



**2018**  
**ANNUAL REPORT**

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**INSTITUTE OF  
INFORMATICS &  
TELECOMMUNICATIONS**

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IIT | NCSR DEMOKRITOS • 2018

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**229**  
**PERSONNEL**



**32**  
**PHD**  
**STUDENTS**



**21**  
**NEW**  
**RESEARCH**  
**PROJECTS**



**33**  
**POST-DOCS**



**135**  
**PAPERS**



**3690**  
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# Message from the Director of the Institute of Informatics & Telecommunications

Aghia Paraskevi, February 2019

*The Institute of Informatics & Telecommunications (IIT) is characterised by its focus on Intelligent Computing and Networking, ranging from network equipment and communication protocols, to multimodal content analysis with Artificial Intelligence techniques, and finally, the application of integrated solutions in multiple application fields.*

*IIT heavily invests in research around Artificial Intelligence, Augmented and Virtual Reality, 5G Networks, with significant results in each field. Its close ties with industrial stakeholders and particularly innovative start-ups and spinoffs of the Lefkippos Technology Park, further facilitate the rapid incorporation of research results in products and services with huge financial and social impact.*

*Additionally, an even more important aspect of IIT's evolution is its major strategic decision to act as the epicenter of NCSR Demokritos' plan for fully embracing AI and data-driven science for its scientific activities. IIT has already established synergies with other Institutes of NCSR Demokritos, where ICT technologies have been exploited in different domains (energy, environment, security, etc.) through various research projects, especially during 2018.*



*Dr. Vangelis Karkaletsis*

*Director of the Institute of Informatics & Telecommunications*

*NCSR Demokritos*

## Who We Are

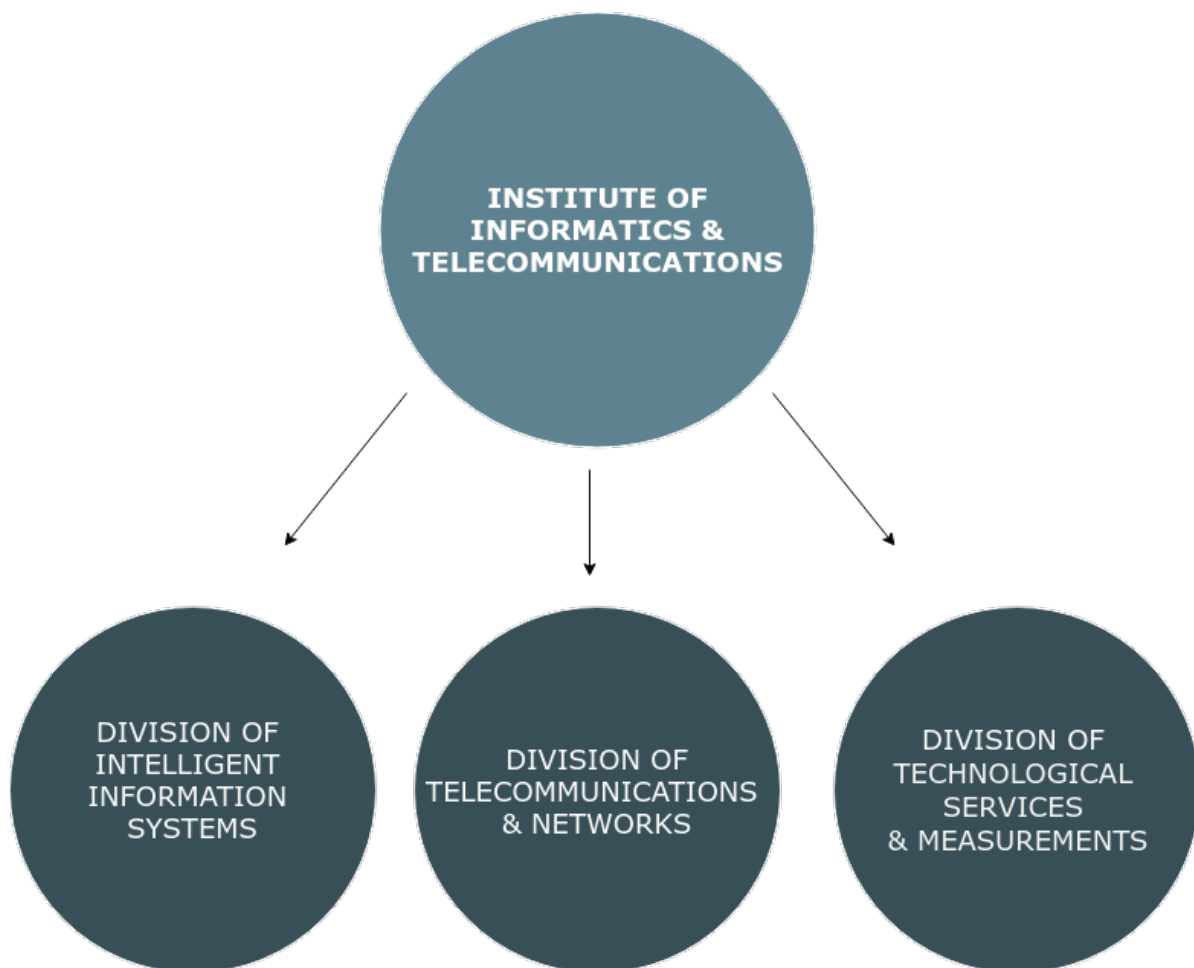
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However, an even more important aspect of IIT's evolution is its major strategic decision to act as the epicenter of Demokritos' plan for fully embracing AI and data-driven science for its scientific activities. IIT has already established synergies with other Demokritos institutes, where ICT technologies have been exploited in different domains (energy, environment, security, etc.) through various research projects, especially during 2018.

