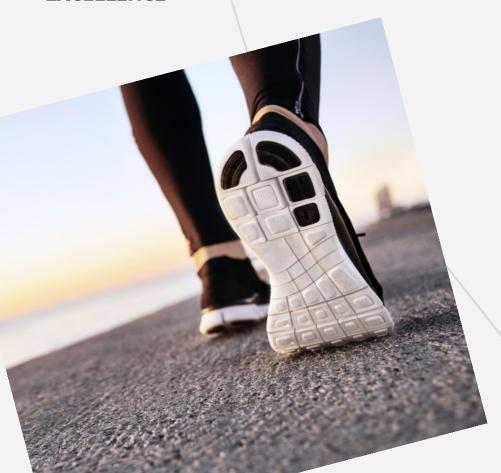
It will also deepen the integration of metabolomics with phenotypic data through the analysis of complex and heterogeneous data in a multilevel scheme.

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PROJECTS OF UPC EXCELLENCE

Funee - APP for the diagnosis of injuries of the anterior cruciate ligament of the knee

The Multimedia Applications Laboratory (LAM UPC) has developed an application that measures the antero-posterior translation of the tibia against the femur to help diagnose injuries of the anterior cruciate ligament of the knee.

The development has been carried out jointly with ICATME (*Institut Català de Traumatologia i Medicina de l'Esport*) of the *Hospital Universitari Dexeus* and l'*Hospital del Mar de Barcelona*.

UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONA**TECH**

Development [MOVit Game](#): an interactive gaming platform to promote physical activity in people with Duchenne using the MOVit wheelchair

The goal is to provide an interactive game platform for physical exercise in a controlled way. The interactive play platform will be used in combination with the MOVit wheelchair.

Instead of using a joystick, the MOVit system allows the user to control the direction and speed of the chair through the cyclic movement of the arms.
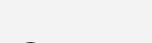
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[MESURAR]() - Monitoring robotic walker users with mobility problems by means of werable sensors

The objective of this project is the development and validation of a monitoring system that provides continuous information of clinical utility on the status of the user who uses the robotic walker.

This project proposes the use of wearable sensors by:

- Obtain information from the user continuously to adapt the control deployed in the walker to their needs.
- Provide useful information to doctors about the evolution of users' health status.

The project will result in a new portable sensor system with the aim of monitoring the activity of people with mobility problems and providing relevant and quality clinical information.

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[ABLE Human Motion](#) - Exoskeleton

ABLE is the first lightweight, easy-to-use and inexpensive exoskeleton that allows people with paraplegia to get out of their wheelchairs and walk again naturally and intuitively.

It helps to mitigate health problems caused by a sedentary lifestyle, increasing self-confidence and independence in activities of daily living.

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MyoSleeve: A care device for the treatment of neuromuscular injuries

MyoSleeve is a portable device for the rehabilitation of neuromuscular disorders related to the forearm: a complete solution based on high-resolution electromyography (HD-EMG).

Myosleeve is composed of three important parts:

- Sleeve made of smart fabric with embedded electrodes for EMG recording that fits the patients' forearm without hindering their movements and transmits the information wirelessly.
- User-friendly and interactive visual feedback system able to keep the patient involved in the treatment through exercises with serious games.
- Programming platform in real time for clinicians where expert algorithms, machine learning, measure precise muscle activation, imbalances and fatigue, among others.
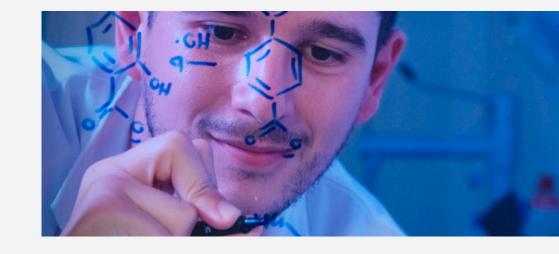

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PROJECTS OF UPC EXCELLENCE

XarTEC SALUT – R&D Network in Health Technologies

The Xartec Salut network is made up of 47 research groups belonging to 17 different institutions.
It is a catalyst for R+D+I in the field of HealthTech through:

- The promotion of the exchange of knowledge between research groups, institutions, hospitals and companies.

- The promotion of the creation of companies and new professional opportunities.

- The offer of the most efficient instruments for the transfer of technology.

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FITLAB-Sensor - Development of methods for measuring the level of effort/recovery in the practice of physical exercise, based on cardiovascular activity, temperature and respiration
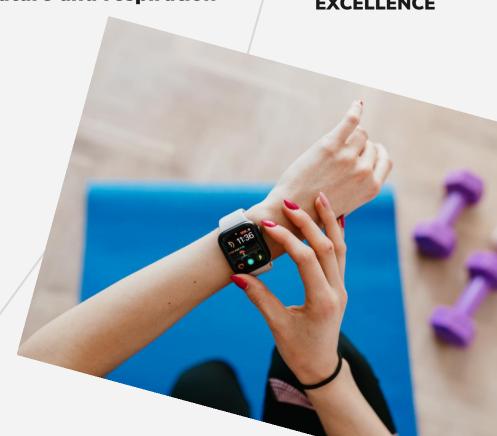
The project aims to advance the development of new sensors and methods of biomedical signal analysis for the study of sleep using discrete and reliable techniques and to study the relationship between sleep quality and performance in sports practice.

It is also intended to develop reliable markers of internal and external load during physical exercise for the study of the balance of effort recovery in sports practice, being able to apply some of these results to the population as well general.

The newest features of the proposal are:
- The use of video and depth signals for the study of sleep
- The identification of the different phases.

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05

EDUCATION

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EDUCATION – BACHELOR'S DEGREES

Grado en Ciencias y Tecnologías Aplicadas al Deporte y al Acondicionamiento Físico (CTEF)

Bachelor's degree in Video Game Design and Development

Bachelor's degree in Audiovisual Systems

Bachelor's degree in Biomedical Engineering

Bachelor's degree in Multimedia Studies

Bachelor's degree in Bioinformatics

Bachelor's degree in Design, Animation and Digital Art

Bachelor's degree in Artificial Intelligence

Bachelor's degree in Informatics Engineering

Bachelor's degree in Data Science and Engineering

More information on UPC bachelor's degrees

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EDUCATION – MASTER'S DEGREES

Master's degree in Neuroengineering and Rehabilitation

Master's degree in Artificial Intelligence

Master's degree in Informatics Engineering

Master's degree in Biomedical Engineering

Master's degree in Innovation and Research in Informatics (MIRI)

Master's degree in Biomedical Data Science

Master's degree in Automatic Control and Robotics

Erasmus Mundus Master in Advanced Materials Science and Engineering

Master's degree in Textile Design and Technology

Master's degree in Data Science

More information on UPC master's degrees

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