

Research **UniTrento**

Skills for innovation



UNIVERSITY
OF TRENTO - Italy



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The University of Trento at a glance





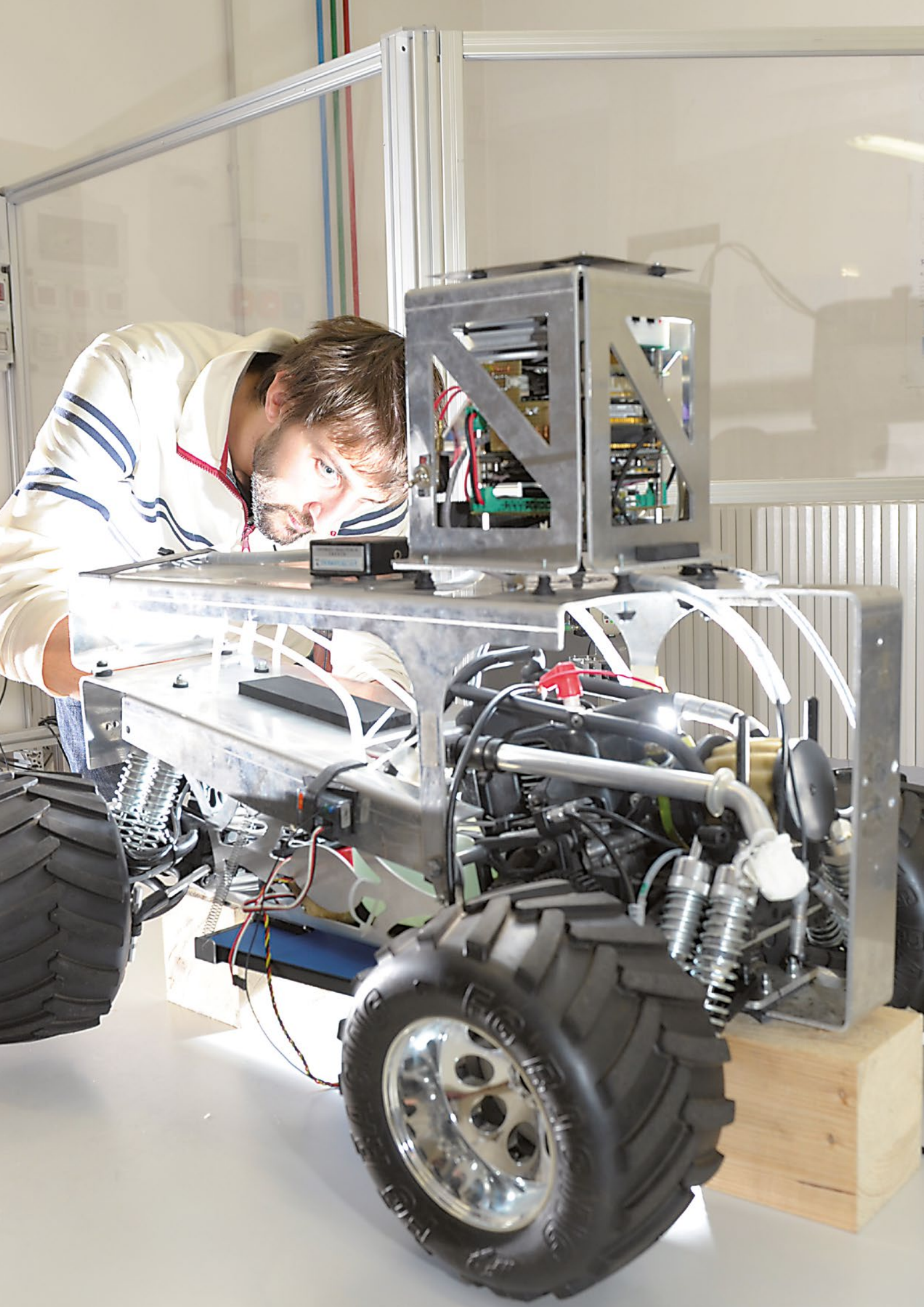
The University of Trento is a medium-sized university, founded in 1962. It is a young, dynamic, research oriented institution, marked by high-level teaching opportunities and facilities.

The figures describing the University – over 16,000 students and about 600 faculty members and 600 staff personnel – reflect this institution, which is organized into 10 Departments and 3 Centres. Moreover, the University continues to expand its fields of research and to offer new courses.

The distinct international approach of the University of Trento is one of its strong points. It is involved in many research networks and has prestigious cooperation agreements with important research centres and universities throughout the world, which encourage scientific exchanges and mobility of teaching staff and students. The University also takes pride in offering Double Degree Programs, which involve high-profile international scientific contacts. Many Master's courses and Doctoral courses are taught in English.

The high-quality research activities are described in the Italian National Agency for the Evaluation of the University and Research Systems (ANVUR) 2013 Report, which evaluated the quality of research in the period 2004-2010: Trento ranks first for scientific production in medium-sized Italian universities. The knowledge and skills of researchers and teaching staff at the University of Trento have significantly increased its ability to access European funding for research projects and to obtain ERC grants.

The University of Trento devotes a lot of energy to the strengthening of international relationships but, at the same time, believes in the continuous consolidation of relations and connections with local bodies. There is constant communication among these groups, and the aim is to find solutions that meet the needs of all parties, i.e. the University pursues the technological transfer to the benefit of the firms and collaborates in the drafting of training and study plans, while firms and public and private bodies offer internship opportunities for students.



Fostering innovation: start-ups and knowledge transfer

The University of Trento has been able to maintain constant communication with business companies. The aim is to establish sound cooperation networks between the academic research carried out in the laboratories and the everyday management of companies, including small ones based in Trentino and internationally-oriented ones.

The University has already been proactive in fostering the attention paid by companies and the productive world to some recently-initiated areas of strategic research. Within the areas of ICT, neurosciences, integrated research, mechatronics, and civil and environmental engineering, fruitful connections have been set up, which have sometimes resulted in the mobility of PhD students and in the creation of start-ups. Since 2007 the University of Trento has supported the creation of fifteen start-ups. Six have concluded their recognition period, while the remaining nine are still active as University of Trento start-ups.

Smart Hydrogeological Solutions s.r.l.

*Department of Civil, Environmental and
Mechanical Engineering*

Software development and application for the management of surface and underground water resources (forecast of extreme events, optimal management of water at basin level, modelling of underground flows, IT support for the recovery of polluted sites).

www.smarthydrosol.com

Xtensa s.r.l.

*Department of Information Engineering and
Computer Science*

Low-cost software products for people with serious motor disabilities. Trading of software, in synergy with commercial hardware, which allows for greater PC/user communication opportunities. The high cost of tools with high technological content can be reduced by shifting the complex content of hardware to the intelligence of the system (software).

www.xtensa.it

Robosense s.r.l.

Department of Industrial Engineering

The mission is the technological transfer from research to business in the fields of robotics, automation and measurement systems.

Robosense transforms the advanced knowledge and new technologies into industrial applications and products, it is a versatile and independent Research, Development and Production structure aimed at understanding and solving the issues and needs of customers through industrial innovation.

www.robosense.it

RSens s.r.l.

*Department of Information Engineering and
Computer Science*

Production and trading of sensors to measure radiation and, in particular, the development of innovative sensors for radon gas (featuring low price, small dimensions, wireless control and simple use).

www.rsens.it

Okkam s.r.l.