### Structure and Organisation of the Institute

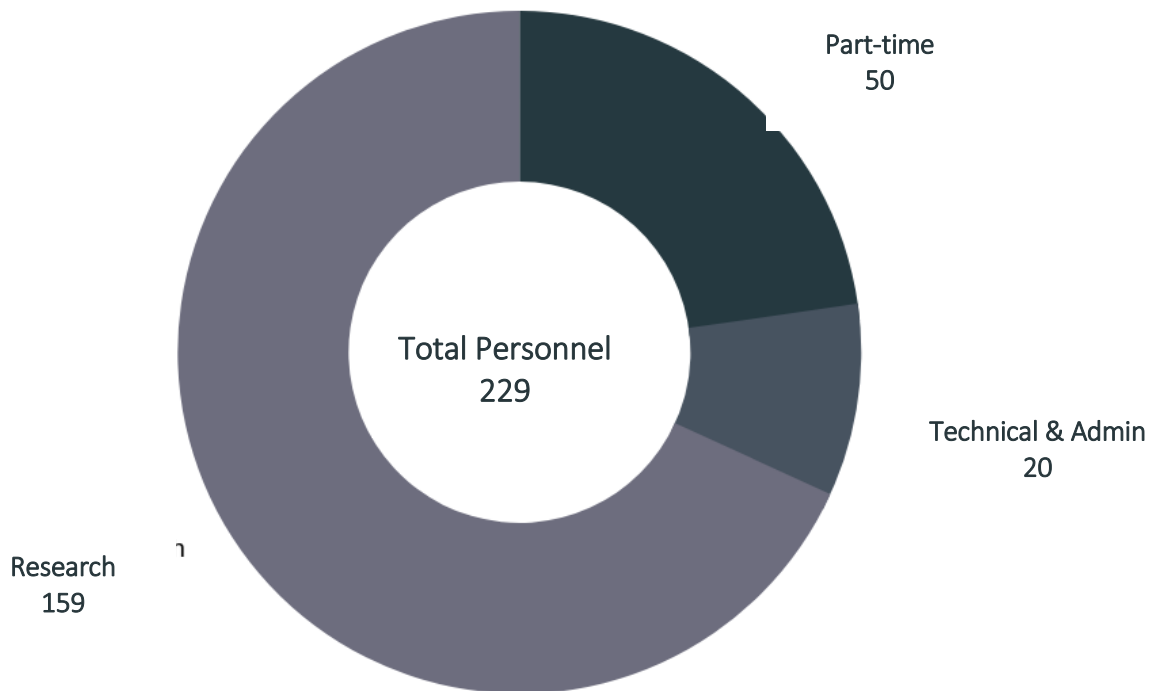
IIT is organised in three main Divisions:





## Our People

The following chart presents the Institute's personnel per type of affiliation.



During 2018, the following changes of tenured personnel took place:

- **Dr C. Koumaras** was appointed as Researcher C in “Telecommunication networks with virtualisation technologies, focusing on multimedia applications QoS”
- **Dr D. Kyriazanos** was appointed as Researcher C in “Integrated Monitoring and Control Systems for the surveillance, security and protection of critical infrastructures and risk management”
- **Dr G. Petasis** was appointed as Researcher C in “Knowledge Representation and Big Data Analytics”
- **Dr C. Spyropoulos** (Researcher A) retired, after serving the Institute for 35 years, being the founder of the Software & Knowledge Engineering Lab (SKEL), Director of the Institute, Vice-President of NCSR D.



# What We Do | Research Areas

The research priorities of IIT are classified below per Division.

