



science research technology education innovation

# **EXCELLENCE**





**ORGANIZATION:** FOUNDATION FOR RESEARCH AND TECHNOLOGY - HELLAS

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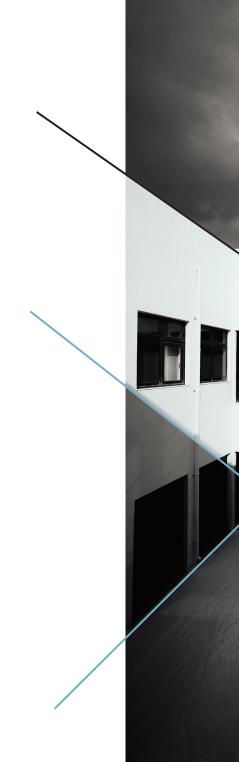
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# **Description**

The Foundation for Research and Technology - Hellas (FORTH) was founded in 1983. It is one of the largest Research Centers in Greece with well-organized facilities, highly qualified personnel and a reputation as a top-level research institution worldwide.

FORTH is constituted of 7 Research Institutes conducting specialized scientific research in strategic high-added value sectors, focusing on interdisciplinary research and development (R&D) activities in areas of major scientific, societal and economic interest, such as: Lasers and Photonics, Microelectronics, Advanced Materials/Nanotechnology, Molecular Biology and Genetics, Biotechnology, Computer Science, Bioinformatics, Precision Medicine, Systems Biology, Robotics, Telecommunications, Applied and Computational Mathematics, Chemical Engineering Sciences, Energy, Environment, Human and Social Sciences, Astrophysics and Astronomy.

FORTH cooperates closely with prestigious Academic and Research Institutions in Greece and abroad and takes a significant interest in the education and training of young scientists.

Today, FORTH plays a substantial role in the planning and implementation of Smart Specialization Strategies (RIS3) in Greece.



A Research Center of Scientific Excellence





# **FORTH** in **Numbers**



- • 7 Institutes in 4 cities of Greece
- • 3 Units
- ••• 1,184 members



### **Distinctions**

FORTH researchers have received major Awards and Distinctions from International Scientific Societies, indicatively:

European Research Council, American Physical Society, Optical Society of America, Royal Society of Chemistry, Russian Optical Society, European Society of Rheology, European Science Foundation, FENS-Kavli Network of Excellence, AXA Research Fund, Academia Europea, European Molecular Biology, Helmholtz Association, Bodossakis Foundation, Empeirikeion Foundation, American Association for Aerosol Research, American Institute of Chemical Association Engineers, Euroscience, Computing Machinery, European Association for Artificial Intelligence, European Institute for Health Records, Society for Medical Innovation and Technology, Galien Foundation, Alexander von Humboldt Foundation, Hellenic Federation of Enterprises, IBM, Getty, Ericsson, Microsoft.

- 28 ERC Grants
- 92 Marie Curie
   Excellence Awards

Ist

- among the Research Centers in Greece, in all comparative evaluations conducted by international committees
- • in Nature INDEX, among the top Research Institutions in Greece (1/2/2016 31/1/2017)
- in Greece in the Ranking Web of Research Centers, Webometrics 2017
- in Greece and 17th among the 50 top European Research Centers in attracting competitive Funding (FP7 Monitoring Report, 2014)

### **The People** (2017)

Members: 1,184

Permanent staff: 347

Researchers: 95

Collaborating Faculty Members: 135

Fellowships/year (incl. postdoctoral): 424

Research associates, technical

and administrative personnel: 530



### Research institutes

### • • • in Heraklion

- Institute of Electronic Structure and Laser (IESL)
- Institute of Molecular Biology and Biotechnology (IMBB)
  - Biomedical Research Division in Ioannina
- Institute of Computer Science (ICS)
- Institute of Applied and Computational Mathematics (IACM)
- Institute of Astrophysics (IA)

### • • • in Rethymnon

- Institute for Mediterranean Studies (IMS)

### • • in Patras

- Institute of Chemical Engineering Sciences (ICE-HT)

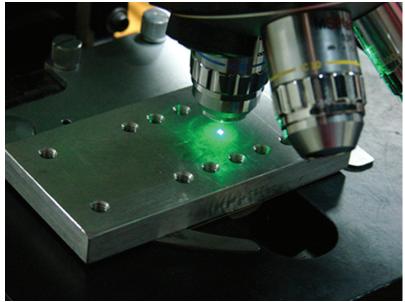
### **Units**

- Crete University Press (CUP)
- PRAXI Network
- Science and Technology Park of Crete (STEP-C)



