



(ENG) <a href="http://www.youtube.com/watch?v=nieE2xJU2Yk#t=37">http://www.youtube.com/watch?v=nieE2xJU2Yk#t=37</a>

(ITA) https://www.youtube.com/watch?v=PIQksa3ZYQM



## Istituto Italiano di **Tecnologia**

is a Foundation that promotes excellence in fundamental and applied research, develops higher education in the area of science and technology and fosters the evolution of industry towards the forefront areas of technological innovation.

Genova Central Research Lab 32.000 sqm, fully equipped, one of the largest single-site labs in Europe





# **Mission and Network**



#### ISTITUTO **ITALIANO DI TECNOLOGIA**

#### Genova Central Research Lab

Advanced Robotics Drug Discovery and Development iCub Facility Nanochemistry Nanophysics Nanostructures Neuroscience and Brain Technologies Pattern Analysis & Computer Vision Robotics, Brain and Cognitive Sciences



**Research Centers** 

Torino

Center for Nano Science and Technology Milano

Center for Space Human Robotics



Center for Genomic Science Milano



Center for Neuroscience and Cognitive Systems Trento



Brain Center for Motor and Social Cognition Parma



Center for Nanotechnology Innovation Pisa



Center for Micro-Biorobotics Pisa



Center for Life Nano Science Roma



Center for Advanced Biomaterials for Health Care Napoli



Center for Biomolecular Nanotechnologies Lecce

Machine Learning @ MIT Nanotech for brain @ Harvard



2003	September 2003:				
	Institutional Law of IIT				
200	2004-2005:				
2004	Board of Trustees for Governance and Mission				
	lune - September 2005:				
2005	Selection of research directors via calls on Nature and Science; 155 applications, 23 short listed.				
	6 winners: 2 from USA, 2 from Europe, 2 from Italy.				
	December 8, 2005:				
	Appointed Scientific Director, Roberto Cingolani				
	<u>December 2005 - December 2008:</u>				
2006	Start up phase				
Т	<ul> <li>Building demolition, reconstruction, refurbishment</li> </ul>				
	<ul> <li>Laboratory design, lay out</li> </ul>				
2007	<ul> <li>Purchase of equipment Installation and test</li> </ul>				
	<ul> <li>Hiring procedures : ≈ 420 staff out of 2000 interviews from 38 countries</li> </ul>				
2008	<ul> <li>Launch the Multidisciplinary Research Network</li> </ul>				





## **The Start-Up Phase**





Aimed at maximizing cross fertilization between disciplines, the scientific plan addresses some of the main trends that will impact the planet in the next decades, namely demographic shift, quality of life, and resource scarcity. To do so, scientific activity revolves around Robotics & Mechatronics, Neuroscience and Smart/Green Materials.

## **Research Platforms**



#### **Executive Committee**

Gabriele Galateri (Presidente), Roberto Cingolani (Direttore Scientifico), Giuseppe Pericu, Francesca Pasinelli, Alberto Sangiovanni Vincentelli.

#### **Scientific Committee**

Giorgio Margaritondo Emilio Bizzi Lia Addadi Adriano Aguzzi Yasuhiko Arakawa Uri Banin Martin Chalfie<sup>◊</sup> Oussama Khatib Alex Zunger Jean-Jeacques Slotine Arto Nurmikko Takeo Kanade Kenji Doja

(EPFL, Switzerland), <u>Chairman</u> (MIT, USA) (Weizmann Institute, Israel) (University Hospital Zürich, Switzerland) (Tokyo University, Japan) (Hebrew University, Japan) (Hebrew University, Israel) (Columbia University, USA) (Stanford University, USA) (Stanford University, USA) (MIT, USA) (Brown University, USA) (Carnegie Mellon University, USA) (Okinawa Inst. of Science, Japan)

## Governance



\* honorary members





## People



Based on SCOPUS bibliometry referred to the 2006 - 2010 period, the SIR 2012 rankings confirm IIT positioning among the world's excellence of scientific research, evaluating the Foundation performance in the same range of the long established top institutions of the world.



ANVUR – Evaluation Agency of the Italian Ministry of Education and Research, ranked IIT no. 1 among the research institutions in Italy in its categories

## Ranking

- IIT Caltech
- MIT
- Stanford
- Weizmann
- EPFL
- GaTech  $\diamond$
- % EXC = % of works of an institution belonging to the top 10% most cited papers.
- % Q1 = Ratio of publications that an institution publishes in the most influential scholarly journals of the world



Field-Weighted Citation Impact indicates how the N° of citations received by an entity's publication compares with the average n° of citations received by all other similar publications in the date universe (same year, publication type and discipline)







## **Performance Evaluation and Funding**

#### **PERFORMANCE MONITORING:**

- **1.** <u>Individual</u> evaluation, on a yearly base, referred to assigned targets (Management by Objectives 20% of gross wage)
- 2. <u>Departmental</u> evaluation, every three years. Panel made of Chairman and selected members of Scientific Committee, plus international independent experts
- **3.** <u>Global</u> evaluation: Evaluation Committee (external scientists and managers)