*Department of Information Engineering and
Computer Science*

The enterprise expands the use of semantic technologies within the company information systems, offering innovative solutions for the management and integration of data. It aims at providing Data Links solutions (connecting information in a dynamic way from different sources), Object Links (interface of real objects and virtual objects on the web) and Business Solutions for the efficient management of information company data or public data in complex contexts.

www.okkam.biz

Seelko s.r.l.

*Department of Civil, Environmental and Mechanical
Engineering*

Development of energy harvesting solutions and investment in new ideas and technologies; the areas of expertise include numerous fields in the horizon of renewable energies and clean technologies.

www.seelko.com

-Skopìa s.r.l.

Multi-service, for-profit corporation which provides:

- strategic intelligence, based on the analysis of changes, risks and opportunities, and consulting services for the development of anticipatory-based skills;
- counselling to communities, governments and businesses through research based on the theory of anticipation. Anticipation includes both forecasts (e.g. extrapolations from time series) and the exploration of possible futures (e.g. scenarios), but its scope is broader than either of them.

www.skopia.it

Intellegit s.r.l

Faculty of Law, Department of Economics and Management

Intellegit is a recently created start up. It will develop innovative solutions based on the research activity done within the eCrime group - ICT, Law and Criminology from the Faculty of Law of the University of Trento (eCrime-UNITRENTO). The main products will include: software for fraud detection, products and services for geostrategic intelligence, intelligence services for security.

www.intellegit.it

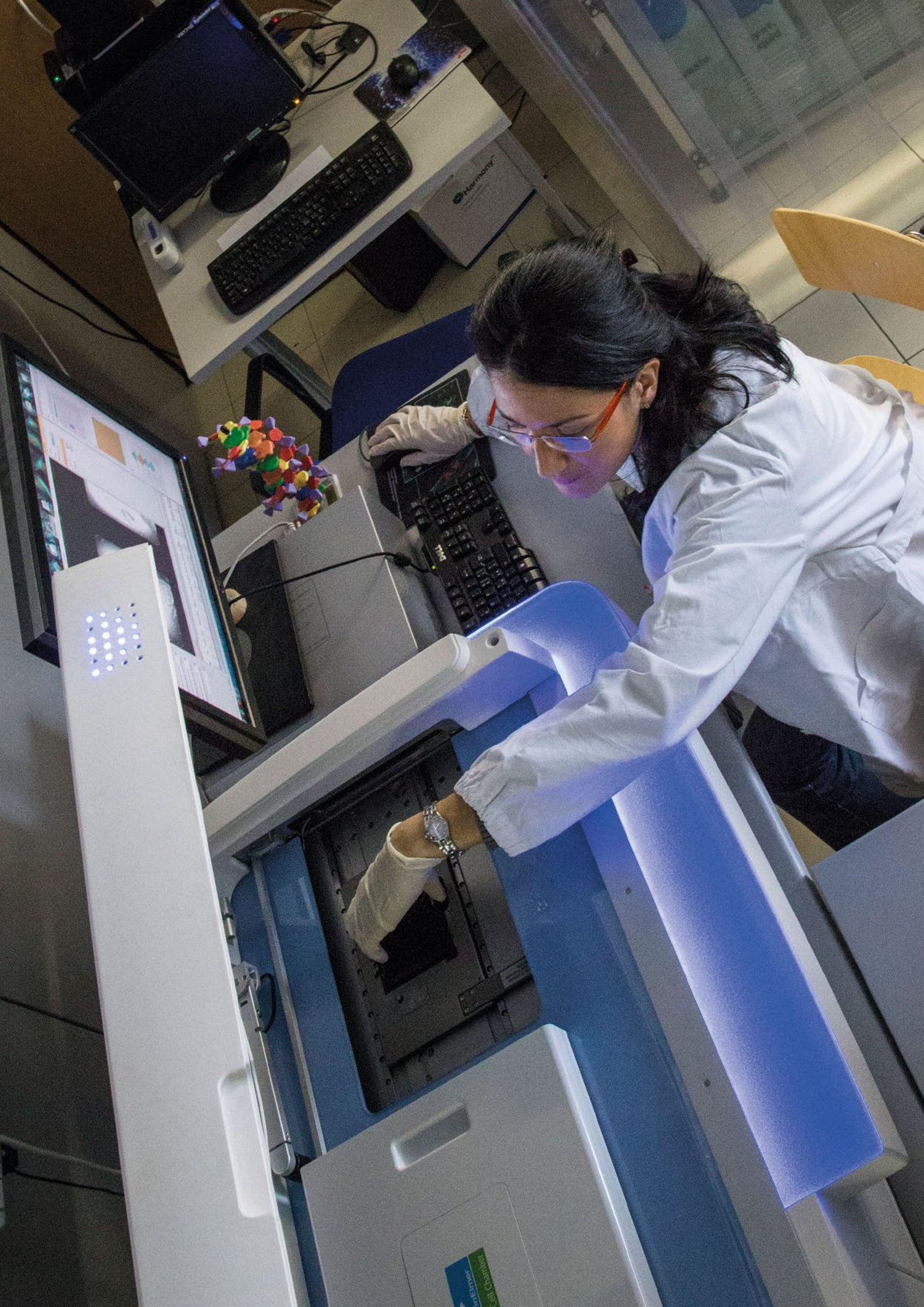
I3 (Intelligent Infrastructure Innovation)

Department of Civil, Environmental and Mechanical Engineering

Research, development and commercialisation of web based IMS – Infrastructure Management Systems interfaceable with structural monitoring systems and applications for augmented reality in mobile devices.

www.i-kubed.com

The strengthening of the connection between academic research and companies depends also on communication. Thanks to the newsletter **KNOWTRANSFER** – a quarterly paper and online publication by the University of Trento – we aim at strengthening the ability to communicate, using the business language. In this way, projects are disseminated and new connections are fostered, in order to create networks with companies, enterprises, public and private research bodies and public administrations.



Research at UniTrento

The research policy at UniTrento is built on few simple principles.

The first is the recruitment of highly-qualified, proactive, enthusiastic young researchers able to develop, thanks to the support of the University, fundamental and ground-breaking research areas.

We then foster networking among researchers and external partners through dedicated staff and facilities supporting the organization of meetings, conferences and other hosting programs; the establishment and consolidation of research collaborations facilitates a continuous improvement in the participation in European and international funding programmes.

Lastly we pay great attention to the organizational structure for research support which is continuously redesigned in order to better help researchers during the entire grant process, from the project development and submission phases to grant management and reporting.

In addition to this, Trentino is a genuine large-scale “living lab”, where the public sector plays an important role as driving force for innovation and research; key members of the business world collaborate in order to develop innovative ideas and, then, the knowledge triangle is further enhanced by the direct involvement of end users.

As a result, UniTrento is the leading University in Italy for research quality among the medium-sized universities (as stated by the National Agency for Research Evaluation, ANVUR 2013 for the period 2004-2010); furthermore, at international level, according to the Times Higher Education survey 2015-2016, UniTrento is ranked among the first 200 world class universities.

Research at UniTrento can be powerfully illustrated through the list of the research topics of our **20 ERC grants** (17 in FP7 and 3 in Horizon 2020). The main goal of the ERC program is to encourage high quality research in Europe through a very selective and competitive evaluation based on the single criterion of scientific excellence.

HORIZON 2020

ERC STARTING GRANTS

1 project in the “Social Sciences and Humanities” domain.