## Intelligent Information Systems Division

- **Content Analysis & Knowledge Technologies:** Natural Language Processing, Multimodal Data Mining, Machine Learning, Knowledge Representation & Data Visualisation.
- **Intelligent retrieval of multimedia content:** Image retrieval, Recognition of visual/audio/textual information, Gesture and action recognition from visual and skeletal data, Emotion recognition from audio data, Heart-rate estimation from visual data, Satellite and radar data analysis.
- **Complex Event Recognition:** Management of noisy and incomplete big data, Event analysis and detection from multimodal content.
- **Big Data Engineering:** Large-scale distributed indexing, Database federation and query optimization, Big Data integration.
- **e-Infrastructures:** Infrastructure abstraction, Execution optimization over heterogeneous computational resources, Distributed processing of extremely large computations.
- **Human-Robot Collaboration:** Human-Computer Interaction, Path and Action Planning.
- **Personalisation & Social Network Analysis:** User Modelling, Trust and Influence Estimation in Complex Networks.

## Telecommunications and Networks Division

- **Antenna technologies:** innovative antennas employing metamaterial-inspired or magneto-electric materials; wearable antenna systems; interactions between antenna systems and the human body.
- **Advanced Tx/Rx schemes and MIMO techniques:** Tx/Rx schemes under various fading conditions; MIMO channel capacity; MIMO systems in cellular and ultra-dense environments; spatial modulation schemes.
- **Radio Access Networks and multi-RAT connectivity:** multi-tier mobile networks; wireless LANs; software-defined radio (SDR); MAC efficiency; access scheduling; multi-RAT connectivity; traffic offloading; network mobility and handovers.
- **Network management, interoperability, softwarization and virtualization:** Network Function Virtualization; VNF placement; SDN-enabled network architectures; network slicing and multi-tenancy; context-awareness; network monitoring.
- **Performance, energy efficiency, QoS and QoE:** modelling and performance evaluation of network components, devices and subsystems; energy efficiency considerations; QoS guarantees; perceived Quality of Experience.
- **Network technologies (WSN, DTN, MANET, VANET) for the Internet of Things:** wireless sensor networks; inference-driven sensor/actuator het-nets in an IoT context; mobile ad hoc networks and delay tolerance; vehicular networks.

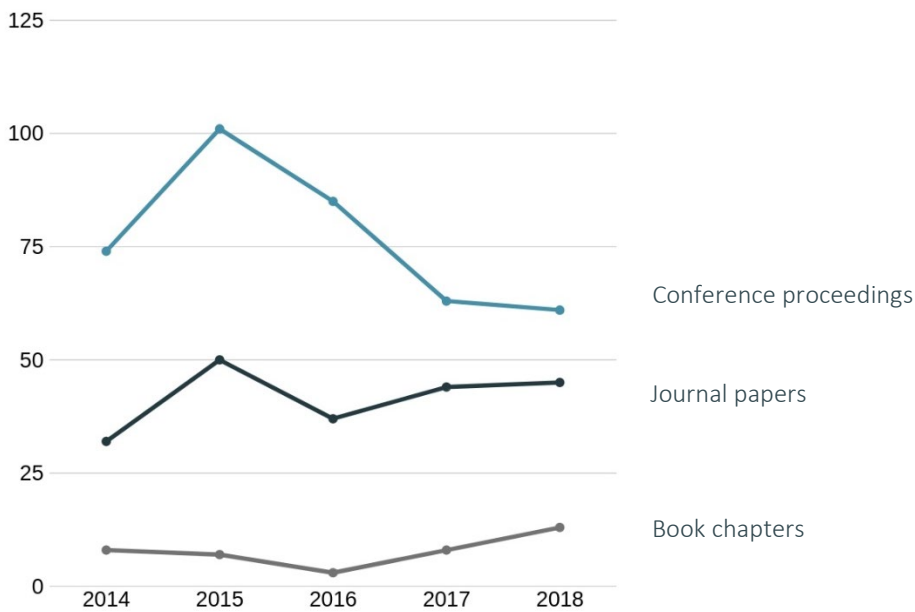
Furthermore, the Integrated Systems Lab (ISL) focuses on the provision of applications in the following areas:

- **C2I Systems for Sea, Land and Air Border surveillance and Critical Infrastructure Protection:** Maritime Border Surveillance, CISE framework, Risk Based Border Security, Airport & Critical Infrastructure Protection.
- **Security Back-End and intelligence:** Data Fusion, Machine Learning and Automated Decision making, GIS seamless indoor/outdoor navigation & localization technologies, Mobile apps, use of Social Media and Public Information Channels, Cybersecurity & cybercrime analytic tools.
- **Simulation Platform, VR/AR Systems & Gamification:** Airport operations, passengers and personnel simulation platform, Crowd agent-based behaviour simulation, Integrated Security Systems and innovative CONOPS in vitro validation, Real time integration with third party simulation tools.

