



HELLENIC REPUBLIC

**National and Kapodistrian  
University of Athens**

EST. 1837



DEPARTMENT OF  
INFORMATICS +  
TELECOMMUNICATIONS

# Scientific Research

## Excellence, Distinctions, Innovation

Prof. Antonis Paschalis  
Chair of the Department

2018



# Department Identity

The Department of Informatics and Telecommunications started as an interdisciplinary program of undergraduate studies of the Departments of **Physics** and **Mathematics** in **1986** and became an independent Department in **1989**

It is a member of the 7 Departments of the School of Sciences of the National and Kapodistrian University of Athens

Supports the following curricula:

- ✓ undergraduate with **6** specializations
- ✓ 3 postgraduate
- ✓ Ph.D.

Participates in **8** interdisciplinary postgraduate study programs

Graduates :

USP: **2.952**    PSP: **1.577**    Ph.D.: **312**





# Vision

The Department of Informatics and Telecommunications aims to be an international point of reference with respect to both **quality of education** and **research excellence** at international level.

Our vision is based on common goals and mutual commitments between the academic staff, the students and the administrative and technical staff of the Department:

- ✓ among the best in the development of cutting-edge technologies and scientific and social exploitation of knowledge
- ✓ among the best in research and international collaborations
- ✓ among the pioneers in social supply in scientific and technological fields related to our cognitive subjects

Member of



INFORMATICS  
EUROPE



# Educational Goals – Undergraduate Studies

The DIT Department offers a modern undergraduate curriculum, based on Information Science curriculums (**Computer Science and Engineering**), jointly proposed by leading international scientific organizations:

- ✓ Association for Computing Machinery (ACM) και
- ✓ Institute of Electronics and Electrical Engineers (IEEE) - Computer Society

enriched with an up to date course cycle  
in **Telecommunications** and **Signal Processing**



Bachelor's degree that certifies, apart from basic knowledge in Information Technology and Telecommunications, focused knowledge in **cross-sector specializations**, where the Department has acquired **excellence in research** at international level:

- ✓ Theoretical foundations
- ✓ Data and knowledge management
- ✓ Software
- ✓ Hardware and architecture
- ✓ Telecommunications and networking
- ✓ Signal and information processing



# Interdisciplinary Postgraduate Study Programs

The DIT Department offers modern post graduate studies:

- ✓ **MSc in Informatics** with specializations in
  - Computer Science Foundations and Applications
  - Data, Information and Knowledge Management
  - Computer Systems: Software and Hardware
- ✓ **MSc in Computer, Telecommunications and Network Engineering** with specializations in
  - Computer Engineering
  - Telecommunications and Signal Processing
  - Computer Networking
- ✓ **MSc in Information and Communication Technologies**



# Postgraduate Study Programs

The DIT Department offers modern postgraduate studies:

- ✓ **MSc in Algorithms, Logic, and Discrete Mathematics**
- ✓ **MSc in Data Science and Information Technologies**  
with specializations in
  - **Big data and Artificial Intelligence**
  - **Bioinformatics – Biomedical data science**
- ✓ **MSc in Management and Economics of Telecommunication Networks and Information Systems**
- ✓ **MSc in Telecommunications and Network Secured Systems**

The DIT Department supports **4** postgraduate study programs offered by other departments