#### **FUNDING**:

- IIT is a Private Foundation, funded by the Italian Government, with annual budget of €95 million, and jointly supervised by the Italian Ministry of Finance and Ministry of Education
- In addition, IIT competes on international level for additional funding

Funding on a competitive base from EU, National and International institutions and Industry

Fondazione Istituto Italiano di Tecnologia









## From Lab to Market







## From Lab to Market



- Technology Transfer is part of the mission of IIT, and is realized through
  - Feasibility studies and applied technology project developed together with industry players
  - Joint Labs between IIT and Corporations/Firms
  - Licensing of IIT technologies, based on know-how or patented technologies
  - Creation of technology-based spin-off companies
- **IP protection is one key activity of IIT**, being the starting point for technology transfer. To this purpose, a dedicated Patent Office has been established.
- A dedicated team and over €1,0M invested in patent protection in 2015, looking into a growing trend.



## **TT** in practice



	Name	Торіс		Name	Торіс
High resolution technology	3Brain	Med-Tech & Drug Discovery: HW & SW platform for	B I G I I TECHNOLOGIES DESIGNING BETTER MEDICINES	Biki Tech	Drug Discovery: SW platform to design new drugs
		in vitro response	iCub house	iCub	Robotics: intelligent interactive robotic solutions
	Circle Garage	Robotics and ICT: wearable sensors network	REHAB TECH ENABLING PEOPLE	Rehab Tech	Robotics and Healtcare: rehabilitation
hiq-nano The ART OF PRODUCING NANOPARTICLES	HiQ-Nano	Smart Materials: High quality nano particles production	<b>CompAct</b>	CompAct	Robotics: workforce support solutions
MICROTURBINES	Micro-turbine	Clean Energy Harvesting: micro converter from fluid to electric power		Dual Cam	Computer Vision: combined audio and video camera
SENSING ELECTRO MAGNETIC PLUS	SEM+	Robotics and ICT: flexible tactile sensors	ribes Technologies	Ribes Technologies	Energy and Smart Materials: roll-to-roll printed polymeric solar cells
optogeniX	Optogenix	Smart Materials & Neuroscience: production of patented probes for brain	Visual Behaviour Analysis for Advertisement	viBe	Computer Vision: customer behaviour analysis technology.
	Artificial Retina	Neuroscience and Smart Materials: biocompatible polymeric implant to repair blind retina	POLITRONICA	Politronica	Smart materials: nano-structured inks for printed electronics
			<b>qb</b> robotics	qbRobotics	Robotics: robotic modules to be assembled

# Spin Off's





Fondazione Istituto Italiano di Tecnologia

## Research



## Humanoid Robotic assistant



#### www.icub.org

- <u>http://www.youtube.com/</u> <u>watch?v=ZcTwO2dpX8A</u>
- <u>http://www.youtube.com/</u> <u>watch?v=ErgfgF0uwUo</u>
- <u>http://www.youtube.com/</u> <u>watch?v=jaTEbCsFp\_M</u>











CONTRO GLI INFORTUNI SUL LAVORO

The INAIL-IIT joint lab is focused on developing robotic solutions for people rehabilitation

http://www.youtube.com/watch?v=5h8HQbvKNeA&sns=em









Developing active robotic prosthesis to allow amputees recovering a large portion of their movements, thus improving the quality of life and work

## **Rehabilitation Robotics**





**CoMan** is a robotic platform focused on compliant behavior. It develops of a new set of mechanic joints and actuators, along with control logic to mimic humans





# **Coman and HyQ**

• **HyQ** is a robotic platform focused hydraulic actuation and a quadruped morphology. Torque and force control allow the robot deal with various situations, making it suitable for operations in hostile environment.

http://www.youtube.com/watch?v=AnwetZpRtFE



## **DualCam: Seeing the Sound**

A real-time

 audio&video image
 provides enhanced
 information and
 timely automated
 response to
 observed events.

https://www.youtube.com/wat ch?v=7lXsufflhkk

## Markets

- Security & Surveillance
- Transportation Systems
- 24/7 Asset Monitoring
- Multimedia & Entertainment







Automatic Audio-Driven Camera Steering and Zooming



#### All-Weather / Night and Day





# **Combination of nanoparticles and polymers** allows to change material properties

A simple sponge becomes an

## **OIL-WATER** separator



By treating the sponge surface with appropriate nanoparticles, the sponge absorbs oil (blue drop) dispersed in water, leaving the latter clean, on top of the hydrophobic surface

## **Smart Materials**



## Paper treatments & encapsulation methods

(a)

## **Cellulose fibers treated with acrylate** nanocomposites

#### Application of the polymer solution on paper by drop casting or dipping or spraying

Microscopic Images of Untreated and Treated Cellulose Fibers

Textile & Paper Industry Constructions Cultural Heritage Counterfeit Packaging





### **Encapsulation of PVP-I in Natural Polymer Beads**





## Special wettability treatments

### Glass substrate response to water drops







## Acrylic coating on glass: self cleaning effect and enhanced surface properties









WCA ~  $60^{\circ}$ 



WCA ~ 60°



## **Green Plastic from vegetable waste**

Most of the plastics we use today are made up of non-degrading petroleum based resources. Lack of degradability and the closing of landfill sites as well as growing water and land pollution problems have led to serious global concern about plastics. Processed vegetables and cereals produce large amounts of waste rich in cellulose all over the world. Such waste was directly transformed into green plastics.