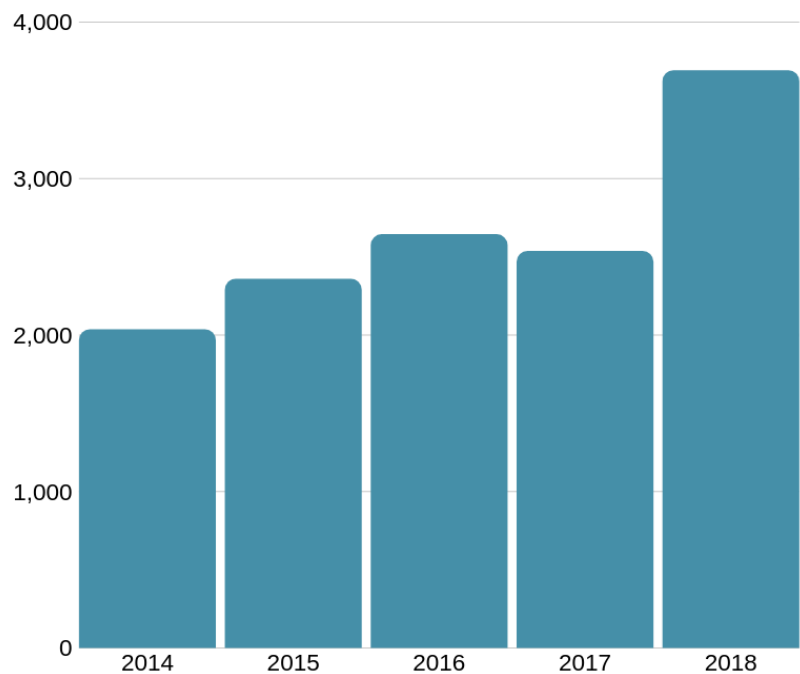
# Research Output

## Academic Achievements

The following table sums up the **academic output** of IIT for the period 2014 - 2018.



The following table sums up the **Citations** of IIT for the period 2014 - 2018.





## Conferences & Workshops

The Institute is very active in the organisation of international and national conferences and workshops, some of which are highlighted below:



IEEE Spoken Language Technology 2018  
December 2018



Big Data for Precision Medicine Symposium  
July 2018



The role of Research e-infrastructures in the National Research Agenda  
July 2018



AI4IoT - Workshop on AI for Internet of Things  
July 2018

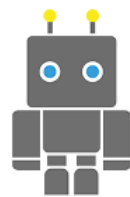
# Research Projects

Projects Initiated in 2018

Twenty one (21) new Research Projects were initiated in 2018 for IIT Laboratories.



Ολοκληρωμένο Σύστημα Διαχείρισης και Επιμέλειας Ψηφιακού Περιεχομένου και Παραγωγής Προσωποποιημένων Ατομικών και Συνεργατικών Αφηγήσεων με Εφαρμογή στο Μουσείο TERIADE



CODESKILLS  
4ROBOTICS

CULDILE

e-TRAUMA

Phaetons

MeLDE

DataStories

VISOR

HealthNET

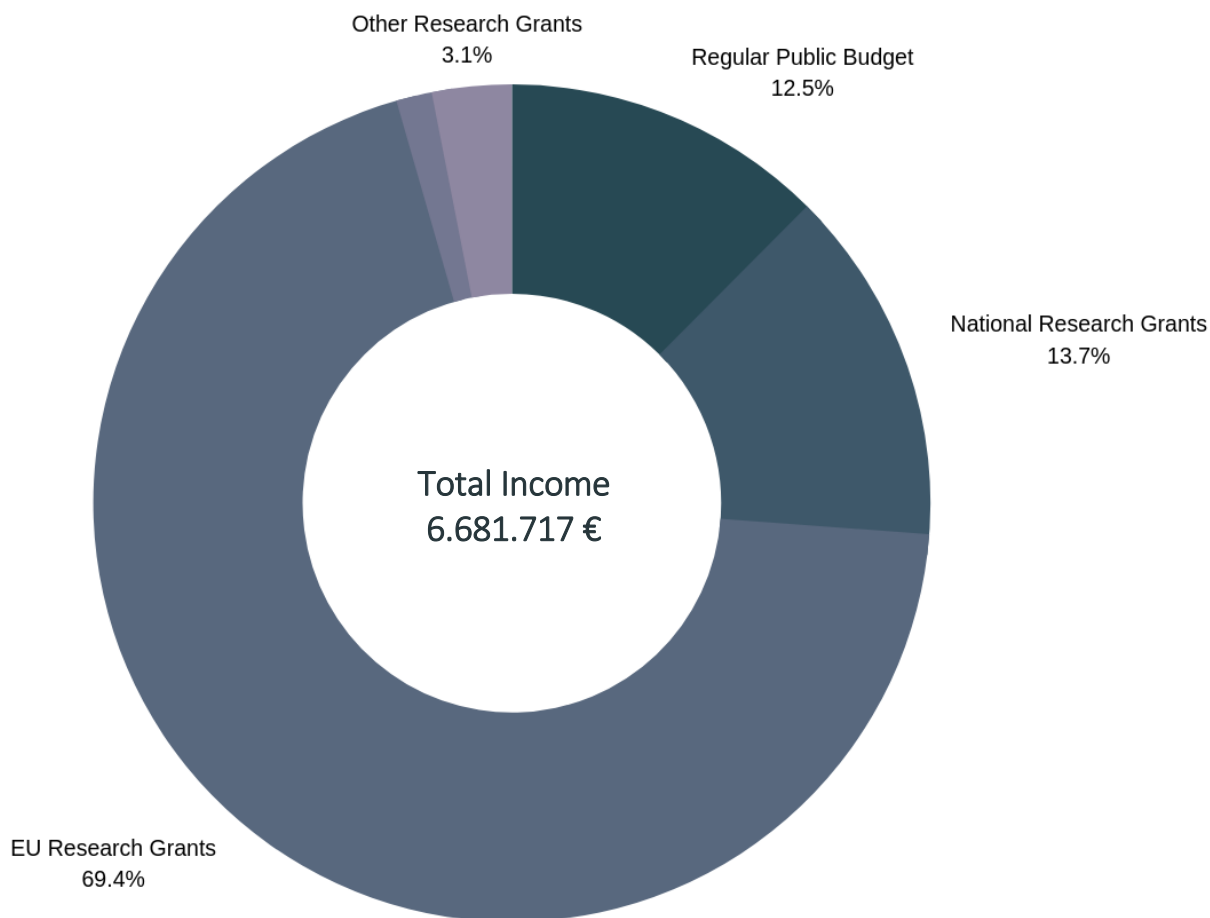
## Projects approved in 2018 to kick-off in 2019