# Department Evaluation

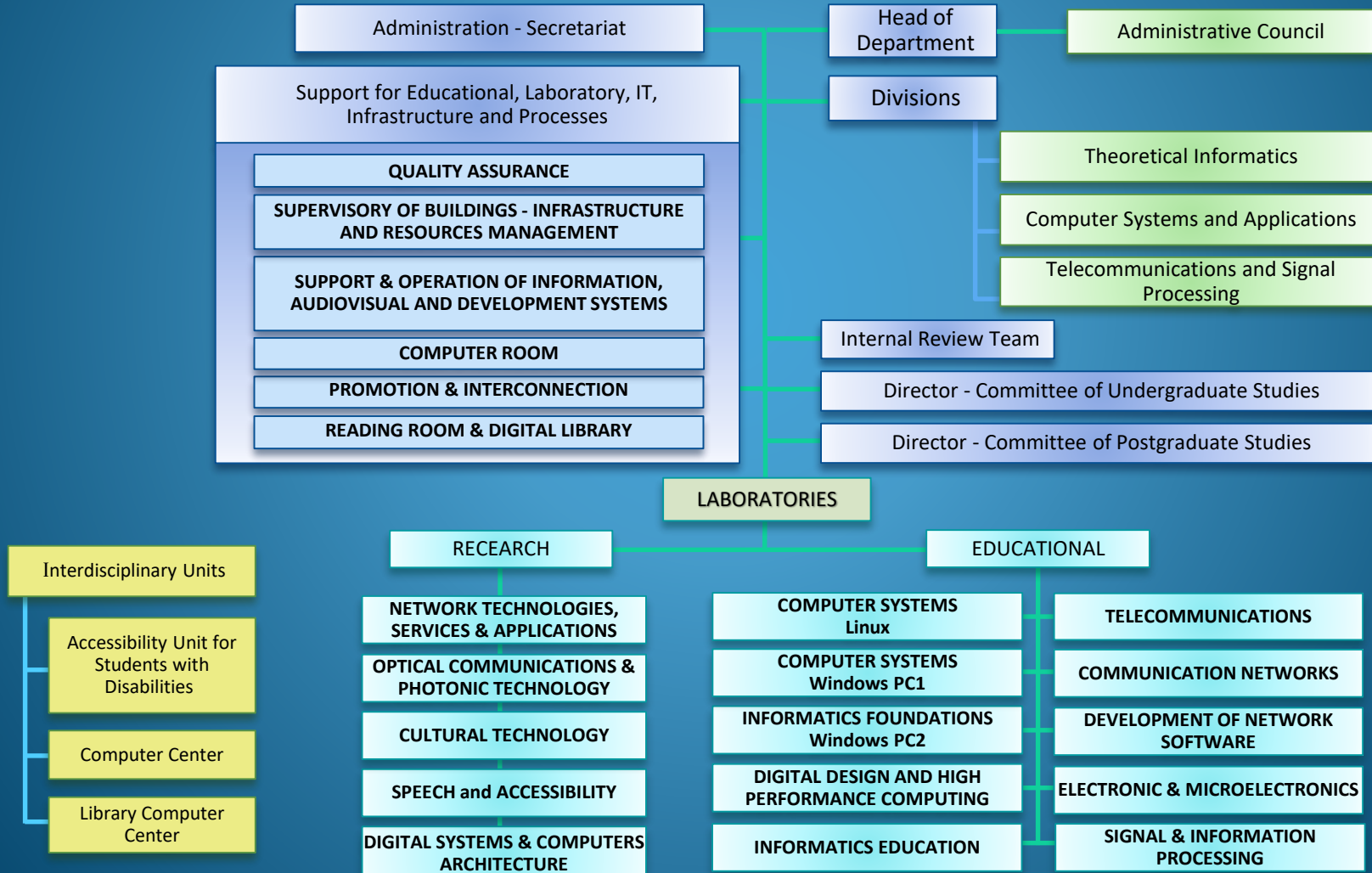
The Committee responsible for the External Evaluation of the Department of Informatics & Telecommunications (May 2011), consisted of five university professors from abroad, states:

“Overall, the committee felt that this is an excellent Department, one of the best in the country (certainly the best among 4-year programmes in the subject of study) that deserves support and encouragement by the Greek State and the National Kapodistrian University of Athens”

According to the annual evaluation carried out by ARWU, the Department of Informatics and Telecommunications of NKUA was ranked in the top 100 departments worldwide for the period 2009 - 2011



# Structure - Organization







# Human Resources & Teaching Work

**21** Professors + **8** Emeritus Prof.

**8** Associate Professors

**7** Assistant Professors

**17** LTS, **5** STLS, **6** AS

The Department offers yearly  
**170** courses in Undergraduate &  
Graduate Programs

- ✓ 84 laboratory courses
- ✓ 20 tutorial courses
- ✓ 4.160 laboratory hours
- ✓ 1.092 hours of practical training (assistantship)

**240** Dissertation & Diploma Theses  
completed each year



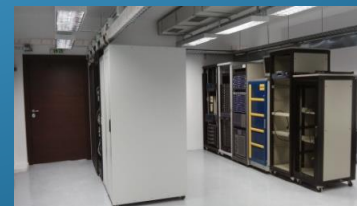


# Infrastructures

- ✓ **3** Amphitheaters (300, 100, 100 seats)
- ✓ **6** Teaching rooms
- ✓ **3** Meeting rooms
- ✓ **1** Reading room
- ✓ **5** Αυτοτελή Laboratories
- ✓ **10** Independent Laboratories
- ✓ **Computer Room**

Support for live broadcast classroom lectures

Ability to view recorded lectures on the Internet





# Honors - Awards

**4** IEEE Fellows (2013 , 2010, 2008, 2007)

ACM Fellow(2004)

EURASIP Fellow (2011)

Member of Academia Europea (2011)

