7

iit istituto italiano di tecnologia

2012


welcome

Dear readers,

We present the 2012, 7th year activity report of IIT. The report shows the scientific results in terms of publications and patents and some important information related to the staff, which has grown to approximately to 1200 people, including foreign scientists from 50 different countries. Over the course of 2012, IIT has achieved the goal of over 160 patents and 6 start-up projects. Contracts and collaborations also increased considerably with Italian as well as foreign companies in the robotics and mechatronics field, textile, packaging, new materials and the energy sectors.

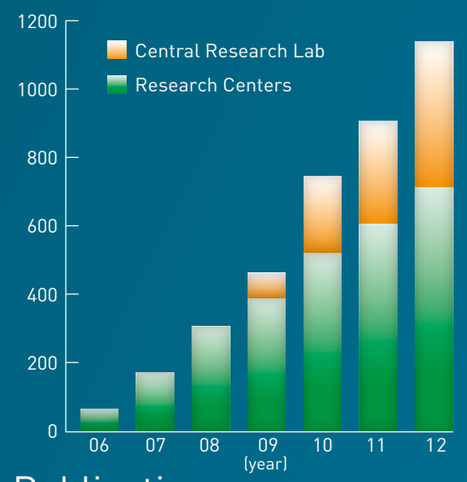
During the year, numerous departmental evaluations have been carried out by international panels of experts. Moreover, during the same year it has been completed the general evaluation of the foundation by the Evaluation Committee, consisting of scientists and managers with an international background, aiming at monitoring and consolidating IIT's operating standards.

Finally, in 2012, IIT has been awarded 64 competitive European projects and the ten-year FET Flagship program "Graphene", top ranked among the European call for Flagship programs within the Future and Emerging Technology field.

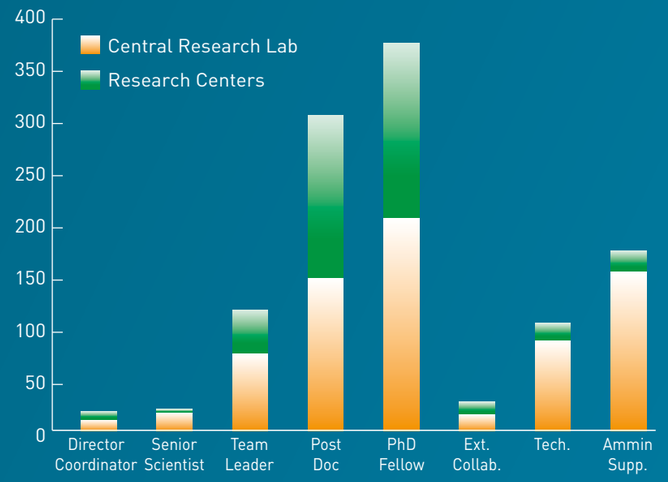
Roberto Cingolani, Scientific Director

Staff

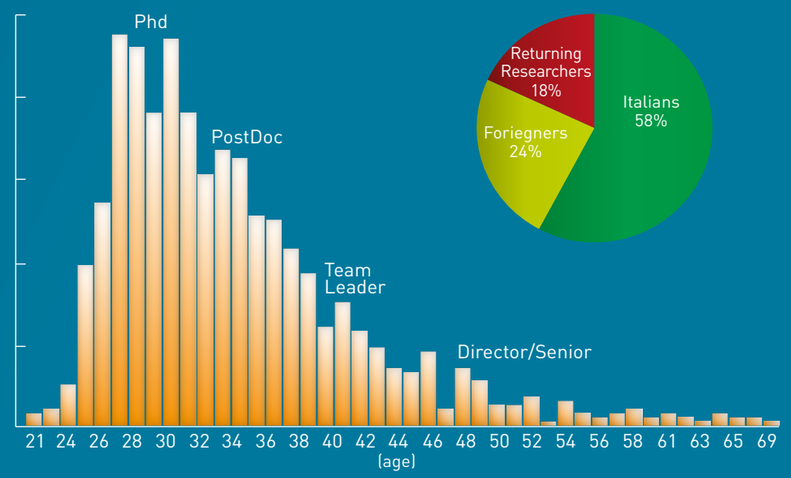
1 Staff evolution over the years



2 Staff role distribution

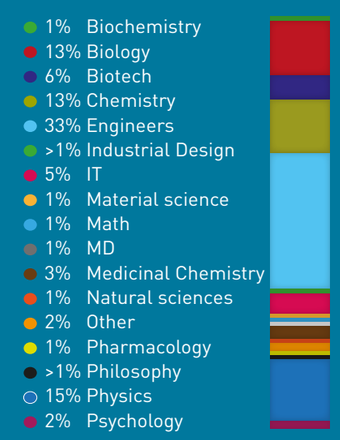


3 Staff age distribution



4 Scientists origin

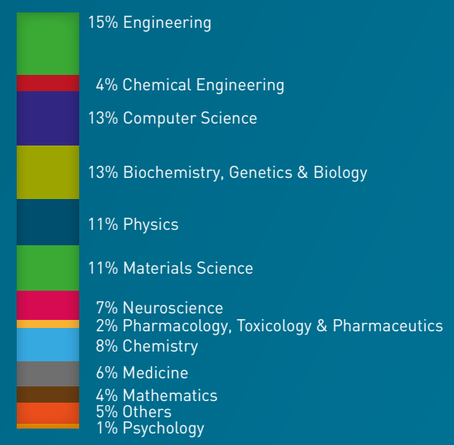
5 Subject degree distribution



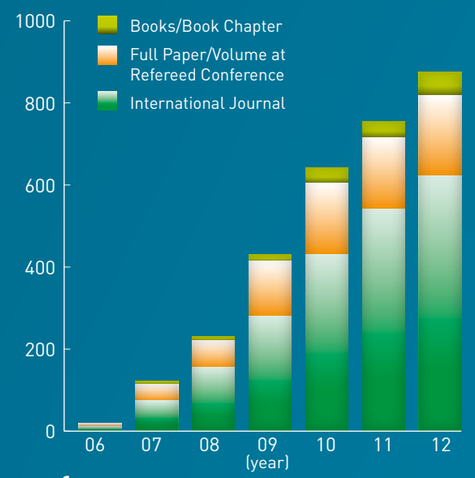
Publications

6 Publications per thematic areas

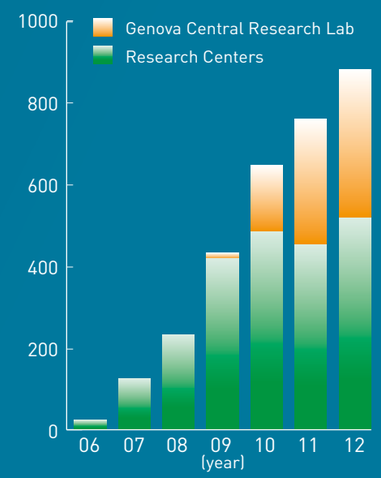
Source: Scopus - sample of 2500 (approx). (31/12/2012)



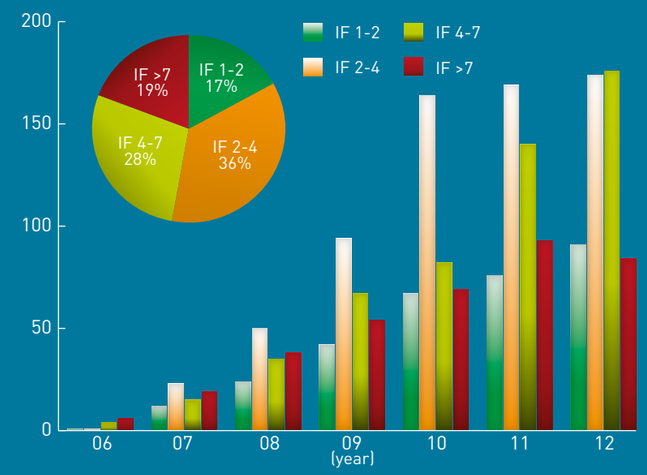
7 Numbers of publications over the years