CRASK – Cortical Representation of Abstract Semantic Knowledge

(1.472.502 euro – 60 months)

Scott Laurence Fairhall

CIMeC - Center for Mind/Brain Sciences

Conceptual representation in the brain has been studied in terms of simple concepts, like an apple (a red/green, round, edible, fruit). The challenge of CRASK is to move beyond this to our complex encyclopedic knowledge (the rebellious Swiss, William Tell, once shot an apple off his sons head with a crossbow). CRASK will use MEG, fMRI and fine behavioural manipulations to meet this challenge. First creating a cortical systems-model of simple concepts, then using this to unlock how the brain creates the combinatorial world-knowledge that is so important for our daily lives.

ERC CONSOLIDATOR GRANTS

1 project in the “Life Sciences” domain.

SPICE – Synthetic Lethal Phenotype Identification through Cancer Evolution Analysis

(1.996.428 euro – 60 months)

Francesca Demichelis

CIBIO - Centre of Integrative Biology

The overall goal of the SPICE research project is the development of an innovative methodology to nominate genomic predictors of lethal cancer and to identify co-targeting solutions based on synthetic lethal combinations, i.e. events that are lethal for cells when concurrent. The innovation stems from the capability of quantifying genomic lesions clonality to infer tumor evolution patterns and allows for the unbiased search of potential co-targeting solutions not yet explored. The methodology exploits information down to base-pair resolution and patient's genetic code from sequencing experiments and combines computational and mathematical tactics to handle highly aberrant genomes typical of advanced and treated tumours. Extensive experimental work will validate the prioritized combinations. Successful results will translate into drug targeting opportunities that will selectively destroy cancer cells.

ERC PROOF OF CONCEPT

1 project in the Physical Sciences and Engineering domain.

SILKENE – Bionic silk with graphene or other nanomaterials spun by silkworms

(149.944 euro – 18 months)

Nicola Pugno

Department of Civil, Environmental and Mechanical Engineering

We aim at producing bionic silk and related super performing macroscopic tissues directly spun by silkworms fed with nanomaterials such as graphene.

FP7

ERC STARTING GRANTS

8 projects: 2 in the “Physical Sciences and Engineering” domain and 6 in the “Social Sciences and Humanities” domain.

MADVIS – Mapping the Deprived Visual System: Cracking function for prediction

(1.488.987 euro – 60 months)

Olivier Marie Claire Collignon

CIMeC - Center for Mind/Brain Sciences

The main goal of MADVIS is to make a breakthrough on two fronts: (1) understanding how visual deprivation at different sensitive periods in development affects the functional organization and activity of the occipital cortex; and (2) use the fundamental knowledge derived from (1) to test and predict the outcome of sight restoration. Using a pioneering interdisciplinary approach that crosses the boundaries between cognitive neurosciences and ophthalmology, MADVIS will have a large impact on our understanding of how experience at different sensitive periods shapes the response properties of specific brain regions. Finally, in its attempt to fill the existing gap between cross-modal reorganization and sight restoration, MADVIS will eventually pave the way for a new generation of predictive surveys prior to sensory restoration.

CoPeST – Construction of perceptual space-time

(1.002.102 euro – 60 months)

David Paul Melcher

CIMeC - Center for Mind/Brain Sciences

Our subjective experience of the environment is that it consists of objects and events occurring at a particular time (“now”) and in a particular three-dimensional space (“here”). How the brain constructs our perception of space and time is a mystery, since the individual neurons in our brain respond to local, specific details in a range of different spatial coordinate systems and with different temporal delays. This project brings together behavioral, neuroimaging and computational approaches

to investigate the mechanisms that underlie our subjective experience of continuous space and time, in order to uncover how uni-sensory, ego-centric sensory responses give rise to the rich, multisensory experience of unified space-time.

Win2Con – Brain-State Dependent Perception: Finding the Windows to Consciousness

(1.499.000 euro – 60 months)

Nathan Weisz

CIMeC - Center for Mind/Brain Sciences

The project was transferred to a new host institution on 30/9/2015.

BIHSNAM – Bio-inspired Hierarchical Super Nanomaterials

(1.004.400 – 60 months)

Nicola Pugno

Department of Civil, Environmental and Mechanical Engineering

The idea of the project is to combine nature, nanotechnologies and nanomaterials, such as graphene, in order to design bio-inspired hierarchical supermaterials with still unattained mechanical properties such as strenght, toughness, adhesion, self-cleaning, self-healing, etc. This research has already led to the discovery of the strongest natural material yet documented (limpet teeth) and to the development of the world's strongest artificial fiber (inspired by spider web anchorages).

STiMulUS – Space-Time Methods for Multi-Fluid Problems on Unstructured Meshes

(918.000 euro – 60 months)

Michael Dumbser

Department of Civil, Environmental and Mechanical Engineering

We develop new algorithms for the solution of general nonlinear systems of time-dependent partial differential equations in the context of non-ideal magnetized multifluid plasma flows with thermal radiation. We will produce new high-order schemes on unstructured tetrahedral meshes that are applicable to a rather general class of problems in general geometries, thus, opening a wide range of possible applications in science and engineering.

COMPOSES – Compositional Operations in Semantic Space

(1.117.636 euro – 60 months)

Marco Baroni

CIMeC - Center for Mind/Brain Sciences

We tackle the meaning induction and composition problem from a new perspective that brings together corpus-based distributional semantics (that is very successful at inducing the meaning of single content words, but ignores functional elements and compositionality) and formal semantics (that focuses on functional elements and composition, but largely ignores lexical aspects of meaning and lacks methods to learn the proposed structures from data).

NeuroInt – How the brain codes the past to predict the future

(978.678 euro – 48 months)

Uri Hasson

CIMeC - Center for Mind/Brain Sciences

The overarching objective of this research program is to use neuroimaging methods to determine how the recent past is coded in the human brain and how this coding contributes to the processing of incoming information.

A central tenet of this proposal is that being able to maintain a representation of the recent past is fundamental for constructing internal predictions about future states of the environment.

FAMINE – Families of Inequalities – Social and economic consequences of the changing work-family equilibria in European Societies

(478.494 euro – 48 months)

Stefani Scherer

Department of Sociology and Social Research

The project investigates social and economic inequalities associated with changes in labour markets, welfare states and family configurations over recent decades in European countries.

Particular focus is given to the new work-family (dis-) equilibria, thus the changes in women's labor-market behavior, the linkage between employment and family decisions, and the (divergent) capabilities of different types of families to compensate for increasing market risks and to shelter family components from increasing economic and occupational insecurity.

The role of the state in moderating the consequences of institutional changes is a core theme.

ERC CONSOLIDATOR

1 project: in the “Social Sciences and Humanities” domain.

TRANSFER LEARNING – Transfer Learning within and between brains

(1.999.998 euro – 60 months)

Giorgio Coricelli

CIMeC – Center for Mind/Brain Sciences

We intend to study social learning mechanisms underlying cortical and subcortical activity in humans. The long-term objective is to develop a neural theory of learning: a mathematical framework that describes the neural plasticity and computations mediating social learning. We plan to develop and test a model of adaptive learning based on three basic principles: (1) the observation of the outcome of the un-chosen options improves the learning process, (2) learning can be transferred from one domain to another, and (3) learning can be transferred from one agent to another (i.e. social learning). The potential findings of this project could lead us to suggest general principles of social learning, and we will be able to measure and model neural activation to show those general principles in action.