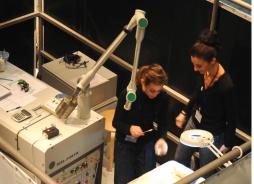








IESL, founded in 1983, has established its international presence by performing high quality fundamental and applied scientific research in:







- Laser science and applications in the areas of strong field physics, atomic and molecular physics and chemical dynamics, theoretical atomic, molecular and optical physics and chemistry, micro/nano-processing of materials, photonics for cultural heritage science, photonic materials and devices, biophotonics & biomedical applications and quantum optics.
- Materials and devices, which include micro/nanoelectronics of compound semiconductors and their devices, nanomaterials and nanophotonics, polymers and soft matter, biomaterials, electronic, magnetic and photonic materials, hybrid nanomaterials and meta-materials.
- Astrophysics and astronomy, with studies in a broad range of astrophysical phenomena utilizing observational data from ground-based and space facilities, and in developing new theoretical methods for the interpretation of the observations. IESL operates the Skinakas Observatory.

# Institute of **Electronic**Structure and Laser

IESL is an active partner of the European Programme of Research Infrastructures: since 1990, IESL has been operating the Ultraviolet Laser Facility, part of LASERLAB EUROPE, participates in the infrastructures IPERION CH and PARTHENOS (Cultural Heritage Science), EUSMI (Soft Matter), NFFA (Nanoscience), ACTFAST (Photonics for SMEs) as well as in the Extreme Light Infrastructure (ELI) and the European Research Infrastructure for Heritage Science (E-RIHS), in the framework of the Roadmap of the European Strategy Forum for Research Infrastructures (ESFRI).

IMBB

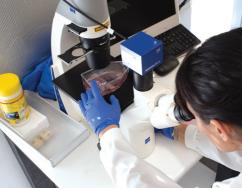
was founded in 1983. It is one of the most prominent life science Research Institutes in

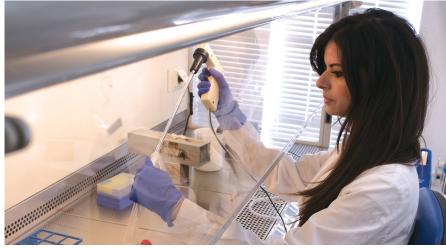
Greece, with an outstanding record of scientific achievements, state of the art infrastructure and a broad range of research, innovation and educational activities. IMBB main mission is to pursue cutting-edge research and promote scientific excellence.

IMBB research directions are accomplished through the use of appropriate model organisms and they are categorized in the horizontal activities referred below:

# Institute of Molecular Biology and Biotechnology







### Hypothesis driven research:

- Mechanisms of regulation of gene expression
- Cellular integration
- Mechanisms of developmental processes
- Neurobiology neurodegeneration and ageing

### Discovery driven research:

- Proteomics
- Post genomics

### Interdisciplinary research:

- Computational Biology
- Optics and Biology
- Biosensors

### **Technology development:**

- Functional genomics
- Environmentally friendly pest control

#### **Products & services:**

- Enzymes, Proteins, Microorganisms fermentation

# nstitute of Computer Science

# ICS

Since its establishment in 1983, ICS has been conducting basic and applied research in Information and Communication Technologies (ICTs). A major activity of ICS is the study, design and implementation of systems in the broader spectrum of ICTs for the development of the Information Society, and the advancement of science for the benefit of Society, Economy and Public Administration.







The main directions of research in ICS are the following:

- Computer Architecture
- Distributed Systems
- Computer Networks & Telecommunications
- Systems and Network Security
- Information Systems
- Human-Computer Interaction
- Signal Processing
- Computational Vision
- Robotics
- Artificial Intelligence
- Computational Biomedicine

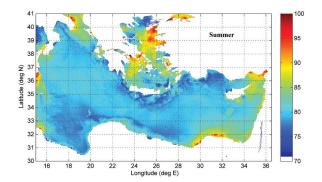
Cross-disciplinary research directions include Ambient Intelligence, Data Science and Advanced Hybrid Imaging Systems, whereas application areas of strategic importance comprise Cultural Informatics and E-health applications and services.

ICS is a member of the European Research Consortium on Informatics and Mathematics (ERCIM) and ran the W3C Greek Office. The Department of Systems and Networks of ICS operates the registry for domain names .gr and .ɛn as well as a Cybersecurity Emergency Response Team (FORTHcert).