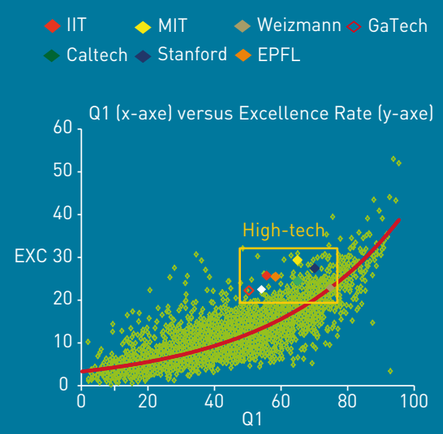
8 Numbers of publications among Genova CRL and Centers



9 Subdivision of publications by Impact Factor range

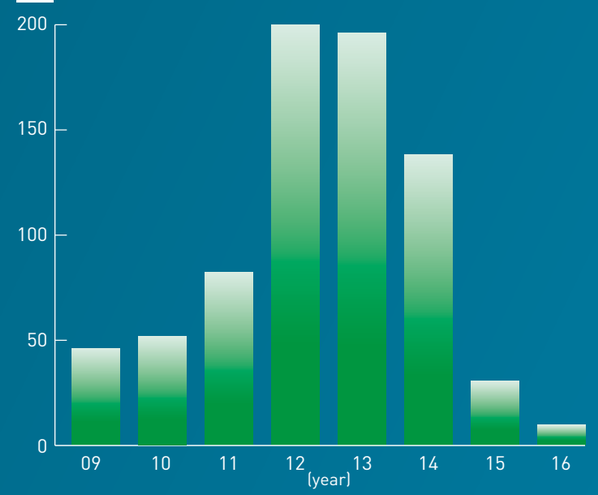


10 Benchmark SCIMAGO (www.scimagoir.com)

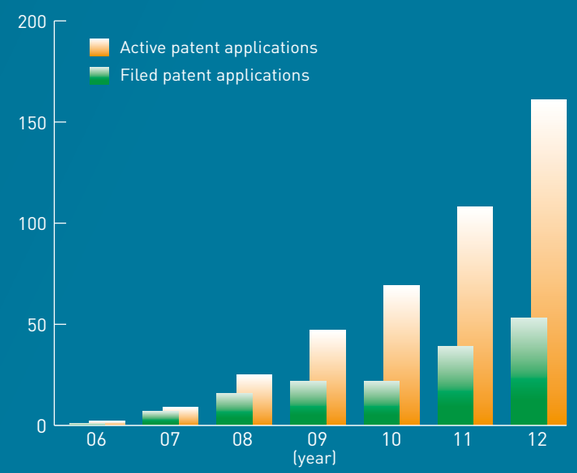


Fund Raising and Technology Transfer

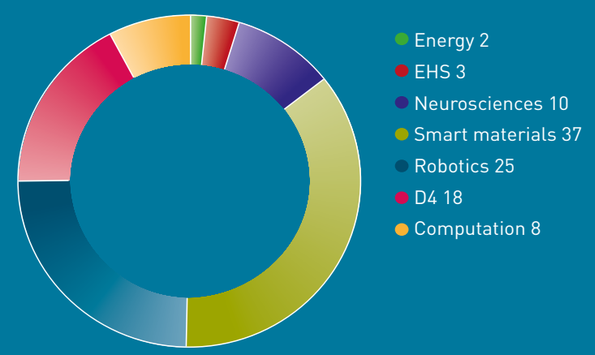
11 Fund Raising



12 Number of patent applications over the years



13 Distribution of patent portfolio by platforms



NEUROSCIENCE

NANOSTRUCTURES

NANOCHEMISTRY

COMPUTER VISION

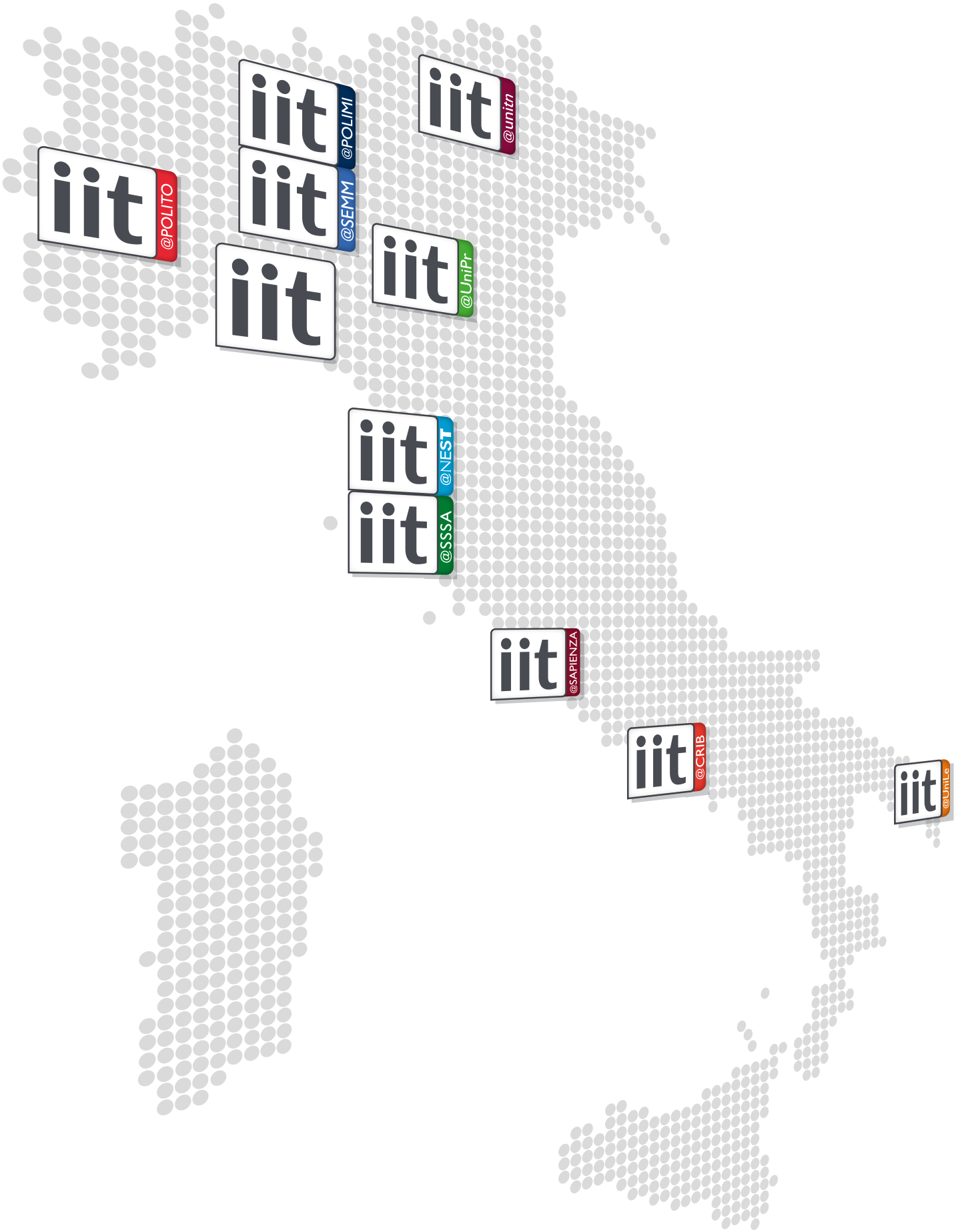
COGNITIVE SCIENCE

DRUG DISCOVERY

ADVANCED ROBOTICS

NANOPHYSCIS

BRAIN TECHNOLOGY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Acronyms

The following list contains the acronyms used to indicate the scientific platforms (i.e. the thematic areas on which the scientific plan is based) departments and centers of the IIT's multidisciplinary network.