ERC ADVANCED GRANTS

6 projects: 5 projects (as coordinator) of which 1 in the “Social Sciences and Humanities” domain and 4 in the “Physical Sciences and Engineering” domain; 1 project (as partner) in the “Social Sciences and Humanities” domain.

OMVac – Outer Membrane Vesicles (OMVs) from “Vaccinobacter”: A Synthetic Biology approach for effective vaccines against infectious diseases and cancer

(2.612.828 euro – 60 months)

Guido Grandi

CIBIO - Centre for Integrative Biology

The project will apply Synthetic Biology to create Vaccinobacter, a new bacterial species for the production of multivalent, highly-effective vaccines. The idea originates from the evidence that Outer membrane Vesicles (OMVs) naturally produced by all Gram-negative bacteria can induce remarkable protective immunity, a property already employed in anti-Neisseria vaccines, now also available for human use. OMV protection is mediated by Pathogen-Associated-Molecular Patterns, known to play a key role in stimulating innate immunity.

INSTABILITIES – Instabilities and nonlocal multiscale modelling of materials

(2.379.359 euro – 60 months)

Davide Bigoni

Department of Civil, Environmental and Mechanical Engineering

The aim of the research ERC project “Instabilities” is to analyze failure mechanisms of ductile materials, which usually occur through a multiscale interaction of discrete microstructures hierarchically emerging through subsequent material instabilities and self-organizing into regular patterns (shear band

clusters, for instance). Through the analysis of material instabilities and taking advantage of analogies with laboratory models of structures, innovative microstructures will be designed to be embedded in solids, in order to open new possibilities in the achievement of ultra-resistant materials and structures. The target will be the realization of a material exhibiting flutter instability or microstructures evidencing strain-gradient effects or innovative metamaterials.

This activity will enable the achievement of innovative dynamical properties, defining, for instance, flat lenses for elastic waves, evidencing negative refraction and superlensing effects, thus opening up new horizons in the dynamics of materials and structures.

Perceptual Awareness – Perceptual awareness in the Reorganizing Brain

(2.139.556 euro/ 653.156 for UniTrento – 60 months)

Angelika Lingnau

CIMeC – Center for Mind/Brain Sciences (partner)

coordinator: University of Verona

The project aims at casting light on the neural and cognitive reorganization of the visual function, following unilateral lesion at various levels of the central visual system, such as, the optic tract, optic radiation, primary visual cortex, and extrastriate visual areas. This objective will be pursued by means of behavioural paradigms associated with fMRI scanning and ERP and MEG recording. The result should lead to the development of novel imagery-based visual rehabilitation protocols which are individually tailored.

PREMESOR – Predisposed mechanisms for social orienting: A comparative neuro-cognitive approach

(2.367.922 euro – 60 months)

Giorgio Vallortigara

CIMeC – Center for Mind/Brain Sciences

The aim of the project is to develop a detailed animal model of vertebrate social predispositions, using the domestic chicken, and relating this work closely to the equivalent behavioral and neural measures in human newborns, including those at risk of autism, for which there is no widely-accepted animal model.

Lucretius – Foundations for Software Evolution

(2.462.095 euro – 60 months)

John Mylopoulos

Department of Information Engineering and Computer Science

The main objective of the project is to develop a theoretical foundation for concepts, tools and techniques that support and facilitate software evolution.

A first focal point is the design of adaptive software systems that can evolve automatically in response to unsatisfactory results. Evolution here means that the system monitors its environment and adapts (i.e., changes its own behavior) if its own performance is not consistent with system requirements. Software evolution is often caused by new rules and regulation, such as new laws.

A second focal point is to study systematic, tool-supported techniques for ensuring that an existing software system complies with a new law. This research includes developing new techniques for building formal models of laws and requirements, also for ensuring their mutual consistency.

The third focal point is the development of new models for software requirements founded on new sets of concepts for modeling requirements, laws, designs and business objectives that lead to software requirements.

QGBE – Quantum gases beyond equilibrium

(1.638.560 euro – 60 months)

Sandro Stringari

Department of Physics

This project aims at theoretically exploring novel dynamic and transport properties of quantum gases at both finite and zero temperature, with special emphasis on the effects of quantum statistics, superfluidity and the role of interactions.

ERC PROOF OF CONCEPT

2 projects in the Physical Sciences and Engineering domain.

KNOTOUGH – Super-tough knotted fibers

(149.490 euro – 12 months)

Nicola Pugno

Department of Civil, Environmental and Mechanical Engineering

We aim at producing super-tough fibers and related macroscopic tissues inspired by spider silk and web.

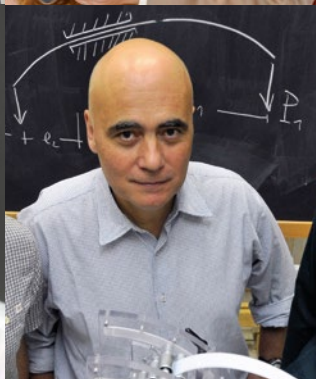
REPLICA2 – Large-area replication of biological anti-adhesive nanosurfaces

(147.000 euro – 12 months)

Nicola Pugno

Department of Civil, Environmental and Mechanical Engineering

We aim at producing large area super-hydrophobic and self-cleaning surfaces inspired by the morphology of lotus leaves.



Departments and Centres at UniTrento

An aerial photograph of the University of Trento campus. The main building is a large, white, multi-story structure with a central dome and several smaller domes. It is surrounded by lush green trees and a few smaller buildings. In the background, a city is visible, followed by a range of steep, rocky mountains under a clear sky.

Department of Civil, Environmental and Mechanical Engineering

Environment, climate change, security, infrastructures, materials, energy, green technologies, architecture: at DICAM we foster innovation and we design and shape sustainability

www.unitn.it/en/dicam

The research activity focuses on the key areas of engineering, planning and applied sciences, such as environmental protection, landscape, architecture, natural renewable resources, energy, biomedical sciences, smart structures and materials, risk prevention, infrastructures and efficient and sustainable structures, building and estates, service networks and territory.

The Department places specific emphasis on the direct transfer of technology from University to business. Indeed the first start-up at the University of Trento, started in 2008, was born within the Department, which currently hosts two of the nine start-ups at the University of Trento.

Within the Department, the research work performed in the Doctoral School in Civil, Environmental and Mechanical Engineering is of central importance. The aim of research is to develop an exploratory approach to topics that are relevant for the society and call for the development of highly-innovative technologies, methods, and solutions, and to transfer specialized scientific results to problems and applied contexts, with a view to fostering innovation and reinforcing the ties between basic and applied research.

The research activities of the Department may be grouped into six areas:

Environmental Resources, Security and Climate Change

Research is grounded on modern fluid mechanics as the basic tool for the quantitative study of geophysical flows and the transport mechanisms of chemical agents (pollutants), biological agents (pathogens) and physical agents (sediments) in the environment. Research activity is mainly focused on the understanding of the complex natural processes which shape the environment and rule the mass and energy exchanges, with a view to devising the best management strategies for natural resources.

Mechanics, Materials and Smart Structures

The main scientific topics are: materials, meta-materials, biomechanics, solid and soil mechanics, structural mechanics and structural systems.

The most innovative subjects deal with the analysis and modelling of the acoustic, mechanic and electromagnetic properties of meta-materials; the mechanic features of biological structures; the properties of geo-materials, and the optimization, structural monitoring and control of the structures, including smart structures.