# IACM

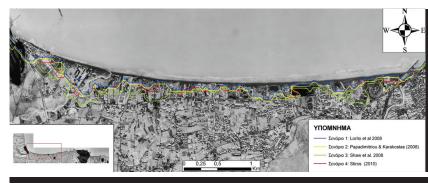
IACM was established in 1985 and it is the only Research Institute on Applied and Computational Mathematics in Greece. It focuses on the development of mathematical and computational methods to address interdisciplinary problems. It successfully fosters synergies among Greek researchers in Mathematical Sciences and is considered a national reference point for the promotion of Applied Mathematics.

It has established long-term collaborations with several European Applied Mathematics Institutes and Centres.



# Institute of **Applied and Computational Mathematics**

IACM research groups are active in the areas of Complex Systems (Applied Analysis and Modelling), Wave Propagation, Regional Analysis, Geographical Information Systems and Remote Sensing, Computational Neurosciences, Socio-Educational Research and Innovation and Numerical Analysis and Computational Science.



Current cutting edge activities involving researchers from various groups and other FORTH institutes are:

- IACM-bio Biomedical applications
- IACM-geo Geosciences applications
- Data Science Programme



# Institute for Mediterranean Studies



IMS research is organized on the following thematic axes:

- Ottoman History
- Global and Mediterranean Economic and Social History
- History of Cities, Diaspora and Immigration in the Mediterranean and the Black Sea
- Maritime History
- History of Technology
- History of Art
- History of Theatre
- Image, Sound and Movement
- Ancient Greek, Byzantine and Modern Literature
- Geo-informatics, Archaeology and Environment

IMS was founded in 1985 to promote research in humanities, social sciences and the application of science and technology to cultural heritage. It has been distinguished for its historical research as well as for the application of new technologies in archaeological research. It has a specialized library and archive material.







ICE-HT, located in Rio-Patras, was established in 1984 as an independent Research Institute and in 1987 became one of the founding Institutes of FORTH.

Its mission includes:

- forefront scientific research
- cooperation with industrial companies in EU and other countries
- development of innovative technological products, key enabling technologies (KETs) and production processes
- participation in the creation of spin-off companies
- cooperation with other research & development (R&D) organizations
- training and advanced education of new researchers
- active participation and contribution to the development of the Region of Western Greece
- significant contribution to the technological advancement of Greece

ICE-HT conducts basic, applied and technological research in a wide range of fields in chemical engineering sciences, and provides specialized services to academia and industry, in the context of three main Research Areas (RAs):

RA1: Advanced Materials / Nanotechnology

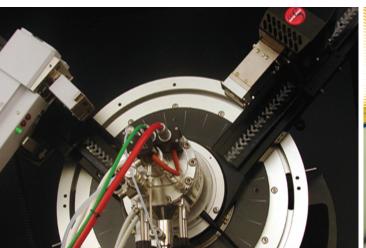
RA2: Energy / Environment

**RA3**: Biosciences / Biotechnology

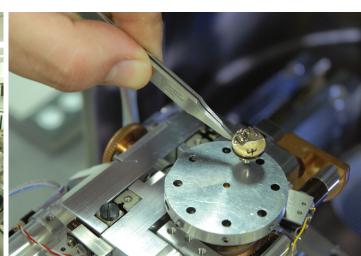
and their interfaces (e.g. nanobiotechnology, materials for energy technologies and environmental applications, biofuels, metabolic engineering / systems biology).

# Institute of **Chemical Engineering Sciences**

# **ICE-HT**







A new Institute, the only one in Greece dedicated exclusively to Astrophysics, has been established at FORTH.

This Institute is the evolution of the very successful Astrophysics and Astronomy research activities that have been taking place in Crete for many years, in strong collaboration between the University of Crete and FORTH-IESL. Its aim is to promote



# Institute of Astrophysics

research in terms of excellence and innovation and to become a critical parameter for equal participation of the country in the rapid development of this field internationally, as well as a pole of attraction for excellent Greek scholars from abroad.

The Astrophysics Group will constitute the main body of the Institute. The basic research infrastructures have already been operating in Crete at the Skinakas Observatory since it was founded in 1986 jointly by FORTH, the University of Crete and the Max-Planck Institut für Extraterrestrische Physik in Germany. The Observatory is located in the Psiloritis area and is distinguished for its excellent observation conditions.

The establishment of the IA will be a catalyst for successful funding applications both from the European Space Agency (ESA) and the European Competitive Programs.