Platforms

Computation

D4 Drug Discovery, Development and Diagnostics

EHS Environment, Health and Safety

Energy

Neuroscience

Robotics

Smart Materials

Departments of the Central Research Laboratories - Genoa

ADVR Advanced Robotics

D3 Drug Discovery and Development

NACH Nanochemistry

NAPH Nanophysics

NAST Nanostructures

NBT Neuroscience and Brain Technologies

NSYN Synaptic Neuroscience (Unit of the NBT Department)

NTECH Neurotechnologies (Unit of the NBT Department)

PAVIS Pattern Analysis & Computer Vision

RBCS Robotics, Brain and Cognitive Sciences

Network Centers

CNCS@UniTn Center for Neuroscience and Cognitive Sciences, Università degli Studi di Trento, TRENTO

CGS@SEMM Center for Genomic Science, Campus IFOM-IEO, MILAN

CNST@PoliMi Center for Nano Science and Technology, Politecnico di Milano, MILAN

CSHR@PoliTo Center for Space Human Robotics, Politecnico di Torino, TURIN

BCMSC@UniPr Brain Center for Motor and Social Cognition, Università degli Studi di Parma, PARMA

CMBR@SSSA Center for MicroBioRobotics, Scuola Superiore Sant'Anna, PISA

CNI@NEST Center for Nanotechnology Innovation, Scuola Normale Superiore, PISA

CLNS@SAPIENZA Center for Life Nano Science, Università degli Studi di Roma La Sapienza, ROME

CABHC@CRIB Center for Advanced Biomaterials for Health Care, Università degli Studi di Napoli Federico II, NAPLES

CBN@UniLe Center for Biomolecular Nanotechnologies, Università degli Studi del Salento, LECCE

2012: 7 year report

News for 2012

2012 is the seventh year for IIT and coincides with the launch of the 2012-2014 three year scientific plan, a program that consolidates the interdisciplinary nature of the institute, focussing on certain areas of functional research in the development of science and technology around humans. The plan follows, and sometimes anticipates, the international trend of technology convergence in nanosciences, biosciences and cognitive sciences.

During this year, the Scientific Technical Committee (STC) has been boosted with the establishment of three thematic panels, dedicated to robotics, neurosciences and nanomaterials, each coordinated by an internationally renowned scientist, and guided by the Chairman of STC, Prof. Giorgio Margaritondo (EPFL, Lausanne) in the development of new activities.

Neuroscience Panel:
E. Bizzi (MIT) - Coordinator

Robotics Panel:
J. J. Slotine (MIT) - Coordinator

Nanomaterials Panel
A. Nurmikko (Brown University) - Coordinator

Beside conducting an annual scientific supervision of the performance of the departments and centres, the STC carries out periodic on site visit for evaluation purposes, also making use of external expert panels, and formulates strategic recommendation for the optimal continuation of activities. The year 2012 saw the implementation of the recommendations received from the panel in charge of the evaluation of the Nanophysics (NAPH), Nanochemistry (NACH) and Nanostructures (NAST) departments in 2011, and the on site visit of the Drug, Discovery and Development (D3) department.

To support the demanding task of evaluation, a committee of external experts (Standing Committee of External Experts - SCEE) has been established, consisting of approximately 150 scientists with expertise in the specific areas of the IIT scientific plan. SCEE members are often asked to examine the scientific output of the researchers, and this represents an important tool for guaranteeing career paths in accordance with meritocratic processes.

Also, during 2012, the evaluation of IIT in terms of structure, organization, management, human resources, scientific setup and results has been completed by the Evaluation Committee, appointed by the Foundation Board in 2011. The Committee, chaired by Prof. Margaritondo, and consisting of 6 other members of the international scientific-managerial scene, concluded its evaluation program after 15 months of work in May 2012, confirming the IIT results highly satisfactory and suggesting important actions for improving the scientific and organizational development of IIT. In particular, the Committee has submitted the following comment:

Evaluation Committee:
G. Margaritondo (EPFL-CH) - President
L. Addadi (Weizmann-IL)
J. J. Slotine (MIT-USA)
M. Baggiolini (USI-CH)
E. Cattaneo (Università di Milano-IT)
P. Pistorio (ST Microelectronics-IT)
E. Bizzi (MIT-USA)

> We found the institute well positioned to fulfill all aspects of its statutory mission. In particular, the development of infrastructures, human resources and quality control is right on target. The research output already meets stringent international standards both in Morego and in the network of poles/centers.

It has also observed some very positive points, such as:

> Special commendations to IIT and its management for:
>
> - The outstanding accomplishments concerning the growth of the institute, in particular its human resources and infrastructure
> - The rapid achievement of research output rates comparable to the best institutions in Italy and abroad
> - The international openness, in particular in its hiring practices
> - The adoption of strict international standards for its quality evaluations
> - The rapid and effective establishment of the center/poles in many Italian regions
> - The brilliant and cost-effective solution for the IIT central site
> - The dedication and hard work of its staff, in particular the top leaders

Monitoring points have been identified for increasing efficacy in achieving the objectives and preventing future criticalities:

Critical issues:

- Human resources, careers, tenure-track, joint university appointments
- Student association to graduate schools
- Management decentralization and completion of the matrix structure
- Integration of all poles/centers in a real IIT network
- Technology transfer and enterprise creation targeting in particular job creation for the younger generations
- Effective promotion of the IIT image.

In order to corroborate these recommendations, IIT has undertaken certain actions, such as the development of career plans for scientists (tenure track), the organization of scientific research based on transverse research projects instead of the skills of the individual departments, the consolidation of national networks and the development of technology transfer activities.

In order to support the Scientific Director in the execution of certain strategic activities, a team of 4 Vice-directors has been appointed with specific responsibilities: Recruiting and Career track of the scientific staff, European calls and initiatives, Integration of the IIT Network, Outreach and Science Dissemination.

Finally, the guidelines from the Scientific Technical Committee and the Evaluation Committee led to:

- The establishment of the iCub Facility, with the aim of focusing all the efforts of the robotics area to constantly update the IIT humanoid platform;
- The extension of the IIT network in the United States with the new joint laboratory in the Department of Neurobiology at Harvard University in Boston (USA);
- The consolidation of the Computational Machine Learning laboratory, established in 2010 at MIT (USA).

Finally, over the course of the year, the visibility of IIT has also been enhanced thanks to the participation of researchers in public science communication events and competitions.

The original **Technology Transfer** proposals relating to start-up projects participated in the "Start-cup Ricerca - il Sole 24 Ore" selection, the 2012 National Innovation Prize (PNI) and Italia Camp Prize. In particular, the following remarkable projects have been awarded:

- Rehab Tech in "Start-cup Ricerca - il Sole 24" Ore;
- Microturbine in "Start-cup Ricerca - il Sole 24 Ore", PNI and ItaliaCamp;
- SEM+ Intel prize at PNI.

NEST National Prize. Thanks to the work published in Nature Methods entitled "Live-cell 3D super-resolution imaging in thick biological samples", Francesca Cella Zanacchi has received the 2011 NEST National Prize, awarded by the Pisa laboratory each year for the best publication in experimental nanosciences by researchers aged under 35.