Surveying, planning and design for sustainable places – SusPlaces

Research in this area is related to the transformations of the city and the territory, in the perspective of sustainable development.

The virtuous interaction between anthropic and natural processes, at urban and rural levels, is based on the knowledge, methods and tools capable of meeting the requirements for inhabiting an area but, at the same time, protecting the biodiversity, the functionality of the natural ecosystems, and also the sustainability of the energetic systems.

Energy and Green Technologies

The area is marked by an interdisciplinary approach and deals with the modelling and quantitative study of processes and systems of energy transformation and the distribution systems (smart grids) and energy storage. The research activities also include the development of models for a rational use and management of energy and energy saving, and the optimization of technologies for the treatment of water, gaseous and solid materials and targeted to the enhancement of energy and materials deriving from the treatment processes.

Architectural Sciences

The area is mainly concerned with topics related to architectural planning and has a strong multidisciplinary nature. It considers the architectural project in its historical evolution and contemporary trends, the knowledge in building design and materials, the relationship between shape and building feasibility, and the (traditional and innovative) building techniques. It also deals with refurbishment and renovation of existing buildings, the legal framework and management of the entire project and implementation/building, quality testing and the representation of architecture, the city and the territory.

Modelling and Simulation in Engineering and Sciences

The area deals with the mathematical modelling and numerical simulation of complex (natural or artificial) systems through the development of new algorithms for calculations that are able to support, integrate or replace complex experiments and theoretical surveys. The research is marked by multi-scale approaches, validation of models and quantification of uncertainty. Calculation and simulation methods are used, which derive from sciences and engineering, to be applied in all phases of the life-cycle of an engineered product-system. Modelling and simulation are interdisciplinary topics, due to their strong connection with the main sectors of mathematics, physics and geophysics, mechanics and material sciences.

Research Laboratories

- Applied Chemistry-Physics
- Applied Mathematics
- Atmosphere Physics
- Biomasses
- Building Planning
- Building Refurbishment and Recovery
- Chemistry of Materials for Engineering
- Computational Mechanics of Solids and Structures
- Ecology
- Energetic Technologies
- Geodesy and Geomatics
- Geotechnics
- Health and Environment Engineering
- History and Architecture
- Hydraulics
- Hydrology and Hydraulic Constructions
- Materials for Energy
- Material Tests and Structures
- Physic Modelling of Structures and Photoelasticity
- Residual tensions
- Shot-Peening and X-rays
- Sustainable development planning

Three research centres are also active within the Department:

Centre for Metrology (CUM)

The main activity of CUM is in the field of calibration of load cells in tension and in compression and material testing machines.

Centre for Intelligent Buildings (CUNEDI)

The mission of CUNEDI is to investigate the potential of domotics – home automation – by experimenting on real cases, and to provide scientific and planning support to public and private bodies in developing innovative solutions for domotic installations.

Centre for the Protection of Mountain Environment (CUDAM)

Over the years, CUDAM has gained wide experience in the analysis and in the monitoring of works and strategies for the hydrogeological protection and stabilization in mountain areas. The aim is to provide tools for the management of the territory as regards hydrogeological safety, in order to implement new technologies (hardware and software) and devices for the monitoring and control of the environment.

UNESCO Chair in Engineering for Human and Sustainable Development

The key goal of the Chair, established in 2011, is to contribute to the growth of a new generation of engineers, able to make technological choices that promote human development, in a social, environmental and economic sustainability perspective. The Chair pursues its goals through an integrated system of research, higher education, as well as institutional partnership with other Universities, local and national government institutions, international organizations, NGOs and civil society actors, other UNESCO Chairs, private companies.

ERC (European Research Council) grants

ERC Starting Grants:

BIHSNAM – Bio-inspired Hierarchical Super Nanomaterials

Nicola Pugno (1 million euro – 60 months)

STiMulUS – Space-Time Methods for Multi-Fluid Problems on Unstructured Meshes

Michael Dumbser (0.92 million euro – 60 months)

ERC Advanced Grants:

INSTABILITIES – Instabilities and nonlocal multiscale modelling of materials

Davide Bigoni (2.38 million euro – 60 months)

ERC Proof of Concept:

KNOTOUGH – Super-tough knotted fibers

Nicola Pugno (149.490 euro – 12 months)

SILKENE – Bionic silk with graphene or other nanomaterials spun by silkworms

Nicola Pugno (149.944 euro – 18 months)

FET - Future Emerging Technologies Grants

ExaHyPE - An Exascale hyperbolic PDE engine

Michael Dumbser, Co-PI at UniTrento (2.795.000 euro – 48 months)

Department of Economics and Management

Decision-making, experimental economics, consumer choice, financial markets, entrepreneurship, innovation and technical progress, tourism and environment, macroeconomics and business cycles, international trade, behavioural economics, algorithmic social sciences, public and healthcare management: a multidisciplinary approach to study economic and social phenomena.

www.unitn.it/economia



The Department of Economics and Management (DEM) features a multidisciplinary research environment where researchers apply a vast array of different approaches to describe the choice of economic agents, investigate their determinants, and analyse their effect at the individual, sectoral and aggregate level.

Research activities take place within formal and informal research groups that boost a vast network of national and international collaborations: these ensure that the Department regularly hosts research fellows and visiting scholars from abroad, as well as a seminar series that runs throughout the academic year.

DEM covers most research areas in the economic and management domain and its members apply a wide range of approaches ranging from theoretical to empirical research, from quantitative to experimental methods, from the analysis of case studies to computer simulations. The goal of all activities is to promote high-quality research that may contribute to the international academic debate.

Business Ethics, Social Enterprises and Social Innovation

A broad research program in business ethics and corporate social responsibility addresses issues like the foundation and implementation of multi-stakeholder models of corporate governance and responsibility, corporate culture, and forms of accountability that differ from conventional financial accounting. In fact, alternative forms of economic organizations (nonprofit, cooperative and social enterprises, hybrid organizations) and social entrepreneurship cannot be evaluated based only on shareholder value. Further topics of research include accounting and accountability practices for profit and non-profit organizations, social and environmental accounting, managerial practices leading to social as well as economic value and fairness.

Decision Making and Economic Choices

This lively multidisciplinary research area combines insights from economics, cognitive psychology, game theory and the mathematical foundations of choice theory regarding individual and collective preferences and decisions in the economic domain. The reference point for experimental methods aimed at understanding how human cognition affects economic behaviour is represented by the Cognitive and Experimental Economics Laboratory (CEEL) of DEM, which offers support in the planning, organization and actual implementation of experiments. CEEL also offers young scholars research-training opportunities through workshops, research grants, and partnerships with PhD programmes.

Financial Markets and Economic Activity

Researchers study the behaviour of financial markets and their interaction with economic activity, both at the micro and macro levels. Current areas of research cover statistical methods and models for financial data, non-standard probability distributions and their financial applications, estimation methods for multivariate loss distributions, the impact of financial market imperfections on household and firm behaviour, behavioural finance, financial stability, corporate finance, technical innovation in the financial sector.

Firm Behaviour, Strategic Management and Organization

This broad research area combines insights from management, economics and quantitative methods to study the behaviour of firms and the dynamics of business environments. Researchers investigate how the interplay between entrepreneurship, innovation, and organization provide innovative solutions to problems such as the identification of sustainable business models for new business ideas, or the relationship between technological development and organisational structures. Additional lines of research deal with the degree of firm heterogeneity and its role in industrial dynamics, firm behaviour in international markets, the determinants of competitiveness and productivity. Research in this field employs a wide range of approaches that include in-depth case studies, micro-econometric and spatial statistics techniques for large firm-level datasets, sampling methods for business surveys.