Crete University Press was founded in 1984, initially financed by a grant from the Pancretan Association of America, and has since been operating, under the umbrella of FORTH, as a non-profit, self-funded publishing house. It publishes books for students, scientists and the average reader, covering the fields of natural, formal and social sciences, humanities, as well as the arts. Furthermore, since 2015, CUP has been providing free online courses through the Mathesis programme, placing emphasis in the joy of learning and

insisting on the highest quality standards, with a view to keep Greece abreast of the evolving changes in worldwide education.

Through its publishing activities, CUP principally aims to complement academic teaching with carefully selected textbooks, encourage and facilitate original research with publishing opportunities, and provide the broad educated public with first-class books on hotly debated issues of our times. Compliance with the international quality standards, openness, and maintenance of its intellectual autonomy have always been its guiding principles. It is based in Heraklion, Crete, while maintaining offices and a bookshop in Athens.





# Praxi Network

PRAXI Network started out in 1991 assisting Greek small and medium-sized enterprises (SMEs) and research organisations in their technology transfer and innovation related endeavours.

Its mission is to render them more competitive by linking research and industry, promoting innovation and entrepreneurship as well as transnational cooperation.

Established in 5 cities (Athens, Thessaloniki, Heraklion, Volos, Patras), with more than 30 executives and almost 30 years of know-how, PRAXI Network:



- Operates the Technology Transfer Office of FORTH, providing support for the commercial exploitation of research results. It is a member of the European Technology Transfer Offices (TTO) Circle.
- Supports SMEs to innovate and grow internationally, by being a member of the Enterprise Europe Network, the largest network of integrated business support to SMEs and coordinator of the Greek node.
- Informs and advises on the EU Framework Programs for Research, Innovation and Technological Development, as a National Contact Point.
- Functions as the coordinator of the European node of ASEM – Cooperation Centre for Science, Technology and Innovation – CCSTI, between Europe and Asia.
- Develops a Foresight Unit to systematically explore future trends and promote innovative thinking and creativity for businesses, and research institutions.
- Contributes to the design and implementation of national and regional policies, mechanisms and tools to support and finance innovation.





Science and Technology Park of Crete (STEP-C) was established in 1993 as an initiative of the Foundation for Research and Technology Hellas (FORTH). The Park has a total of 4000 sq.m floor space with more than 100 offices and labs, accommodating small technological and service companies in two buildings.

Particularly the main objectives of the Park are:

- technology transfer and commercial exploitation of mature research outcomes
- assessment, management and exploitation of intellectual property rights
- promotion and support of innovative entrepreneurship
- hosting and support of innovative start-up & spin-off companies
- training of companies' staff
- training seminars on Intellectual Property and Patents management, Innovation and Regional Development, Quality Assurance and New Management Techniques, Business Meetings and Brokerage Events for the promotion of new technologies across Greece
- collaborations with local and regional authorities and business associations: STEP-C has developed bilateral



### Science and Technology Park of Crete



coordination activities with key regional and national actors, in the areas of Entrepreneurship and Regional Development, Technology Transfer and Exploitation and plays an important role in the development and implementation of Regional Innovation Policy.

STEP-C is a member of the International Association of Science Parks and Areas of Innovation (IASP) and member of the European EURAXESS Network.

### significant innovations



#### Laser in Cultural Heritage

The Institute of Electronic Structure and Laser (IESL) has developed a novel laser-based system – a worldwide innovation for the cleaning of the Parthenon West Frieze and the Acropolis sculptures, which received the 2012 Keck award by the International Institute for Conservation of Historic and Artistic Works (IIC). The laser system utilizes two different beams, one in the UV and one in the IR, with a controlled intensity ratio. The system is both effective and safe for the ancient masterpieces, without any undesirable side effects. This innovative technology led to the establishment of a common research lab with the Palace Museum of the Forbidden City in Beijing.

#### Portable molecular diagnostic system

The Institute of Molecular Biology and Biotechnology (IMBB) has pioneering work related to the development of a portable molecular diagnostic system for performing DNA tests, with application in the fields of healthcare and agro/food safety. Based on this patented technology, nucleic acid detection can take place in a simple, rapid and cost effective manner, thanks to the use of acoustic biochips and 3D-printing technology. The system is currently used for the detection of viruses, pathogens and genetic mutations in a variety of samples, i.e., blood, saliva, nasal swabs, food and plants. It has also been shown to operate at the point-of-care or in the field by using a smart phone for detection.