Member of Royal Society of Edinburgh (2009)

**14** Best Paper Award

**8** Best Student Paper Award

**3** PhD Thesis Award

**Gödel Prize** from ACM SIGART for introducing what is today known as the “price of anarchy“, the first quantitative measure of the degree of inefficiency of equilibria in game theory (2012)

IEEE Signal Processing Society - Education Award (2014)

**Athanasios Papoulis Award** for Sustained Fundamental Contributions to Research and Education in Signal Processing and Machine Learning (2014)

**Xanthopoulos-Pnevmatikos Award** for Excellence in Teaching (ITE) (2006)

**2017 Satellite & Space Communication Distinguished Service Award**

**2** Golden Core Member from IEEE Computer Society (2002, 2005)

Continues/Meritorious Service Award from IEEE CS (2005, 2007, 2013)

Meritorious Service Award from EURASIP (2014 )

ACM SIGMOD Contributions Award (2017)



# Research Excellence Funding

- ❖ **1 European Research Council (ERC) Advanced Grant**
  - ALGAME (Algorithms, Games, Mechanisms, and the Price of Anarchy)
  
- ❖ **3 European Research Council (ERC) Starting Grants**
  - SPADE: Sophisticated Program Analysis, Declaratively
  - PPP: Protecting and Preserving Human Knowledge for Posterity
  - CODAMODA: Controlling Data Movement in the Digital Age
  
- ❖ **1 Marie Curie Chair Program**
  - MMng: Architecting Next-Generation Multimedia Systems
  
- ❖ **Yahoo Faculty Research and Engagement Program Award (2015)**
  
- ❖ **IBM Faculty Award (2016)**
  
- ❖ **Google Faculty Research Program Award (2017)**



# Research Excellence Funding

## ❖ 9 Projects of Action Excellence I & II

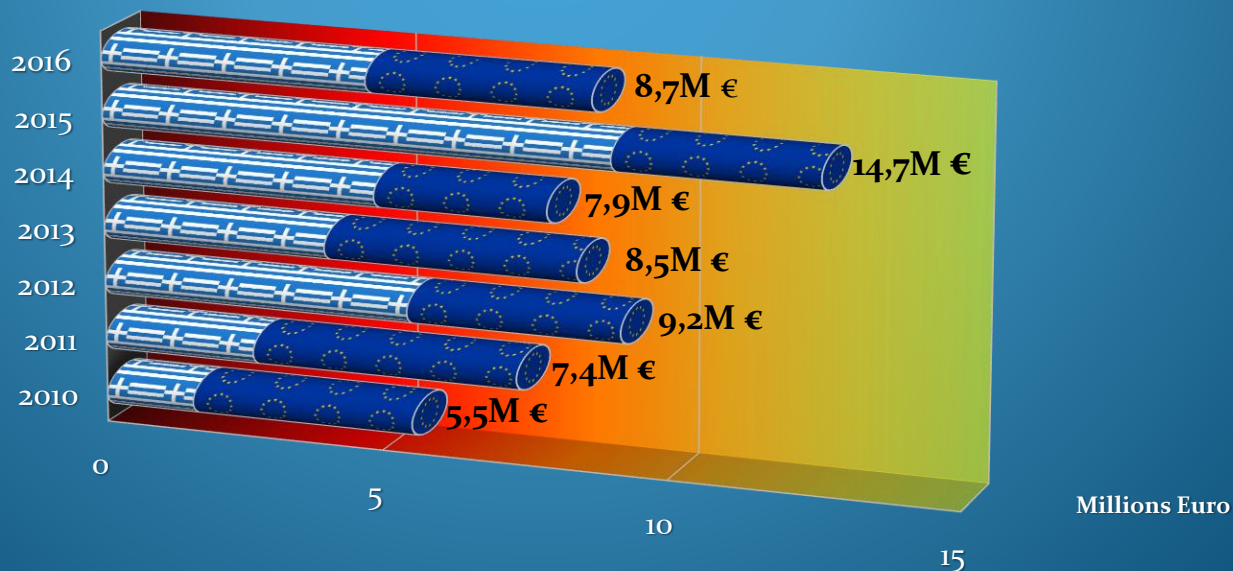
- **ART-IN-SPACE:** Adaptive, Robust to Threats, Immune to Nonlinearities, Sparse Opportunistic Cognitive Radio
- **ASSURANCE:** Adaptive Sparsity-Aware Distributed Learning with Applications to Cognitive Radio
- **CONNECT:** Chaos Optical Networks: from Sensing to Cryptography
- **ESPRESSO:** Exploiting Structure in Polynomial Equation and System Solving for Geometric and Game Modelling
- **FINER:** Towards Fully Integrated Elections and Referendum Systems
- **MMD:** Mining Mobility Data
- **Morph-PL:** Advanced Programming Languages with Class Morphing
- **SCARE:** Scalable Reasoning and Query Processing for Linked Geospatial Data
- **SCORPIUS:** Single-Chip Radiation Tolerant Dynamically Reconfigurable Payload Data Processing Units for Future Space Applications
- **StochSoCs:** Flexible Systems on Chip for Parallel Stochastic Simulation of large biochemical networks in Systems Biology