Household and Labour Economics

Research in this field focuses on individual and household choices in the realms of education, consumption and labour market participation. Empirical research covers Italy, the European Union as well as emerging and developing countries. The study of the mathematical foundations of welfare, inequality and poverty measures provides additional insights for applied analysis.

Institutions, Norms and Economic Policies

Drawing from game theory, experimental and behavioural economics, social and public choice, the theory of distributive justice, this area of research investigates the emergence and stability of impartial agreements on principles of justice, social contracts, norms and institutions. Researchers study the underlying reasoning and cognitive processes that lead to such institutions and norms, as well as their role in shaping incentives and therefore influencing economic activity. The governance of common goods and self-regulation, and the functioning of multi-stakeholder and multilevel governance in welfare systems based on shared social responsibilities represent further topics of research.

Faculty members at DEM also study the role of European institutions in shaping international and national economic policies and economic outcomes, with a special emphasis on the handling of the recent economic crisis.

Tourism, Environment, Sustainable Business and Consumption

This area of research, which brings together researchers from different fields (management, environmental economics, statistics, psychology and economic history), aims at analysing the behaviour of individuals, enterprises and institutions in different sectors such as tourism, culture, agriculture, and commerce. Sustainability is the main keyword and provides the common framework of reference to study multi-stakeholder systems capable of fostering local development. The mathematical foundations of multicriteria aggregation methods and the construction of sustainability indexes are also active research lines. The multidisciplinary perspective integrates quantitative, qualitative and experimental methods.

Faculty of Law

*Biolaw, Criminal Law, International Law,
Public and Private Law, Administrative Law*

www.unitn.it/giurisprudenza



Research at the Faculty of Law is carried out in a wide range of subjects, thereby favoring the development of individual research areas and, at the same time, strengthening the fundamental unity of the structure, which is the essential feature of the legal profession.

The scientific activities are organised into the following areas:

- Administrative law
- Civil procedure law
- Commercial law
- Comparative studies
- Criminal law
- Criminal procedure
- Economics
- Historical and juridical studies and canon law
- International law
- Labour law
- Philosophical-juridical studies
- Private law
- Public law
- Roman law
- Sociological-juridical studies

There are sixteen research groups in the Faculty:

Biolaw

The Biolaw research team deals with the relationship between life sciences and the law. Alongside traditional issues, such as equality in the access to health care, abortion, in vitro fertilization or end-of-life decisions, the research covers a number of cutting edge topics such as regenerative medicine, genome editing, synthetic biology and neurosciences. A multidisciplinary and comparative approach is constantly used in order to get a comprehensive picture of the area.

Legal methodology (CERMEG)

The group focuses on the topic of methodology in the field of legal sciences. The exchange of ideas between theoreticians, with different approaches, and highly qualified lawyers and barristers is proof that the methodologies and reasoning strategies have an influence on the administrative practices of the law, and that they are marked by a strong interdisciplinary nature.

Law of Tourism Sports

The aim of the study group is to revise the current Treaties and offer a thorough and systematic analysis of the norms of civil and criminal responsibility and the safety rules regarding sport tourism.

European company law and EEIG

The researchers analyse the European Economic Interest Group (EEIG) within the productive pattern of the EU, testing the advantages offered by the individual national implementing laws, and also evaluating the phenomenon of law shopping, which has been legislated and stimulated by the recent decisions of the European Court of Justice.

eCrime

The group focuses on research into eCriminology, and it was created in response to the fact that Information and Communication Technology (ICT) influences contemporary society in an invasive way (eSociety). The group's aim is to form an open network of top level researchers who share the same research interests and seek to open up new frontiers in criminology.

eHealthLaw

This website has been conceived for scientific and educational purposes by a group of Italian academics who work to (and are interested in) promoting knowledge and legal analysis of the law of e-health. The website has been online since March 14, 2014, and, being a continuous work in progress, over the time will be constantly updated and expanded to offer to the public of interested readers an authoritative point of reference on all technical elements of knowledge useful to get an understanding, also in a comparative vein, of the several issues addressed by the legal regulation of e-health.

European Legal Integration (Elinis)

The aim of this group is to circulate the Italian scientific production regarding the laws on European integration, in particular with regard to those with a critical review of the traditional structures and of the academic *acquis* regarding legal studies in the EU.

Negotiation and Mediation

The Research Group is aimed at deepening the analysis and promoting the use of two ADR tools, that is two Alternative (to the in-court proceedings) Dispute Resolution devices: Negotiation and Mediation.

Since Negotiation and Mediation have progressively and increasingly captured the attention in global and European context and, more recently, also at the domestic level by the Italian law-maker, the Research Group objectives are the following:

- on the one hand, to study Mediation and Negotiation's principles and practice in a comparative perspective, highlighting strengths and weaknesses of these two ADR mechanisms;

- on the other hand, to offer students and practitioners the chance to gain knowledge of negotiating and mediating techniques, organizing various educational initiatives.

The Negotiation and Mediation Research Group is composed by academics, practitioners and Alumni of the University of Trento – Faculty of Law, who are all interested and expert in Negotiation and Mediation. Thanks to their different expertise they will contribute significantly to train jurists, who have also the skills to deal the conflict other than in the in-court-proceedings.

Italian Laboratory

The group's aim is to study the history of Italian political thought from the Middle Ages to the present day.

Italyspractice – Italy's Diplomatic and Parliamentary Practice on International Law

This blog is run by a team of scholars and students of international and EU law. Our personal and professional connection is the University of Trento – some of us are based at the School of Law and/or the School of International Studies, whereas some others are Trento alumni that have kept strong ties with their Alma Mater.

Law and Technology (LawTech)

The research group focuses on the relationships and the reciprocal influences between law and technology. On the one hand, the law is used for technology regulation but, on the other hand, the law employs technologies to pursue its own goals. These are two main research areas which are recent developments of European contract law and behavioural theories of contract.

Network for the integration of migrants (PONTEST)

The aim of this group is to analyse the difficulties migrants, especially those from Eastern European countries and countries of the “enlarged EU”, face as regards access to, and integration in, the labour market. The group members focus on the specific needs emerging from the local economic patterns and the internationalisation processes of enterprises.

The Common core of European Private Law

This group explores the development of a shared work methodology that may facilitate sophisticated specialised communication among professional lawyers who have already been trained in their own legal tradition, rather than focusing on the creation of a potential common European Lawyers' Board. The group also carries out comparative research on all European legal systems and focuses, above all, on those systems which might be considered as less influential at European level.

Legal comparison, translation and linguistics (TRANSJUS)

The goal of this study group is to improve the writing and the terminology used when drafting legal papers within a multilingual context. The group aims at developing constructive synergies among different professionals – language experts, legal experts and, above all, experts in comparative law – through research on legal terminology, reviews on the theory and methodology of legal translation applied to the transposition of the community legal data.

Jurisdiction and Pluralism

The Research Project JPs aims at exploring the impact of the plurality of pluralisms on basic features of the judicial organization and function. It does this by analysing ways of accommodation experienced so far and by attempting to draw some insights from the coexistence of different legal traditions within the same legal order, whether it be a nation-state or an international or supranational jurisdiction.