Four (4) new Research Projects were approved in 2018 for IIT Laboratories.



# Financials of IIT in 2018

Annual Income of IIT (in €)



EU Research Projects	4,375,492 €
National Projects	977,545 €
Regular Public budget	1,046,038 €
Technology Services	170,640 €
Education and Training Services	112,003 €

# Collaborations

## Interdisciplinary

IIT intensified its effort to establish collaborations within Demokritos as well as with other Greek Institutes with similar research interests. As a result, a number of projects where these collaborations take place started in 2018:

- DARE (collaboration with NCSR INRASTES)
- BigMedilytics (collaboration with NCSR IBA)
- Hellenic Network for Precision Medicine (collaboration with ATHENA, FORTH and NCSR INRASTES)

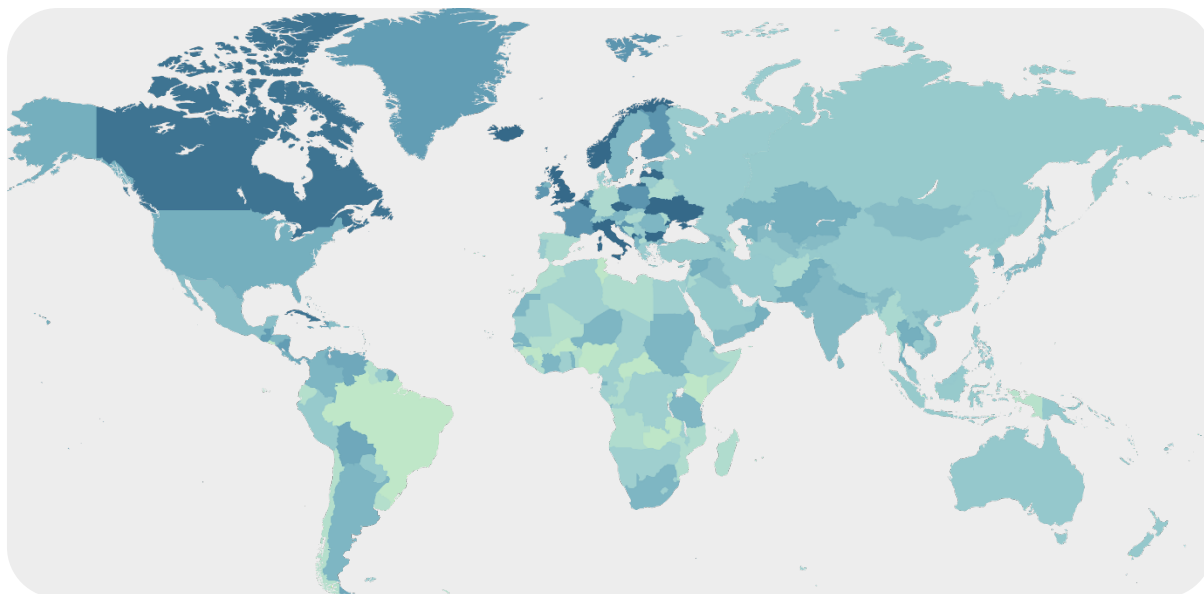
Additionally 4 were approved to start in 2019:

- IS-ENES 3 (collaboration with NCSR INRASTES)
- AI4EU (collaboration with CERTH, FORTH and NCSR INRASTES)
- ExtremeEarth (collaboration with NCSR INRASTES)
- Fair4Fusion (collaboration with NCSR INRASTES)



## International University Programmes

IIT initiated in 2008 an ambitious PhD scholarship program, collaborating with universities in UK, US and Canada. Apart from the PhDs, this international program enabled other joint research and educational activities; new projects co-funded by the US and the EU, joint summer schools and seminars.



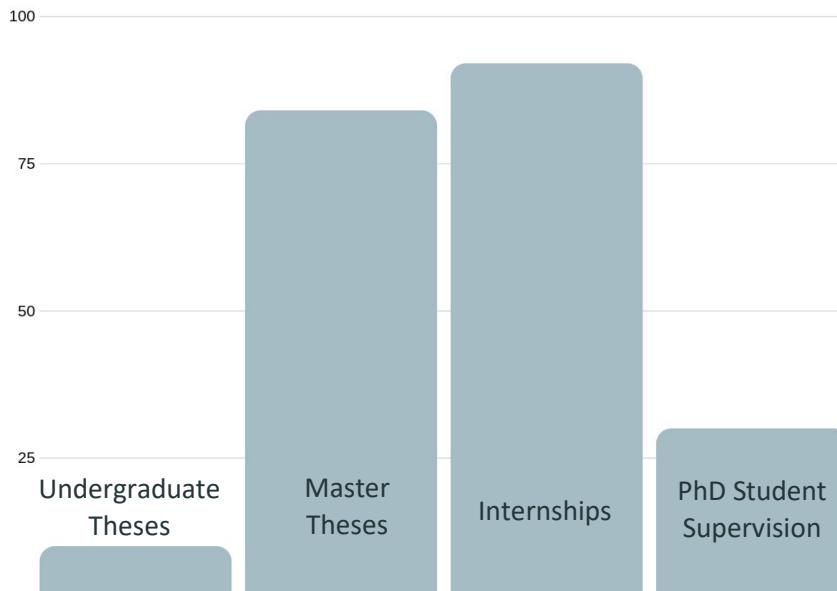


# Education

The Institute is particularly active in the higher education landscape, maintaining strong ties with national and foreign universities, participating in national cross-institutional MSc programs, establishing PhD scholarships programs with foreign Universities, organising training courses, summer schools. This subsection summarises the education activities of the Institute pertaining to higher education.

## PhDs, Theses Supervision and Internships

The following table summarises the active theses and internships supervised by IIT researchers during 2018.



## Joint Master Programmes in Collaboration with Universities

Several researchers of the Institute have been very active as lecturers in MSc courses. During the reporting period, the Institute participated in three cross-institutional MSc programmes with Greek universities:

- a. **MSc in Data Science**, Department of Informatics & Telecommunications, University of the Peloponnese<sup>1</sup> (hosted at NCSR)
- b. **MSc in Specialization in ICTs and Special Education: Psychopedagogy of Integration**, Department of the Greek Philology, Democritus University of Thrace<sup>2</sup> (hosted at NCSR)
- c. **Informatics in Medicine and Biology**, Department of Informatics & Telecommunications, National & Kapodistrian University of Athens<sup>3</sup>



<sup>1</sup> <http://msc-data-science.iit.demokritos.gr/>

<sup>2</sup> <http://specialedu.iit.demokritos.gr/>

<sup>3</sup> <http://itmb.di.uoa.gr/indexEng.html>



## Joint PhDs Scholarship programs

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- a. **Rice University**, Department of Computer Science<sup>4</sup>
- b. **University of Texas at Arlington**, Department of Computer Science and Engineering<sup>5</sup>
- c. **University of Houston (UH)**, Department of Computer Science<sup>6</sup>



<sup>4</sup> <https://www.cs.rice.edu/>

<sup>5</sup> <https://cse.uta.edu/>

<sup>6</sup> <http://www.uh.edu/nsm/computer-science/>

## Seminars & Lectures

During 2018, the Institute continued its seminar programme for ICT in special education, active since 2012. The seminar is taking place at the premises of NCSR 'Demokritos' and it is mainly addressed to teachers and professional in the field of mental health of children and youth<sup>7</sup>. Additionally, the Institute has also organised and implemented annual free seminars at the same field<sup>8</sup>.



IIT continued its support to the SciFy Academy seminars, targeting SMEs and aiming to train them on Digital and Entrepreneurial Skills. IIT supported several of these seminars (AI school for Business, AI and Digital Humanities, AI and news and media, e-health), extending further its network with SMEs.