TR35 - Young Innovators Prize. Despina Fragouli, Matteo Laffranchi, Monica Gori and Francesca Cella Zanacchi are the 4 "under 35" researchers who, thanks to their original research, have been awarded the TR35- Young Innovators prize, established by the famous MIT Technology Review and organized in Italy by the Entrepreneurship Innovation Research Forum of the University of Padua together with Technology Review Italy.

Humanoids 2012 - Winner of the Best Paper Award. The work of Antonio Bicchi, senior scientist at IIT and a researcher at the Piaggio Centre, Pisa, aimed at the creation of a humanoid hand, received the award at the 2012 Humanoids conference.

Sette Green Awards. The invention of the oleophilic sponge made by the Smart Materials group, coordinated by Dr. Athanassia Athanassiou, senior scientist at IIT, received the Sette Green Award, the recognition that the magazine Sette Green from Corriere della Sera awards to people who by their ideas gave a remarkable contribution to the ecology and environment safeguard.

I giovani innovatori alla conquista del MIT

SARANNO PREMIATI VENERDÌ A PADOVA I 12 RICERCATORI "UNDER 35" SPECIALIZZATI NELLE TECNOLOGIE BIO, INFO E ADVANCED TECH, SELEZIONATI DA TECHNOLOGY REVIEW ITALIA. IN SETTEMBRE VOLERANNO TUTTI A BOSTON PER CONFRONTARSI CON I LORO COETANEI E COLLEGHI DI TUTTO IL MONDO

Ilaria Fusco

Francesca Gella è una ricercatrice dell'Istituto Italiano di Tecnologia. Ha messo a punto una "scenicaperimaginga" super-risoluzione di campi spessi" per le analisi e radiografie mediche in 3D non invasive con

tipu a Cambridge. Massachusetts, dove in settembre, presso il Media Lab del Mit, si eserciterà la finale mondiale.

e nuove proposte si dividono in categorie tecnologiche: Bio, Info e Advanced Tech (Robotica, Trasporti). Nella prima sezione, per esempio, sarà premiato a Gori, anch'ella dell'Iit, che entato uno Studio sul recupero delle disabilità sensoriali dei o nei primi anni di vita, tra- ilizzo il piattaforme robo- izzate per la riabilitazione e le attività motorie. Nel- a sezione, dal Cnr invece rana dei Mercato, a pro- sori ottici intracefalici a barre fluorescenti", anturizzati che possono lotti nel corpo umano danneggiarlo ed anzi eco- rici. I vettori lodati

| I PROTAGONISTI |

Nelle immagini, alcuni dei giovani ricercatori-inventori premiati venerdì prossimo a Padova per il concorso Tc Italiana. Nella foto grande **Francesca Romano**; alla s dall'alto: **Despina Fragouli, Matteo Laffranchi** e **M** Qui sopra, **Luigi Abbatelli** (1), **Martino Fornasa** (2), **F** (3) e **Marco Rolandi** (4). Tutti, compresi gli altri quattr partiranno in settembre per Boston dove prenderanno p finale della competizione nella sede del **Media Lab** del si troveranno in lizza i partecipanti provenienti da tutti g che ospitano redazioni di **Technology Review**, la rivist

Diversi i concor

Idee ecologiche

SetteGreen premia pc riciclati e spugne

MILANO — C'è chi riporta in vita i pc buttati. E chi ha ideato una spugna che assorbe gli oli. A loro, e non solo, sono stati assegnati i SetteGreen Awards, l'appuntamento della rivista eco del *Corriere della Sera*, insieme al main partner E-On, a Conai (Consorzio nazionale imballaggi) e Coop. Alla Triennale di Milano la madrina Filippa Lagerbäck e il direttore del settimanale Sette Pier Luigi Vercesi (*nella foto sotto*) hanno premiato — con sculture ideate dallo Studio Pabio Novembre —

persone ed enti per il impegno ambientale. Massimiliano De Cin (associazione Nuova onlus) ha vinto nell categoria «People» l recupero dei pc. L'I Italiano di tecnolog ricevuto il premio categoria «Invenzi per aver ideato un spugna che assorb separandoli dall'a Rotoprint è stata nella categoria «Tecnologia», pe creato un sistem riciclia gli imball sezione «Cultur a Envinet, eco- network gratui Bioplanet (alle insetti per dife coltivazioni) h categoria «Fo (Milano) è st — nella cate «Comune» — migliorato le energetiche scolastica. N «Scatto Gre foto di Simona

L. Ber.

nòva 24

IN GIAPPONE

Vince la mano robotica italiana

A Osaka, nella patria della robotica più avanzata, la mano robotica italiana sbaraglia il campo degli umanoidi e riceve il più prestigioso riconoscimento della conferenza internazionale Humanoids 2012. La mano robotica di nuova generazione, nata dalla collaborazione tra Università di Pisa, Istituto Italiano di tecnologia di Genova e Centro "E. Piaggio", è in grado di compiere i movimenti di un arto umano, ma è indistruttibile ed economica, e destinata a rivoluzionare sia la robotica sia il settore delle protesi. La chiave sta nella struttura "soft", che la rende flessibile e robusta allo stesso tempo. Il device è stato realizzato ...finanziamenti europei, con il ...rtice "The

Il Sole 24 ORE

Premi Start cup. Assegnati i riconoscimenti Cnr- Sole 24 Ore

Quattro campioni hi-tech

Marzio Bartoloni
GENOVA

Massicce dosi di innovazione, prototipi già pronti per il mercato e un team solido di ri- qualche caso

gnosticano le malattie neurologiche, dalle microturbine portatili che generano energia agli strumenti per l'analisi del gas. Per il settore

ria in grado di rivoluzionare l'approccio fisioterapico attuale è al- la base del

metodi tradizionali. Il Sole 24 Ore ha assegnato al progetto Tocal il premio per la migliore comunicazione anche sulla base dei quasi 20mila voti dei lettori arrivati sul proprio sito. Il proge

ne la realiz- ta di identità destinati osmesi e al-

L'INFORMATICIEN

ACTUALITÉS DÉBATS DOSSIERS

TECHNOS RÉSEAU MOBILITÉ SÉCURITÉ SERVEURS CLOUD HPC LOGICIEL DÉVELOPPEMENT

mardi 18 juin 2013

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InnoRobo 2012 : découvrez iCub et son intelligence artificielle en vidéo

par Orianne Vatin, le 19 mars 2012 17:44 ★★★★★

iCub est un petit robot humanoïde conçu par le consortium RobotCub, composé de plusieurs universités à travers toute l'Europe. L'objectif principal de cette plate-forme est l'étude de la cognition robotique « développementale », par le biais de la mise en œuvre d'algorithmes bio-inspirés ou non.

A l'occasion du salon InnoRobo, c'est l'IIT (Istituto Italiano di Tecnologia) qui l'a présenté. Dans la démonstration ci-dessous, vous le verrez soumis à plusieurs tests.

Son intelligence est évolutive, par exemple, il est possible de lui apprendre à saisir un objet. Ensuite, si l'objet est déplacé, il saura toujours le saisir.

Il sait aussi reconnaître différents objets. Pour l'instant, il est utilisé exclusivement dans le cadre de recherches liées à la robotique et aux sciences cognitives.

C'est un projet ouvert : les plans et les spécifications du robot sont accessibles à tous, et tous ses logiciels sont Open Source. iCub mesure 104 cm, pour un poids de 22 kg.