#### From vegetable waste (e.g. cocoa)

**To Plastic** 











## ...with tunable mechanical properties









Tomato skin



Photocromatic polymers for window integrated solar cells







## Solarprint





- This Spin-Off Company develops energy converters based on a microscale traditional turbine used in the energy industry
- Suitable application are energy production in remote infrastructure, converting fluid flows into electric power (SMART GRID, battery recharging, stand-alone energy back-up, ...)





## **Micro Turbine**







- An artificial hair cell obtained by self-bending of a strained multilayer may be used as sensor or energy harvester in several applications: flow/pressure sensing in liquids and any fluid, hydrophones, prosthetics, scanning probes, biochemical sensing in liquids (water, oil, wine ...)
- The readout system is both based on a m-strain gage, integrating a Wheatstone bridge, and/or a piezoelectric approach. The fabricated MEMS are water-proof by virtue of a conformal parylene coating and fabrication process allows for large scale production.



Piezo MEMS based on aluminum nitride on Kapton substrates for energy harvesting applications

## **Micro Energy Harvesting**

#### **Artificial Hair Cells for flow** sensing in AUV



# Nanochemistry labs







# Magnetic Nanoparticles for Biomedical Applications



#### Amphiphilic polymer coated dimers









#### **Before Hyperthermia**

#### After Hyperthermia





# Nanodiagnostic for POC diagnostic

• Hybrid nano-sensors, combining nanomaterials with organic sensing elements, allow simplified detection (up to naked-eye), suitable for point-of-care diagnostics



#### SEMI-QUANTITATIVE VIRAL DNA DETECTION

#### BASED ON CONTROLLED AGGREGATION OF GOLD NANOPARTICLES





## Graphene, the marvelous material

## 2010 Nobel Prize in Physics



- Strongest Material

ullet

- **Highest Surface Area** ullet $- 2630 \text{ m}^2 \text{ g}^{-1}$
- **Optically Transparent** ●



100 times tensile strength of steel - Young's modulus = 1 Tpa - Tensile strength = 80 Gpa

#### **Record Electronic Properties**

60% higher conducibility than silver and copper; 1 million times the current density of copper - e<sup>-</sup> mobility 200 000 cm<sup>2</sup>/V s - Bulk resistivity =  $10^{-6} \Omega \text{cm}^{-1}$ 

#### Highest Thermal Conductivity

5 times that of copper, better than diamond - Thermal conductivity = 5000 W/mK

Superior to active carbon

**Completely impermeable** 







# **Producing Graphene inks**



## Il progetto si propone di avviare lo sviluppo di Precision Medicine,

combinando:

- Genomica,
- Big-Data Analytics ,
- Nuove Tecnologie Diagnostiche per Cancro e Malattie Neurodegenerative

È il primo progetto al mondo che combina questi diversi approcci per identificare soluzioni che migliorino le condizioni di vita della nostra società.

#### Alcuni dati:

- Nel 2008 in Europa: 2.45 milioni di casi di cancro, 1.23 milioni di decessi, €126 Miliardi il costo;
- Nel 2030: WHO stima 13 milioni di morti per cancro nel Mondo
- Nel 2050: 100 milioni di casi di malattie neurodegenerative nel Mondo

#### <u>Italia</u>

- 2014: 366.000 nuovi casi di cancro (1000/giorno)
- Oggi (feb. 2016): circa 1.2 milioni di malattie neurodegenerative







# uman echnopole





- Il progetto è stato presentato al Governo a febbraio 2016.
- Una commissione
   internazionale di esperti è
   stata nominata per la
   valutazione del progetto.
- Il progetto impiegherà circa
   1.600 nuovi ricercatori per un
   budget stimato di €150 milioni
   l'anno.



## Il progetto



## La struttura dello Human Technopole

## **7 RESEARCH CENTERS**

- Medical Genomics Center
- Neurogenomics Center
- AgriFood & Nutrition Genomics Center
- Data Science Center
- Center for Computational Life Science
- Center for Nanoscience and Technology
- Center for Analysis, Decisions, Society

# 3 FACILITIES □ Central Genomics □ Imaging □ Data Storage & HPC

Lancio di chiamata interna di idee





## **II** Team







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