Regarding the lecture programme, the Institute maintained its monthly organisation of lectures given by invited speakers and colleagues of the Institute, in the field of Informatics and Technology addressed to colleagues of the Institute and external participants in the framework of the dissemination of knowledge and science.



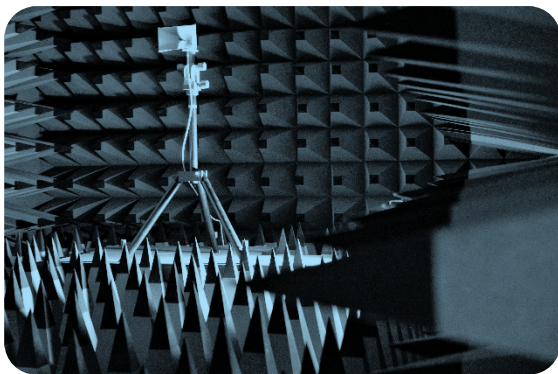
<sup>7</sup> <https://www.iit.demokritos.gr/news/annual-seminar-nel-2018-19>

<sup>8</sup> <https://www.iit.demokritos.gr/news/free-seminar-icts-special-edu-2017>

# Innovation

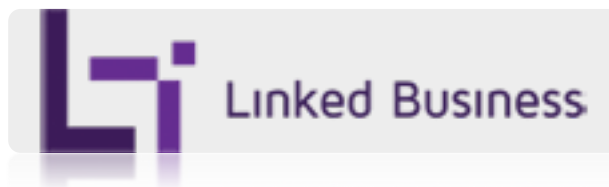
## Service Provision

- Document image analysis: tools for page segmentation and binarization integrated to the Transkribus platform (<https://transkribus.eu>); tools for pre-processing, segmentation and word spotting provided through the channel of the Impact Centre of Competence (<https://www.digitisation.eu>); business document image analysis tools for the recognition of invoices and receipts integrated at the purebills company platform (<https://purebills.com>); services for the recognition of receipt images for the TPG rewards company (<http://tpgrewards.com>); services for the analysis of the characteristics of the handwriting for the NeuroScript, LLC company ([www.neuroscript.net](http://www.neuroscript.net)); services for historical document image analysis for the University Innsbruck, Department for German Language and Literature (<https://www.uibk.ac.at>)
- Data analytics: Collaboration agreement with IBM Hellas, undertaking document analysis for the Greek language (classification, named entity recognition, opinion mining), a service that was integrated with IBM services.
- Data analytics: Agreement with the non-profit organisation SciFY for exploiting NewSum technology for multi-document, multi-source and multilingual document summarisation.
- Antenna characterization measurements: provision of specialized technological services related to antenna design, prototyping and antenna characterization measurements. Measurements take place in the RF shielded Anechoic Chamber of the Institute. These services are directed both to the academic/research area and the market activated in the design, development, test and support of all types of wireless networks (mobile telephony, radio, WiFi, etc.).
- Consultation services: ISLab provides regular consultation services (annual contract) to the National Organisation for Medicines on issues related to network security and resiliency. ISLab collaborates also with startups MIST.IO and DEVOQ Technologies, consulting on opensource cloud platforms, Internet Security and SDN/SDDC.
- ISL delivered a first implementation of Risk Based Security Proof of Concept in an operational airport environment in compliance with the IATA/ACI Smart Security recommendations.
- ISL also had key involvement in the implementation of the Common Information Sharing Environment implementation (CISE), enabling cross-border and cross-sector exchange of information in the context of integrated European Maritime Security. As a result, the CISE compliant OCULUS SEA C2 platform was developed, deployed, tested and optimized, with the participation of the Hellenic Coast Guard and the Hellenic Ministry of Defence, integrating systems and assets from various industrial and research labs partners across EU, under a common System of Systems solution developed by IIT.



## Spin-offs & Start-ups

- Initiation of business for the spin-off company Syndesis LTD<sup>9</sup>. Syndesis is transferring to the market the research results of the ehealth unit of IIT.
- The internal NCSR processes for founding the NewSum spin-off have been completed. NewSum technology<sup>10</sup> for multilingual and multi-document summarisation, text analytics are constantly enriched with new methods, while new services and products are being developed. Currently, the process for funding NewSum through a funding agent is in progress.
- Initiation of business for the start-up company LinkedBusiness<sup>11</sup>