# Funding

- ✓ Total Research and Development **61.685.200 €** (2010-2016)
- ✓ **219** active Research Projects in 2016
- ✓ The research funding of the Department constitutes **18% - 20%** of the total research funding of NKUA
- ✓ In absolute numbers, the Department contributes about **8M €** annually to the NKUA and over **4M €** per year in the Greek economy (foreign exchange)

Total Research and Development Funds

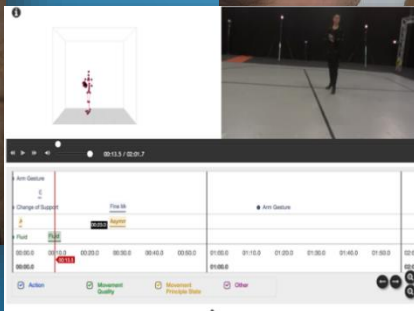
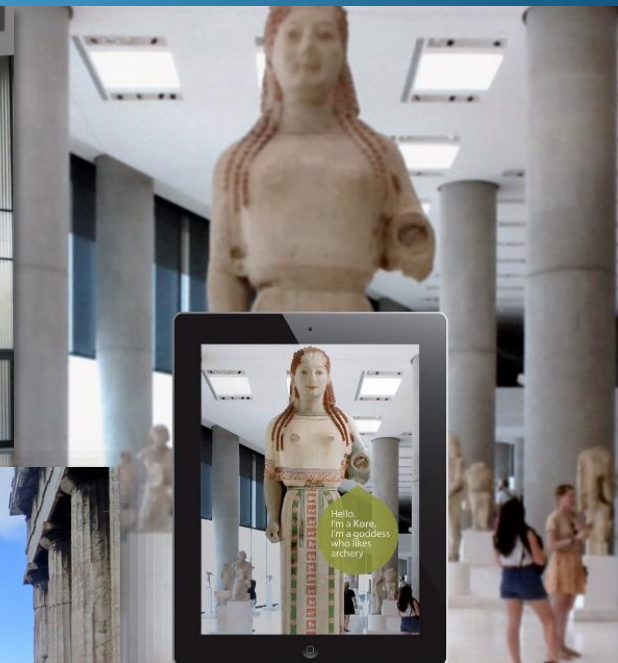




# Digital Applications for Culture and the Creative Industries

Embodied interaction for  
teaching dance

Research and applications for  
digital cultural heritage



WHOLODANCE



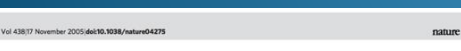
**EMOTIVE**  
Storytelling for cultural heritage

[www.emotiveproject.eu](http://www.emotiveproject.eu)



# Photonic Technology & Optical Communications

- ✓ **Photonic driven Physical Security:** Photonic Encryption based on Chaotic Laser Pairs, Synchronized Chaotic Laser Networks, Unclonable Secure Optical Cryptosystems (TR35 World's Top Innovators Award, MIT, USA)
- ✓ **Photonic driven Ultra-Fast Communications:** Ultra-High Speed Fiber Optic Communication Systems, Design and experimental evaluation of high performance telecom components (quantum-dot/ micro-disk emitters)
- ✓ **Photonic Driven Computation & Neuromimeticism:** Ultra-Fast Neural Networks based on Photonic Components, Ultra-Fast Real-Time Signal Prognosis, Neuromimetic Photonics based on Quantum-Dots

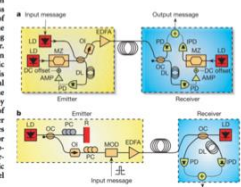


## Chaos-based communications at high bit rates using commercial fibre-optic links

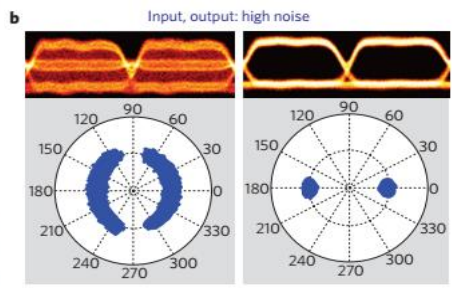
Apostolos Argyris<sup>1</sup>, Dimitris Syrydis<sup>1</sup>, Laurent Larger<sup>2</sup>, Valerio Annovazzi-Lodi<sup>3</sup>, Pere Colet<sup>4</sup>, Ingo Fischer<sup>1</sup>, Jordi Garcia-Ojalvo<sup>5</sup>, Claudio R. Mirasso<sup>1</sup>, Luis Pesquera<sup>6</sup> & K. Alan Shore<sup>7</sup>