LIA – Laboratory of institutional Innovation for complete Autonomy

The LIA Project promotes cultural and scientific activities aimed at studying in depth, using a comparative juridical method, the rationale and the methods of developing a strategy of institutional innovation defined as “complete autonomy” of the region of Trentino. This “complete autonomy” is interpreted as an advanced formula – and, thus, as a pioneering experience with respect to the special autonomy already provided for, and guaranteed, by the Constitution of the Italian Republic.



Department of Humanities

Philosophy, History, Literature and Languages

www.unitn.it/lettere



Research in the Department of Humanities encompasses two areas:

- Philosophy, History and Cultural heritage;
- Language, Philology and Literature studies.

Philosophy, History and Cultural heritage

In the field of philosophy, researchers deal both with the history of philosophy, from the ancient world to contemporary philosophical issues, and with a more theoretical approach, mainly in the fields of ethics, aesthetics and political philosophy. Specific attention is devoted to theological studies and interreligious dialogue.

In the field of history, the research focuses on the history of institutions and of the administration, social structures, and communication structures, and on the interactions between history and culture. In this regard, particular interest is paid to the Alpine regions and the relationship between Italy and the German world. From a more theoretical point of view, specific studies are dedicated to the means of diffusing the historical memory – at individual and collective levels – and to the relationship between historical research and political ideologies.

In the field of cultural heritage, the research activities focus on three main topics: Archaeology, History of art, and Music.

Languages, Philology and Literature

Research in the areas of Languages, philology and literature focuses on texts and their contexts.

As regards languages, the department fosters research in English, German, French, Russian, and Spanish, both from a historical point of view (the study of literature) and from a synchronic point of view (the study of the spoken languages).

Philology and literature are two subjects that are strongly connected, following the best Italian and European traditions. The research focuses on two main areas: the classical and medieval traditions, both Latin and the vernacular, and contemporary literature, seen from a comparative and theoretical point of view.

Two laboratories are at work in these areas: one for the study of European cultural journals (CIRCE: Catalogo Informatico delle Riviste Culturali Europee); and one for the study of contemporary poetry (SEMPER: Seminario Permanente di Poesia).

Two journals are published by scholars working in this area: the «Osservatorio critico della germanistica» (German Studies) and «Ticontre» (Theory, Text, Translation).

In the Department, there are the following laboratories:

Aesthetics in Practice and Community Design

The research group investigates places and communities, applying the methodologies of design and aesthetics. To this end, the activities in the laboratory are based on the principles of action-research and on the community design. Techniques in the areas of photography, scenic design and cinema are also studied.

Archaeology

The Laboratory carries out researches in the fields of landscape archaeology and classical archaeology. It is also dedicated to the development of computer science technologies, geophysics methodologies and building archaeology for the study of ancient cultures and societies. Since many years the Laboratory is involved in the creation of the Digital Archaeological Maps of Dougga (Tunisia), of the Parc National d'El Kala (in the east of Algeria), and the area of Karasis (Turkey). Thanks to collaborations with local institutions, other fields of research are the imperial palaces of Rome and the area of Trentino in the Roman period.

Archival Science (LADD)

The activities performed in the laboratory focus, in particular, on record management and on the study and enhancement of historical archives.

Musical Philology

In the laboratory, research work is carried out on the history of music, in particular, concerning the conservation and preservation of the musical heritage. The most traditional philological methodologies are complemented by the new digital technologies and their applications in musicology.

Microfilms and Digital Photography

The group carries out research in the field of documents regarding the cultural heritage, using digital technologies. Particular attention is devoted to manuscripts, ancient printings and archaeological evidence.

Laboratory “Bernardino Bagolini”

The activities of Laboratory “Bernardino Bagolini” (LAB) deal with prehistoric and medieval archaeology and historical geography. The LAB investigates human behaviour within its historical, social and ecological context. Research projects on distinct topics are undertaken in Trentino, around Italy and abroad, focusing from single archaeological remains to archaeological sites and cultural landscapes. The LAB is equipped with facilities for the study of archaeological record, database managing, GIS, microscopic observation, cartography and has close collaborations with academic and public institutions, to foster the humanistic and scientific knowledge of past societies.

Digital Research on the European cultural periodicals

The laboratory aims at promoting the study of the most important Italian and European cultural periodicals produced in the 20th century. The main research project is Circe, a digital library offering free universal access to about 100 periodicals: the purpose is both to file and preserve them, and to create a centre of study that, by providing the basic tools for the research, promotes publications, theses, and congresses on this important cultural field.

Theatre Laboratory

The main research activities of the Theatre Laboratory are:

- 1) Arianna, a digital database of theatre iconography, whose section Shakespeariana contains more than 11.000 catalogued images
- 2) Osservatorio Teatrale, a website of theatre reviews about contemporary staging
- 3) Foyer, periodical debates with scholars, directors and other theatre professionals, in collaboration with the Centro Culturale Santa Chiara
- 4) participation to international projects such as LaiRem and Iconodanza
- 5) equipe and individual studies on medieval theatre, theories on acting, Shakesperean tradition.

Laboratory of Experimental Phenomenology

The Laboratory of Experimental Phenomenology carries on from the theoretical tradition of phenomenology and develops it experimentally. The Laboratory conducts experiments on the nature of the primary (perception) and secondary (conceptualization and imagination) cognitive processes, paying particular attention to the visual and acoustic perception of complex patterns.

LabSA

The LabSA (Laboratory of Ancient History) inherits the activities of the former Sepesta (Permanent Workshop of Ancient History) in terms of promoting the historical and philological study of the past, as well as interdisciplinary and cross-cultural studies. The LabSA does this by promoting collaboration among scholars from different countries and research areas (history, philology, archaeology, epigraphy, anthropology, history of religion, political studies); by strengthening relationships with other institutes of classical studies in an international framework; and by drawing early-career scholars and students into critical debate about the investigative, analytic and interpretative methods and techniques appropriate to its aims.

Dionysos – A digital archive of the ancient theatre

The “Dionysos” laboratory encourages and coordinates scientific and didactic activities regarding the ancient theatre and its tradition, within a wide range of prestigious cultural institutions, both national and international, such as, theatres, universities, research centres, libraries and museums. The main part of this laboratory consists of a digital archive of the ancient theatre. The archive currently consists of about 450 detailed data sheets which record ancient Greek and Roman plays that were performed throughout the years 1948-2012 in Italy. This archive is the first one to be compiled in Italy, and it is continuously expanding. The laboratory also contains a digital archive of manuscripts and printed editions of ancient dramas from the sixteenth century to today, and an archive of videos and films inspired by ancient dramas.

The Study and Research Center “Antonio Rosmini”

The Study and Research Center “Antonio Rosmini” intends to embody an interdisciplinary approach to the figure of the great philosopher from Rovereto. It seems that this is required not only because of the encyclopedic breadth of his thought, but also because of Rosmini’s multi-faceted personality. He played a major role both in terms of the history of philosophy and more generally in cultural history.

The objective of the Study and Research Center “Antonio Rosmini” is to encourage, in the approach to the reflection on Rosmini, a rigorous historical-philosophical and, if necessary, philological or historical-cultural hermeneutics. Indeed, for a full and correct understanding, Rosmini must first of all be positioned in the context of his time, and particularly in the cultural and philosophical debate that saw him as a protagonist alongside.

In this view, an appropriate approach to the writings of Rosmini requires not only proper philological exegesis, but also diachronic projection into the context of the evolution of Rosmini’s thought, through the extremely varied sources on which he drew, and finally in relation to the interpretations of these texts provided by authoritative later thinkers.