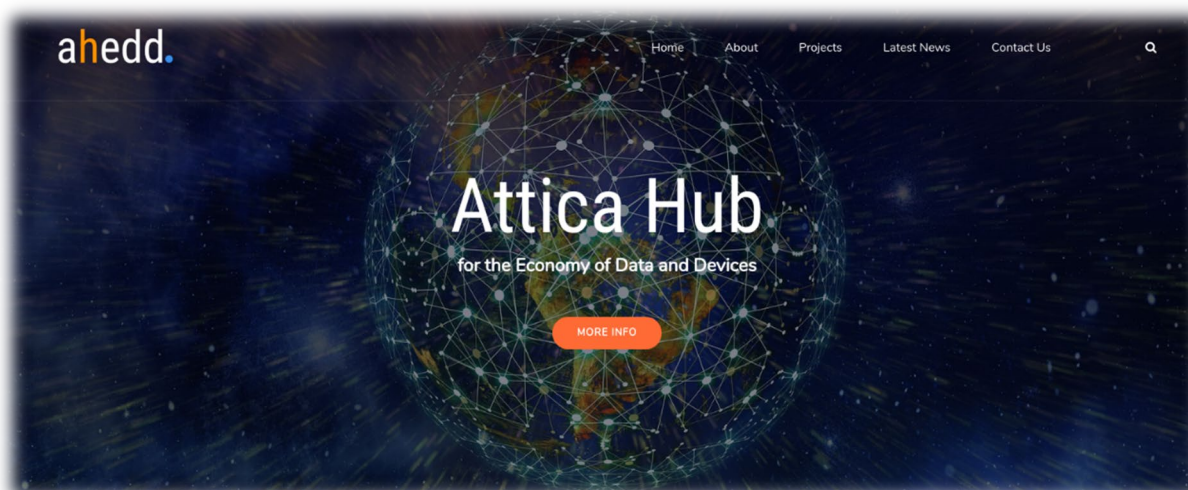


## Projects for Research Exploitation

During 2018, StoryBot and OpJ, the two Google DNI projects that kickstarted the presence of IIT in the initiative, were successfully completed. Near the end of the year, a new Google DNI project kicked-off, continuing the efforts of exploiting research results in the News & Media Sector.

## Digital Innovation Hub

IIT together with the NCSR Innovation office are establishing a Digital Innovation Hub (DIH). The Hub's mission is to develop and orchestrate a digital innovation ecosystem in order to match the opportunities and challenges faced by SMEs in the region with commercial-ready solutions on big data management, artificial intelligence-empowered analytics and IoT, and their applications in different fields with strategic impact to the Greek economy: Maritime, Culture, Agriculture, News and Media, Health. During 2018, work on preparing and setting up the DIH was intensified. The action is thus advancing and will be ready to run by mid-2019.



<sup>9</sup> <http://www.syndesis.eu/>

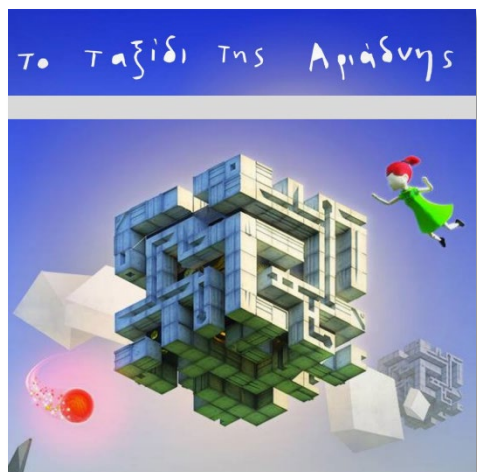
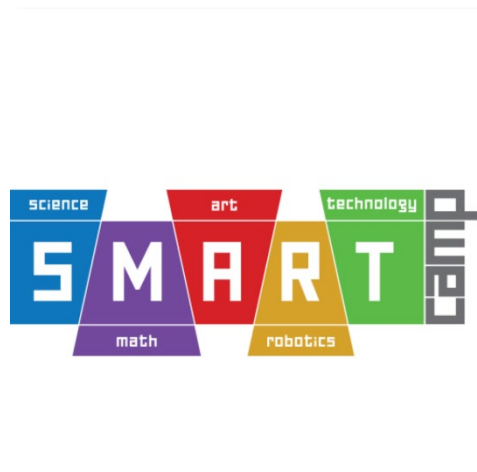
<sup>10</sup> <http://www.newsumontheweb.org/>

<sup>11</sup> <https://www.linkedbusiness.gr>



## Science Communication

The Institute invests significant amounts of time and resources to help communicate the produced scientific knowledge to the wider society. The highlights of the year 2018 can be summed up to:



## Future plans

### Expansion of the Institute of Informatics & Telecommunications

A new, smart IIT building will be built, in order to accommodate the expanding needs of the Institute concerning research, innovation, education, networking, exhibitions and the dissemination of research results. It will also provide the necessary lab spaces to develop, test and exhibit applications and will host approximately 150 people of the IIT personnel. The necessary procedures will begin in 2019.







**DEMOKRITOS**  
NATIONAL CENTRE FOR SCIENTIFIC RESEARCH

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