Chaotic signals have been proposed as broadband information carriers with the potential of providing a high level of robustness and privacy in data transmission<sup>1,2</sup>. Laboratory demonstrations of chaos-based optical communications have already shown the potential of this technology<sup>3,4</sup>, but a field experiment using commercial optical networks has not been undertaken so far. Here we demonstrate high-speed long-distance communication based on chaos synchronization over a commercial fibre-optic channel. An optical carrier wave generated by a chaotic laser is used to encode a message for transmission over 120 km of optical fibre in the metropolitan area network of Athens, Greece. The message is decoded using an appropriate second laser which, by synchronizing with the chaotic carrier, allows for the separation of the carrier and the message. Transmission rates in the gigabit per second range are achieved, with corresponding bit-error rates below  $10^{-6}$ . The system uses matched pairs of semiconductor lasers as chaotic emitters and receivers, and off-the-shelf fibre-optic telecommunication components. Our results show that information can be transmitted at high bit rates using deterministic chaos in a manner that is robust to perturbations and channel disturbances unavoidable under real-world conditions.

*Research information: chaos enhances the robustness of com.*



## All-optical phase and amplitude regenerator for next-generation telecommunications systems



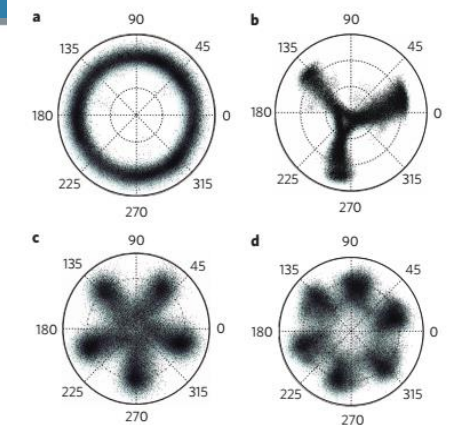
## Artificial Neuron Based on Integrated Semiconductor Quantum Dot Mode-Locked Lasers

Charis Mesaritakis<sup>1</sup>, Alexandros Kapsalis<sup>1</sup>, Adonis Bogris<sup>1,2</sup> & Dimitris Syrydis<sup>1</sup>

Neuro-inspired implementations have attracted strong interest as a power efficient and robust alternative to the digital model of computation with a broad range of applications. Especially, neuromimetic systems able to produce and process spike-encoding schemes can offer merits like high noise-resiliency and increased computational efficiency. Towards this direction, integrated photonics can be an auspicious platform due to its multi-GHz bandwidth, its high wall-plug efficiency and the strong similarity of its dynamics under excitation with biological spiking neurons. Here, we propose an integrated all-optical neuron based on an InAs/GaAs semiconductor quantum-dot passively mode-locked laser. The multi-band emission capabilities of these lasers allow, through waveband switching, the emulation of the excitation and inhibition modes of operation. Frequency-response effects, similar to biological neural circuits, are observed just as in a typical two-section excitable laser. The demonstrated optical building block can pave the way for high-speed photonic integrated systems able to address tasks ranging from pattern recognition to cognitive spectrum management and multi-sensory data processing.



## Multilevel quantization of optical phase in a novel coherent parametric mixer architecture







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# Pan-European Robotics Test Fields Network

Mobile IoT Research  
Coordinator: ΕΚΠΑ





# Space Technology Designed in Greece

- ✓ **Hardware Accelerator for On-Board Image Data Compression** for the ASPIICS Coronagraph System of the ESA PROBA-3 mission
- ✓ **Cutting-edge technology high-speed hardware accelerator IP Cores** for CCSDS real-time **data and image compression for optical and hyperspectral sensors, channel coding for near-earth and deep-space communications and authenticated encryption targeting space-grade FPGAs**
- ✓ **Collaboration with AIRBUS** in the development of the next generation **High-Speed Integrated Satellite Data System**

**Hyperspectral Applications**

**Space / Airborne Platforms**

**CCSDS 123.0-B-1-E IP Core**

esa  
European Space Agency