### **Large-scale Data Linking and Integration**

The Institute of Computer Science (ICS) has implemented LODSyndesis, the largest (at present) Knowledge Graph for Open Linked Data and complete in terms of equivalence relations. The implementation is based on novel algorithms and indices and - at its present state - links 2 billion data items about 400 million distinct entities from 400 sources. It offers services for data linking and integration such as object co-reference verification, discovery of related data sets, connectivity assessment and others.



## Characterization of atmospheric pollution sources with Zeppelin airship

Among large European projects coordinated by the Institute of Chemical Engineering Sciences (ICE-HT), there is the first ever study of air pollution above a continent, using a Zeppelin airship carrying high-tech research equipment. The acquired measurements led to the discovery of chemical processes taking place above ground, the quantification of the pollution transferred from country to country, and the characterization of certain currently underestimated air pollution sources as significant (biomass burning, meat grilling, forest fires etc.). The results of the study are used by EU to establish rules for limiting atmospheric pollution.

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# State-of-the-art research facilities and Activities





**Highly specialized Research Facilities** in Forefront Laser Technologies, which participate actively in the European Research Infrastructures Programme, in the areas of Ultraviolet Lasers, Cultural Heritage Science, Soft Matter and Nanosciences (we have provided more than 3,500 days of access to more than 500 researchers from all over the world within LaserLab alone).

**"Skinakas" Observatory**, in collaboration with the University of Crete and the Max Planck Institute of Extraterrestrial Physics in Germany, which provides the best observation conditions in the Mediterranean Basin. The Skinakas Observatory offers open days to the public during the summer months.

**Common research lab** with the Palace museum of the Forbidden City in Beijing, for technology transfer on the conservation of monuments and Art masterpieces.

**Internationally Associated Lab** in collaboration with CNRS and Aix-Marseille University.

**The 1st Ancient DNA Analysis Lab** in Greece, one of the few in Europe.

**Genomics Analysis Center** with applications in Biomedicine, in Cultural Heritage and in Agrifood sector.

**Biomedical Imaging Unit** equipped with PET/CT (unique in Crete), in collaboration with the Medical School of the University of Crete and the University Hospital of Crete.

**FORTH Graphene Centre**, the main pillar for graphene research in Greece, which actively participates in the Graphene FLAGSHIP - selected as Future and Emerging Technology (FET) by the European Commission.

Computational-Mathematical Intense Data Modelling unit for Materials science and Bio-Medical applications in collaboration with the National Technical University of Athens.

The first Metabolomic Analysis in Systems & Network Biology Laboratory in South-Eastern Europe, contributing to technologies & applications in Precision Medicine and Agriculture.

**Micro-PET facility** in the context of the research taking place in the advanced hybrid imaging systems programme.

The first Laboratory in the Eastern Mediterranean area offering ground based & satellite remote sensing, prospection and GIS management of cultural heritage monuments, sites protection and environmental resources.

**The only research unit in Greece** exclusively dedicated to the systematic study of Ottoman history.

**The only El Greco Centre** of Art History in the Mediterranean.

**The Largest archive for Neohellenic Theatrical** performances in the Eastern Mediterranean from 1830s to 1930s.

The only Centre of Maritime History in Eastern Mediterranean.

**World-class center** for air quality and climate change research, serving as a consultant and providing atmospheric chemical

transport models to several countries and international authorities.

**1st AXA Chair Grant** in Greece, in Epigenetics research.

**Ambient Intelligence (Aml) Programme**, a long term horizontal interdisciplinary RTD Programme, aiming at developing and applying pioneering human centric Aml technologies and Smart Environments in everyday life.

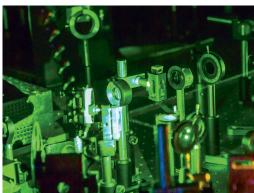
**Data Science Programme** for addressing challenges related to the management and analysis of very large volumes of heterogeneous data in various domains.

**Computational predictive-modelling activities** for geophysical and environmental flows.

**Cutting-edge technology** & expertise in fuel cells, soil pollution monitoring and remediation, clean hydrogen production and CO2 capture.

**Developing processes** for waste biotransformation to useful chemicals.









# edu ca tion

& advanced training

### ••• FORTH:

**awards more than 400 fellowships** per year to undergraduates, Master's and Doctoral students, Postdocs and trainee scientists.