CORRIERE DELLA SERA

Opinioni Economia Cultura Spettacoli Cinema Sport Salute Tecno

NEWS VIDEO

Corriere della Sera › Scienze › Mano robotica italiana premiata in Giappone

LA CONFERENZA INTERNAZIONALE HUMANOIDS 2012 A OSAKA

Mano robotica italiana premiata in Giappone

È in grado di compiere tutte le prese che sa fare una mano umana. Il costo? Qualche centinaio di dollari

Commenti dei lettori 3

Switch 7 0 +1 Tweet

35 19 Share 36 Embed

Link: http://video.corriere.it/mano-robotica-italiana/9802

Alla mano robotica italiana «SoftHand», sviluppata in collaborazione tra il Centro Piaggio dell'Università di Pisa e l'Istituto italiano di tecnologia (Iit) di Genova, è andato il più prestigioso riconoscimento della conferenza internazionale Humanoids 2012 a Osaka. Si tratta del secondo riconoscimento consecutivo conferito quest'anno al progetto dell'arto robotico, che aveva già ottenuto un premio analogo alla conferenza mondiale di robotica e sistemi intelligenti (Iros) in Portogallo.

NOTIZIE CORRELATE

- Il robot italiano va a caccia di un miliardo, *U. Torelli* (4 dicembre 2012)
- Robot law: linee guida per la legislazione dell'AI, *C. Clerici* (9 novembre 2012)

MULTIMEDIA

La mano robotica italiana (07/12/2012)

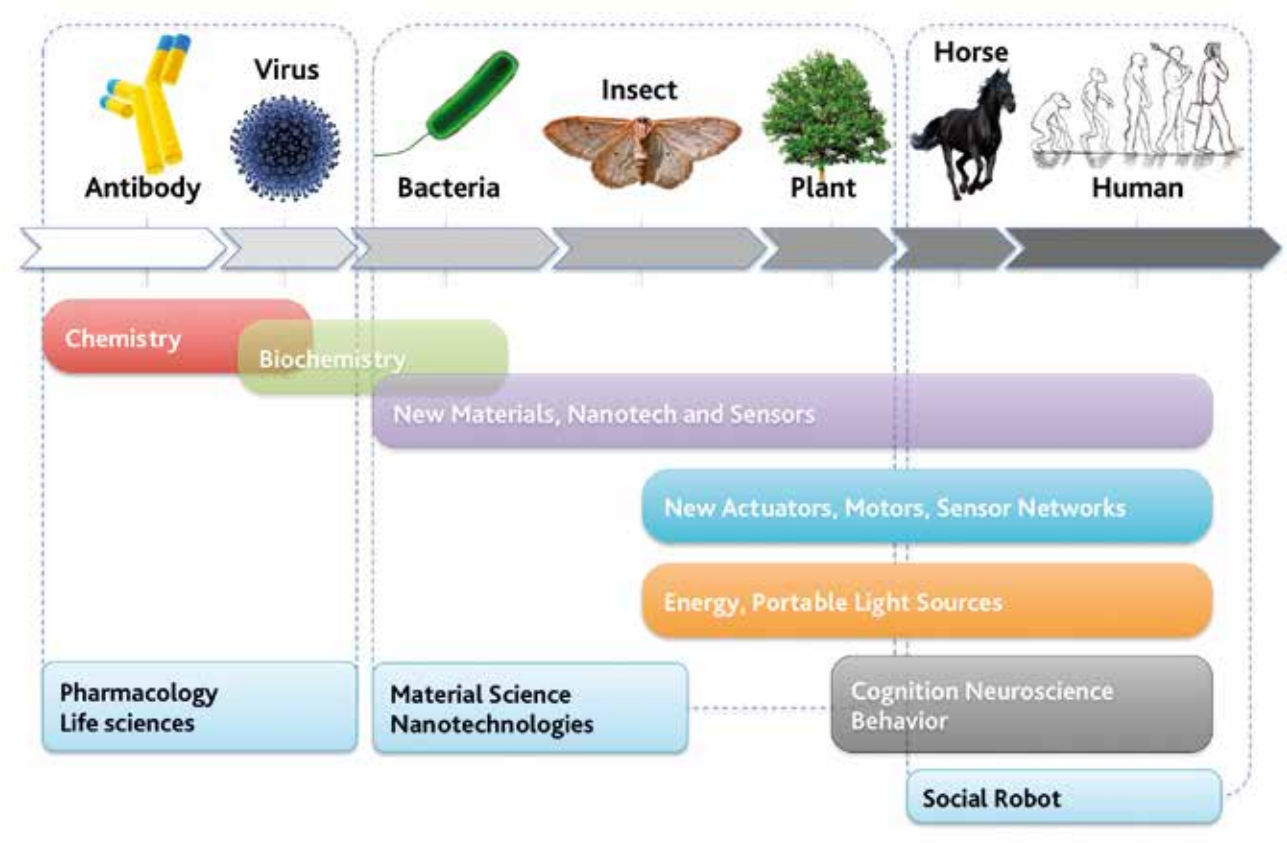
The 2012-2014 scientific plan

2012 has been the first year of the new 2012-2014 scientific plan, based on a complex matrix that crosses over the activities of the organizational structures (the departments of the Genoa Central Laboratory and the ten national centres) to the transverse research themes (platforms) of IIT.

The scientific plan relies on the idea that a biomimetic approach to technology can provide solutions for society's problems, such as the ageing of the population, lack of resources and increasing pollution. Mimicking nature makes possible to find sustainable solutions that are also compatible with society's level of development, thus optimizing energy consumption. The aim of IIT is the creation of an ecosystem of technologies that are "**inside**, **outside** and **close**" to humans.

The highly interconnected scientific-technological platforms, through which IIT research progresses are: Robotics, Smart Materials, Neurosciences, Energy, Drug Discovery, Development and Diagnostics (D4), Environment, Health and Safety (EHS) and Computing. These platforms tackle cutting edge scientific problems at several levels of complexity and scale, ranging from nanometric size up to dimensions compatible with humans. For example, at the nano- and micrometre scale, IIT is developing particles for the treatment and diagnosis of several diseases (inside humans), for environmental analysis and defining the properties of novel materials (outside of humans) and artificial bioinspired structures useful for the development of specific tasks supporting and replacing humans, such as exoskeletons, animaloid and humanoid robots (close to humans).

Visit the IIT website at **www.iit.it** to download the scientific plan.



The interconnectivity of the platforms and the complexity of the objects investigated and produced by IIT show a high level of interdisciplinary research. For example, robot development requires complex biomechanical, life and materials sciences, electronics, sensoristics and nanotechnology skills. Integrated with these disciplines, in order to give robots cognitive capacity, it is necessary to include insight of neurosciences and the study of human-machine interactions. Finally, the development of robots that are energy autonomous requires research plans scouting for novel energy sources which are light, portable as well as highly efficient and integrated.