**participates in interdisciplinary graduate programs** in collaboration with Greek Universities:

"Photonics and Nanoelectronics" & "Nanotechnology and Energy Applications" in collaboration with the University of Crete and the Technological and Educational Institute of Crete.

"Biomedical Engineering" in collaboration with the University of Crete & the Technical University of Crete.

"Bioinformatics", "Brain and Mind", "Ottoman History" and "Theatrical and Cinema Studies" in collaboration with the University of Crete.

"Microsystems and Nanostructures" in collaboration with the National Technical University of Athens and Demokritos Research Centre.

FORTH Researchers teach in many graduate programs offered by Greek Universities.

organizes an annual series of advanced seminar lectures,

on cutting-edge research fields in Physics, Chemistry, Biology, Mathematics and Computer Science, in collaboration with the Alexander S. Onassis Public Benefit Foundation. The main objective of the series is to provide an advanced education and training framework for talented Greek and International graduate and senior undergraduate students, which are selected to participate based on academic merit.

**supports secondary education initiatives** for student career advising and interaction with research labs in Greece. Each year, more than 1,100 high school students visit FORTH premises and become acquainted with its scientific activities.

**is visited by 2,500 people every year**, for the last 12 years, on "Researcher's Night", an initiative of the European Commission taking place in parallel in 300 European Cities, on the last Friday of September.

has trained more than 15,000 scientists in new technologies.

has established Crete University Press (CUP), with 600 titles published to-date (25 publications / year), 2,100,000 copies sold (100,000 / year) and 22 Awards. CUP Books have been adopted as textbooks in 1,700 university courses across the country. Crete University Press has established the "Mathesis" Open Online Courses (with 45,000 students to-date).



# employment and entrepreneurship

### ••• FORTH:

has directly or indirectly created >1,200 highly skilled jobs through its activities.

**has contributed to the "brain gain"** by hiring or collaborating with new scientists who currently work as University Professors and Collaborating Faculty Members at FORTH.

has established and developed the first Technology Park in the country, located in Patras, currently supervised by GSRT.

has established the Science and Technology Park of Crete which hosts and supports start-up companies.

has established the PRAXI Network and contributed to more than 500 research and technology contracts with Greek and International companies and Organizations.

has created and operates business clusters in various technology sectors (Hellenic Bio Cluster, Hellenic Photonics Cluster, Innovation Greece).

has developed scientific and technological collaborations with more than 300 companies.

has developed and supported several spin-off companies.

**promotes conference tourism:** ~30.000 overnight stays / year.

directly supports the market of the Regions of Crete and Western Greece with ~ 3 M€ / year.



# Contributions to the **SOCIETAI** and **regional Development**



**provides support to the local regional and municipal authorities**; has contributed to the design of the Research and Innovation Strategies for Smart Specialization (RIS3) in the Regions of Crete, Western Greece and Epirus.

**implements the pilot program "Crete Innovation Initiative" (CrInI)** in cooperation with the local Academic and Research Institutions for the development of a knowledge-based economy in Crete.

has established health information infrastructures in hospitals and medical units in various Greek Regions.

has developed interactive systems, online services and smart environments that contribute to the improvement of urban quality of life as well as, specialized systems and services for the elderly and disabled people.

has participated in the development and operation of the Greek "Safeline" which responds to reports for illegal online content.

**has contributed to the analysis,** diagnosis and conservation of Cultural Heritage objects and monuments.

is involved in projects for the evaluation of the effects of climate change on Monuments like Knossos and Castello a Mare ("Koules") in collaboration with Heraklion Ephorate of Antiquities.

**cooperates widely with cultural Institutions** for the promotion of Greek culture, history, traditional products.

**provides air pollution measurement services** and electromagnetic radiation measurement services from mobile phone antennas in urban environments.

**participates in the Agrifood Cooperation** and is a member of the respective Scientific Committee in the Region of Western Greece.

**actively participates in the Entrepreneurship** and Development Alliance in Western Greece.

**creatively cooperates with the Patras Science Park** for the exploitation of research results and promotion of innovation.

has carried out research in the history of the cities of the Eastern Mediterranean and the Black Sea Aegean and Ionian island communities (18th-20th centuries) and has formed large databases on agricultural and industrial production, on trade, shipping and population structure.

has developed IoT infrastructure and intelligent technologies contributing to the smart city vision of the Municipality of Heraklion.

**organizes open events and lectures** communicating its scientific accomplishments to the public.

# **Our Vision**



To create and maintain
an environment that fosters
Learning, Research and
Innovation as pillars for
Regional, National and European
socio – economic growth