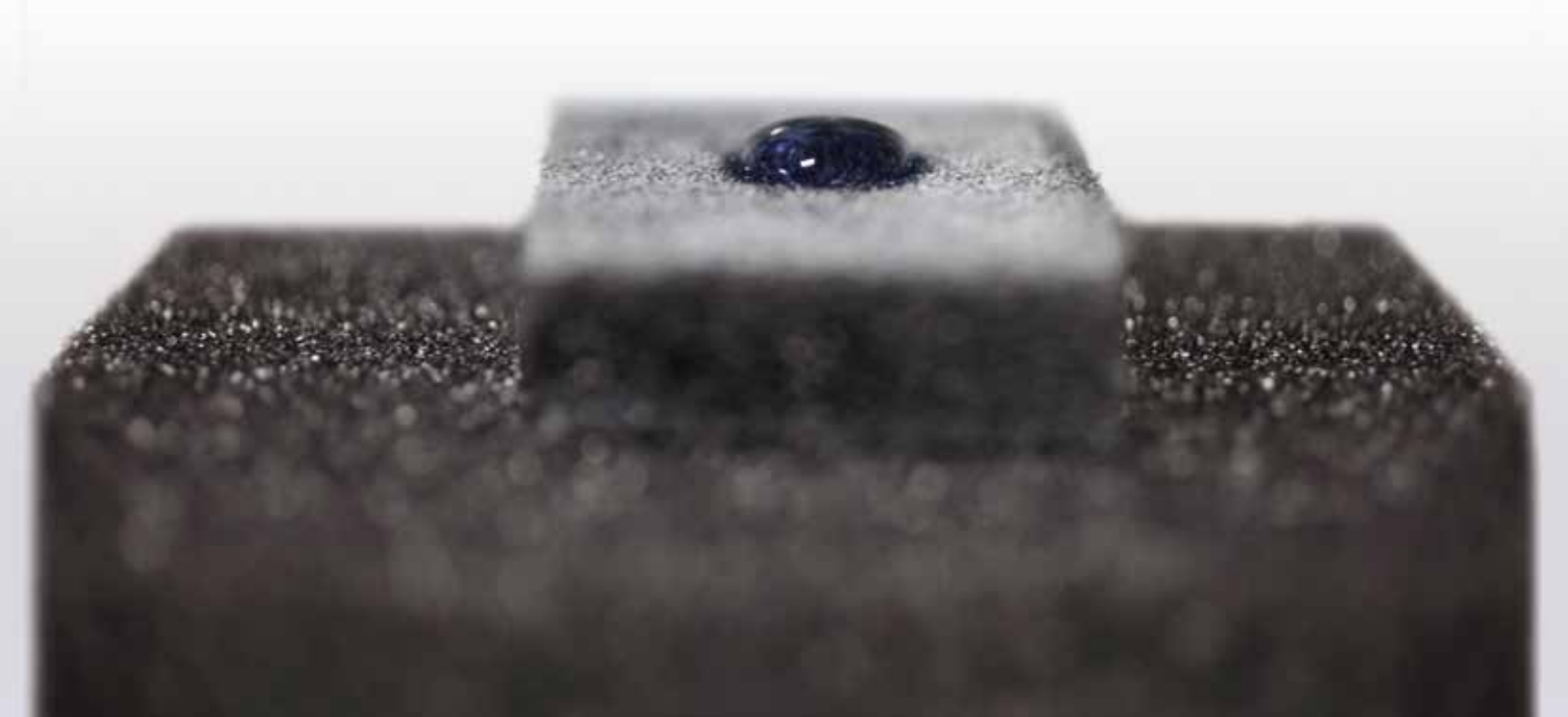
The IIT scientific plan has long-term scientific value, but also results in developments with very high-short and medium-term application potential. For example, the latest developments in materials science, aimed at giving robots biomimetic characteristics, led to the identification of novel treatments for natural fibres with tunable properties, thus broadening their field of application (see box Smart materials). In the same way, the need to make robots energy efficient makes possible to find solutions which are applicable to the automotive and domotics sectors, or improved energy exploitation in vast and remote areas (see Microturbine project, page 14).

Smart materials

Two examples of novel materials created by IIT during 2012 are a sponge capable of absorbing oils by separating them from water and which can be moved by magnets, and a multifunctional paper - hydrophobic, fluorescent, antibacterial and magnetic.

The oleophilic sponge is made using low cost materials and nanotechnology processes which can be easily reproduced as well as scaled up. Indeed, the raw material is polyurethane foam, a polymer commonly used for packaging and heat insulation, which, when treated with iron oxide nanoparticles and polytetrafluoroethylene (commercially known as Teflon) acquires magnetic, superhydrophobic and superoleophilic properties. The process makes the starting material capable of absorbing up to thirteen times its weight of oily substances. The potential applications are numerous, first of all in the environmental sector for cleaning oil contaminated water (ref. Calcagnile et al., "Magnetically driven floating foams for the removal of oil contaminants from water", ACS Nano, Vol. 6 (6), 2012).

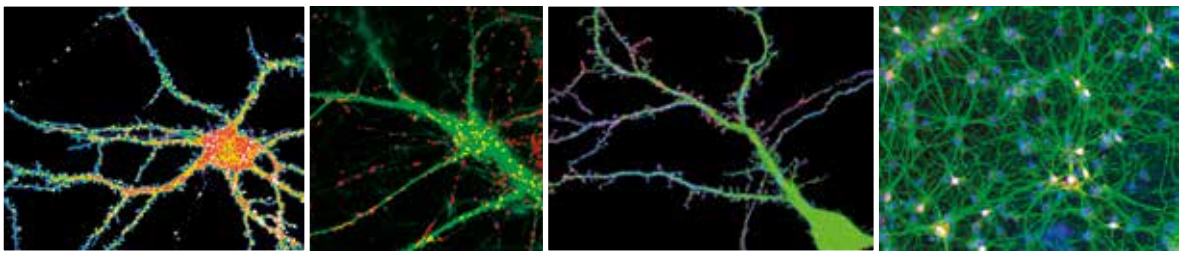
The smart paper is still printable and recyclable, even after the modifications that have made it hydrophobic, fluorescent, antibacterial or magnetic. The manufacturing process involves the production of a polymer enriched with nanoparticles, which, once spread onto paper – or other cellulose-based materials – surrounds the fibres forming spongy three-dimensional polymer shells that entrap a controllable quantity of nanoparticles. The overall appearance of the material, whether paper or fabric, is not altered, but its properties are different depending on the type of nanoparticles used: the material becomes antibacterial with silver nanoparticles, self-cleaning or highly hydrophobic with wax or Teflon, fluorescent with quantum dots, or magnetic with magnetic nanoparticles. The invention has numerous potential uses: it can be used as a packaging material, or for the preparation of impermeable, antibacterial or antifungal fabrics, useful in the fields of healthcare, the garment industry and domotics etc. (ref. Fragouli et al., "Superparamagnetic cellulose fibre networks via nanocomposite functionalization", Journal of Material Chemistry, Vol. 22, 2012).



Brain function

Genes, microcircuits and neurotransmitters: important factors underlying the function of a complex organ such as the brain this is the main topic which IIT researchers are investigating, with discoveries published in international scientific journals.

The interaction has been identified between microRNAs encoded by "junk" DNA and the expression of the FOXP2 gene, also known as the "language gene". While in the past it was thought that approx. 95% of DNA had no function, and was thus defined as "junk" DNA, we now know that this portion is important for regulating gene expression by encoding microRNAs and other types of RNA. IIT researchers have identified approx. 3000 genes potentially regulated by microRNAs and have focussed on one of these, FOXP2. This gene is responsible for the correct structuring of the brain area dedicated to language during brain development, which starts at the embryonic phase and continues into the first years of life. In particular, researchers have identified two specific microRNAs that are involved in the expression of the FOXP2 gene, and whose action is fundamental for guaranteeing the correct positioning of neurons in the brain cortex so that their connection with the basal ganglia occurs when both structures are mature, thus forming the cortico-basal circuit. This result is important, since when the FOXP2 gene is not expressed at the correct time or in the correct way, it causes severe verbal articulation disorders, such as verbal dyspraxia, accompanied by linguistic and grammatical problems. (Ref. Clovis et al., "Convergent repression of Foxp2 3'UTR by miR-9 and miR-132 in embryonic mouse neocortex: implications for radial migration of neurons", Development, Vol. 139 (18), 2012).



Another study demonstrated the role of chloride as an orchestrator in neuro-receptors: its intracellular presence induces a change in the type of GABA receptors present in the synapse. GABA is one of the body's most important neurotransmitters with inhibitory function participating in correct brain function. It is present inside synapses in two major subtypes, one controlling the release of rapid and constant currents in neural circuits (like the ticking of an internal clock), and the other intervenes in modulating slow currents that are more influenceable by the surrounding biochemical environment. Researchers have shown that the presence of chloride in the cell induces a change in the type of GABA receptor, consequently affecting the cell's electrical behaviour. This discovery makes possible to understand the correlation between the quantity of chloride inside the neuron and the onset of certain brain disorders characterized by compromised communication between neurons, and thus consider future pharmacological solutions. (Ref. Succol et al., "Intracellular chloride concentration influences the GABAA receptor subunit composition", Nature Communications, Vol. 3 (738), 2012).

Senses and neuronal microcircuits have been the focus of another significant study. Researchers studied the mechanisms and circuits that allow different sensory areas of the brain to communicate with one another, revealing a reciprocal influence between the different neural groups receiving and managing auditory, tactile and visual information. Indeed, the electrical activity of one group inhibits or stimulates the activity of another, such that communication between the sensory areas and those controlling motor decisions is precluded or promoted only for certain senses. Taking the visual system in mice as a model, and thanks to the application of methods for recording and stimulating neurons with high time and space resolution, researchers were able to precisely identify the circuits and cells that mediate the inhibitory effects of one area on another. In particular, the study shows the release of inhibitory neurotransmitters by neurons in the auditory cortex through the tactile and visive neural microcircuits. On the other hand, the neurons dedicated to visual processing inhibit the acoustic cortical areas, while they stimulate the cortical areas processing touch. (Ref. Iurilli et al., "Sound-driven synaptic inhibition in primary visual cortex", Neuron, Vol. 73 (4), 2012).

Human serving robots

HyQ is the hydraulic, quadruped robot designed and developed by IIT researchers, taking their inspiration from animals, from dogs to horses and the ibex, with the aim of assisting humans in emergency situations or in places difficult to reach. In May 2012, researchers tested its ability to walk over real and uneven terrains by taking the robot out of the laboratory to a 20 metre long track. The results have been surprising: the robot is capable of walking at a speed of 2 m/s and overcoming the obstacles encountered along the path by adjusting its step. HyQ is an aluminium quadruped 1 metre long and weighing approx. 70 kg, capable of walking, running, jumping and raising itself on its hind legs. HyQ is one of the few quadruped robots in the world that can make rapid and precise movements thanks to innovative engineering solutions. (ref. Semini et al., ICRA 2012, Saint Paul, Minnesota, USA).

Plants and roots: the plant world can be reproduced as robotic versions capable of imitating their characteristics. Indeed, plantoids are robotic roots developed by IIT at the heart of a project funded as part of the prestigious European Commission Open Future and Emerging Technologies (FET) program. On one hand, the project proposes to carry out advanced studies on the behaviour of root apex - and consequently their physical, chemical and mechanical characteristics – and on the other hand it provides models and early robotic root prototypes that can imitate them, with particular focus on their penetrative, explorative and adaptive capabilities. IIT researchers develop the hardware for the robotic root, the physical sensors to be integrated in the root apex and the actuators. The latter will allow the robot to make the roots penetrate and direct them in addition to acquiring detailed knowledge on the phenomenon of tropism and thus the response of the roots to external stimuli, such as nutrients and gravity. Plantoid robots will be useful for studying the characteristics of soils, also extra-terrestrial soils in the future (www.plantoidproject.eu).

There are approx. 25 exemplars built by IIT and more than 20 laboratories throughout the world use them for research into artificial intelligence: iCub continues to be the world's most extensively used robotics research platform. The robot has the shape and size of a child of approx. 4 years, hence the name "cub". It has 53 movement "joints" (degrees of freedom), the majority of which are in the arms and hands in order to allow holding and detailed manipulation of objects. iCub has video cameras that reproduce vision, microphones for receiving sound, inertial sensors that reproduce balance and force sensors for measuring interaction with the environment. These characteristics make iCub a humanoid robot that is capable to see the surrounding environment, recognize certain objects, understand if a person stands in front of it and respond to simple vocal commands. In 2012, the torso, the arms and palms of the hands on iCub have been covered with an artificial "skin", a surface allowing it to have a sense of touch, recording and responding to physical contact with people (www.icub.org).

IIT numbers

The introduction of the new scientific plan sees the staff of the Genoa Central Laboratory reaching its operating level and a progressive increase in network staff. At the end of 2012, the total number of IIT staff is 1143: over 450 scientists in the Genoa laboratory, almost 400 scientists in the network centres and less than 300 administrative support and technical staff, predominantly at the Genoa site (fig. 1 and 2).

The distribution of staff categories shows a percentage of scientific and technical support staff of approx. 85%, compared to an administrative and research support structure consisting of the remaining 15%.

Figure 3 shows the age distribution diagram for scientific staff. This shows a mean overall age of less than 34 years old and, in the subdivision associated with the various types of scientific profiles, indicates a predominant presence of younger scientists (over 75% post docs and Ph.D. students) and an average age in the top roles (senior scientists and directors) of less than 50 years old.

In addition to the high degree of international attraction with regard to post-docs, the high concentration of younger scientists is also guaranteed by collaboration agreements with Italian universities, whereby a consistent number of doctoral students conduct their highly scientific specialization internally and under the supervision of IIT scientific staff. In particular, in 2012, the number of students conducting their educational and research activities in accordance with the IIT scientific plan was 311, approx. 180 of which at the central lab.

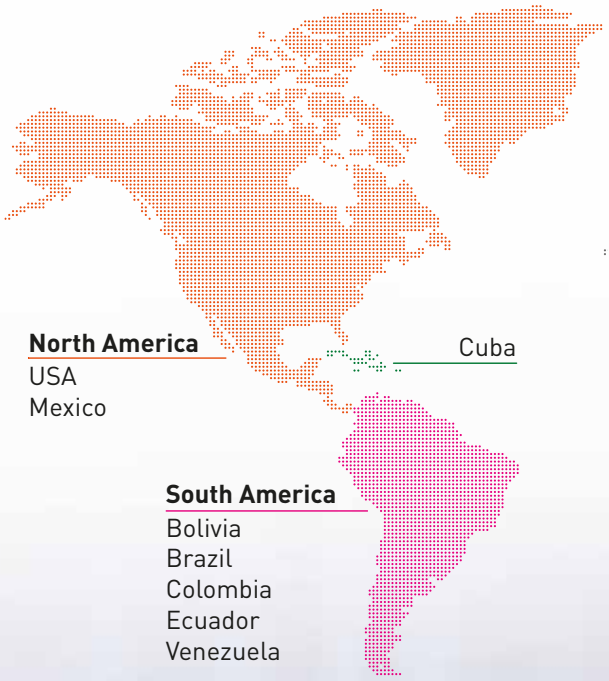
The PhD students and post-docs are characterized by young age and high turnover, the latter the result of the general propensity of the scientists to come into contact with different modes of research, enriching their professional experience. For example, over the course of the year, young IIT scientists have obtained prestigious positions at international research institutes, such as ETH and the Max-Planck Institute.

Great staff turnover is an essential condition for keeping the productivity high and for always having a suitable reserve of young talents in which to invest for future career prospects.

Within this framework, IIT has introduced "tenure track" and "long term contract" procedures, making it possible to select and maintain the best brains throughout the world. Applications for "tenure" positions are examined by a panel of external experts, who play the important role of evaluating them according to international standards, thus helping to reinforce the scientific-technological quality of IIT.

Thanks also to this approach, the number of countries providing researchers and Ph.D. students has risen to approx. 50, confirming the attractiveness of IIT and its ability to be a multicultural entity. 42% of researchers are from overseas: 24% are foreign nationals and 18% are Italians returning home after long periods overseas (fig. 4).

Countries of origin of the staff of IIT



The cultural melting pot is matched by a strong sense of interdisciplinarity, given by the broad range of scientific curricula of the staff. An analysis of the distribution of qualifications has shown the presence of over 17 disciplinary areas comprising the hard and applied sciences, life sciences and medicine, but also philosophy, psychology and industrial design (fig. 5).

The multidisciplinary nature is the key point of the 2012-2014 scientific plan, and in order to reinforce it, an internal program has been launched in 2012 for the development of 2 year interdepartmental projects, to involve the sharing of a post doc between two departments or one department and a centre. An external panel has evaluated the 50 proposals received, selecting 14 of them.

The distribution of publications also confirms the broad disciplinary variety. Indeed, according to the categorization of the Scopus database (Elsevier), these cover over 13 scientific categories, evenly presenting all the fundamental sectors of the technical sciences and many of the life sciences (fig. 6).

The growth trend in the number of publications recorded over the years has also been confirmed in 2012, with over 850 for that year, giving a total of over 3000. The infographics (attached to the cover) make possible to observe the figures representing the trend of publications over time, subdivided according to type (fig. 7) and their distribution between the Genoa Central Laboratory (over 500 publications in 2012), and the network of centres (almost 400) (fig. 8).

The number of joint publications from the various research centres or departments has increased by approx. 65, in addition to the numerous communications submitted for international conferences.

At the end of 2012, IIT publications in high impact journals constitute approx. 47% of the total. Figure 9 shows the percentage distribution according to Impact Factor (IF) ranges for scientific publications in international journals for the period 2006-2012. The IF ranges roughly reflect the classes of publications as: proceedings (IF 1-2), topical journals (IF 2-4), high level sector journals (IF 4-7) and very high brand journals (IF >7).

Finally, both the mean individual productivity of over 2 publications per member of staff (which includes directors/coordinators, senior scientists, team leaders and post docs), and the mean Impact Factor for researchers of approx. 7, maintained an optimum level.

Evaluation and Ranking

The international character of the Institute places qualitative as well as quantitative verification and evaluation processes for research activities at the centre of scientific planning and human resource improvement. An external Evaluation Committee periodically verifies the achievement of scientific objectives and the adoption of management measures for the attainment of international standards. This activity runs alongside the internal evaluation of the staff according to a Money By Objective (MBO) model.

In 2012, analysis activities have been the following:

- yearly evaluation of the activity reports for all directors and coordinators by the STC;
- Evaluation Committee final report;
- on site visit for Department D3;
- partecipation to the National University and Research System Evaluation Agency (ANVUR) program.

According to a benchmark set by the Evaluation Committee in 2012, the mean number of citations per IIT publication is comparable to that of other international institutions. The following statistic has been calculated by considering the mean number of citations per publication in February 2012 over the output for 2009 and 2010.

	2009	2010
IIT	9.84	5.19
Weizmann	8.37	5.54
EPFL	8.45	4.91
Caltech	11.02	7.20
KTH	6.61	4.28
Imperial College	8.48	4.64
MIT	12.06	6.13
Berkeley	9.37	5.45
Stanford	9.31	5.08

The bibliometric parameters (Q1 and EXC) of IIT evaluated by the Scimago Institutions Rankings (Report 2012, www.scimagoir.com) are consistently comparable to those of the above internationally acknowledge institutes (fig.10).

Training and Collaborations

In 2012, IIT extended its network of national and international research and training collaborations with public and private institutes and with companies, signing approx. 40 framework and implementation agreements. These agreements foresee the possibility for researchers to reciprocally benefit from advanced laboratories and to share scientific knowledge, and frequently co-supervise doctoral students. For example, in relation to the development of the IIT scientific plan platforms, the following agreements have been defined:

- Robotics and Computational: Waseda University, University of Verona, University of Pisa;
- New materials: Nanjing University, IMT Alti Studi Lucca, University of Barcelona, Kilometro Rosso
- D4 and Neurosciences: Department of Pharmacology - University of Bologna, University of Trieste

Moreover, agreements have been made for the development of training and orientation internships with national and foreign teaching universities, such as University of Genoa, Roma Tre University , Università Politecnica delle Marche, École Polytechnique Universitaire "Pierre et Marie Curie" and Université d' Aix-Marseille.

As part of the Erasmus program, IIT has welcomed students from European universities, including Université de Bourgogne, Delft University of Technology and Utrecht University.

Finally, within the framework of institutional partnerships aimed at advanced teaching programs, joint Ph.D. agreements should be highlighted, allowing students to complete their specialization training in subjects included in the IIT scientific plan, and inside its laboratories. 107 joint doctoral grants have been awarded in 2012, taking the total number of doctoral students to approx. 311.

Within the context of advanced teaching programs, IIT and University of Genoa, together with important Ligurian high-tech companies and institutions, have collaborated in setting up the masters degree in "Technology Transfer, Entrepreneurship and Innovation", with the aim of giving graduates specific skills for the management of innovative processes in high-tech companies and research institutions.

Scientific planning and technology transfer

The achievement by IIT of a high level of scientific quality is also confirmed by the growth in fund raising from competitive projects and technology transfer results. At the end of 2012, the Institute has a project portfolio equal to a total of almost € 60 million, representing a source of funding for specific research projects, some also long-term (fig.11).

In particular:

- 64 projects funded by the European Union
- 12 projects funded by the Ministry of Health
- 19 projects funded by Italian or European Foundations
- 5 projects funded by US Foundations or Institutions

In addition to these projects, 1 European Research Council (ERC) grant and 3 Marie Curie programs have been awarded.

2012 has seen a large increase in technology transfer activities; besides approx. 160 patents filed, 25 awarded (fig. 12 and 13) and numerous license procedures initiated, the first start-up projects have been launched in relation to original inventions by IIT researchers, among which:

3Brain: develops devices for cellular diagnostics of pharmaceutical interest. The system consists of a chip capable of reading and analyzing neuronal activity in complex networks of cells, allowing better understanding of brain function, in addition to studying diseases and testing medicinal products.

HIRIS: Human Interactive Reliable Integrated System born within a human-computer interaction project. It is a modular and reconfigurable system of sensors and actuators capable of interacting with one another and exchanging information by means of advanced haptic feedback (touch, vibration, heat). For marketing of the technology, the company Circle Garage has been set up, focussing on the gaming, outdoor&sports, field operations and security sectors

Microturbine: aims to market a turbine with a diameter of 14 millimetres that exploits the fluid pressure available in an environment or in an industrial plant to produce electricity on site.

QB Robotics: produces components for robotics applications aimed at the creation of compliant robots, namely with movements similar to those of humans, increasing their energy efficiency, speed and versatility.

Rehab Technologies: aimed at the creation of a company producing and marketing robotic solutions for rehabilitation, particularly of the ankle and wrist. The project benefits from ongoing collaborations with INAIL and Giannina Gaslini Hospital.

In addition to the above, a further three start-up projects are in the process of being finalized.

As confirmation of the growth in technology transfer activities, industrial partnerships have reached a value of approx. € 4.7 million, including in-kind contributions in the form of instrumentation from global leading companies in the field of microscopy and in the printing and treatment of novel materials.

The rise, over fivefold, in the value of commercial contracts with respect to the previous year is the result of their increase in number as well as their mean value. It is interesting to note that this mile stone has been achieved thanks to the contribution of more technological centres and platforms.

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