Department of Industrial Engineering

*Mechatronics, materials engineering,
embedded electronics support decision making*

www.unitn.it/en/dii

The Department performs research in the sectors of industrial engineering, in particular, in mechanics, mechatronics, materials engineering, electronic and micro-electronic systems, managerial information systems, and optimisation methods and models to support decision making. The Department's research objectives are the structure of materials, and their features and applications; new materials and technologies; automation systems of processes and machineries; energy production and storage; the design and implementation of mechanical/electronic integrated devices, with specific functions in innovative applications; the optimisation of products and processes.

The Department cooperates with various national and international research institutions, and is involved in basic and applied research projects, with a strong connection to the industrial world.

The research areas are:

Materials Engineering

The expertise and research activity of the members are focused on materials production and optimisation, structural and functional materials applications, nanomaterial and nanotechnologies, surface engineering.

The activities are aimed at investigating and developing new materials, products or systems, and their production, fabrication or assembling for innovative applications or use in demanding areas.

The relevant areas of applied research are:

- biomedical technologies and applications
- materials for energy, environment and sustainable development
- materials and technologies for cultural heritage
- materials characterization, optimization, morphological and structural design as function of the application
- materials processing
- mechanical and processing industry

Most of the activities are carried out in cooperation with international – and national – partner universities and research centres. Several research projects are jointly developed with industrial partners worldwide.

Mechatronics

The research in this area focuses on the system-level engineering of smart, innovative, intelligent, mechanical systems, and is carried out within large-scale collaborative EU projects and Industrial collaborations. The main research topics are: intelligent manufacturing and automation, measurements systems and sensor data fusion, intelligent systems (in particular automated vehicles and robotics), space technologies, bioengineering (virtual physiological humans) accessibility and assisted living, optimal control, nonlinear and hybrid control systems.

Electronic-and Micro-electronic Systems

The research programme is mainly focused on the technological issues related to the design, modelling and characterization of intelligent electronic systems, and their ability to be distributed and “embedded” in an environment in order to solve complex problems. In this general context, the research at the Department covers the following main topics:

- design of wireless sensor networks
- techniques and algorithms for the localization and synchronization of mobile-wireless devices
- measurement and control systems in mechatronic applications
- systems and techniques for energy harvesting and power management
- systems and algorithms for parameter estimation in energy smart grid

Novel micro-electronic sensors and micro-electro-mechanical systems (MEMS) for scientific, industrial and consumer applications are also developed, covering all steps from the conceptual idea to the realization of prototypes, with emphasis on:

- particle and ionizing radiation detectors
- optical and image sensors
- interface electronics for sensors
- MEMS and biosensors

Operational Research

In this area, topics are related to: problems of guided optimisation, optimisation on graphs, models and systems to support decision making, models for the management of stocks, multiple-criteria evaluation methods, project management, information retrieval systems, analytical databases, applications of databases on the web, information systems for management purposes, e-learning platforms for training in companies, social network platforms for management, multimedia applications, web strategies for branding, promotional and e-commerce activities, requirements for evaluating website quality and for website re-engineering.

Within the Department, there is also the following structure:

BIOTech – Biomedical Technologies

BIOTech aims at fostering research in the field of biomedical sciences and technologies in cooperation with external public and private partners, research institutions, companies and health service facilities.

Research Laboratories

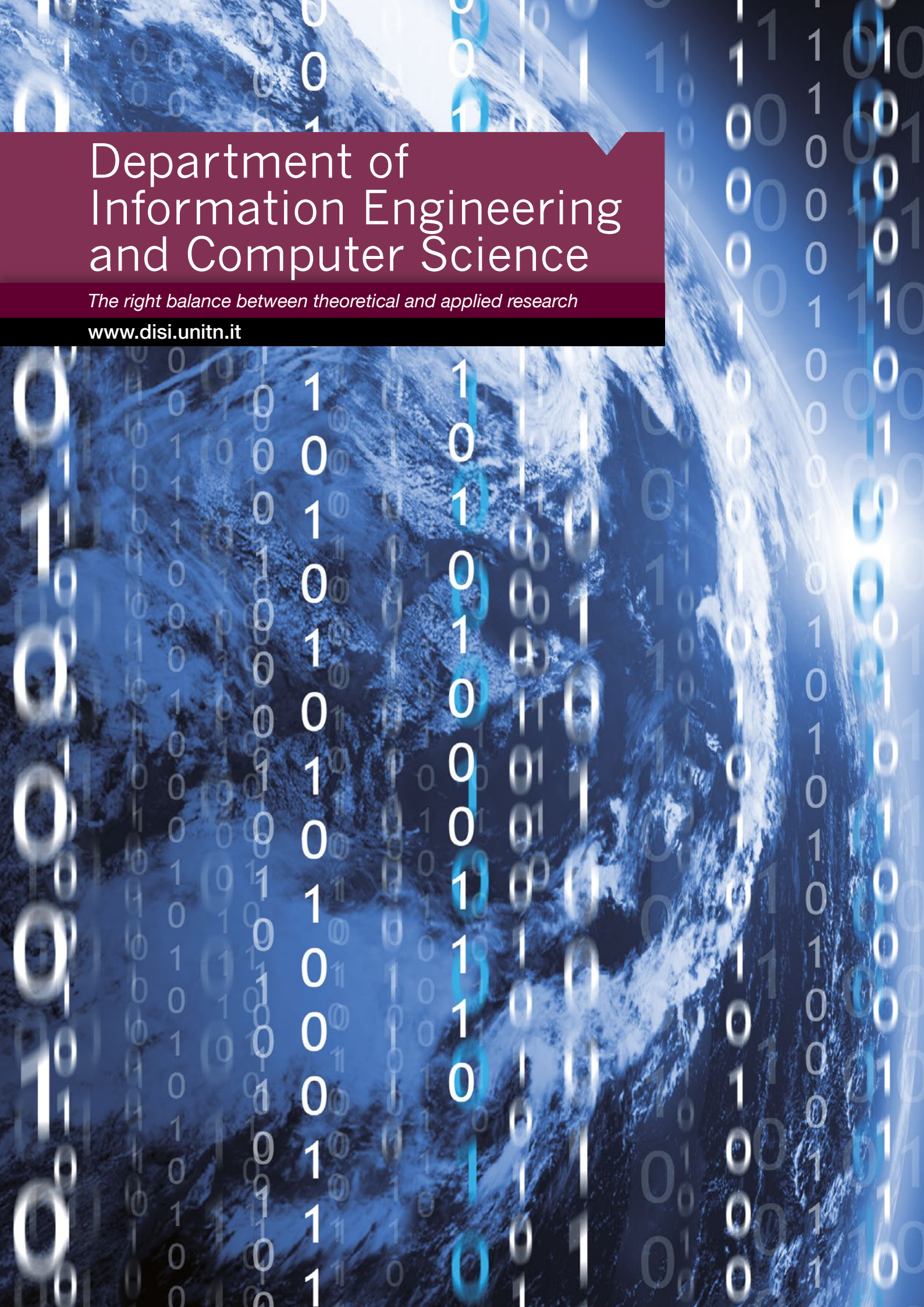
The research activities are carried out in the following laboratories:

Materials Engineering Area

- Cultural Heritage
- Glass and ceramics
- Materials chemistry
- Mechanical design and metallurgy
- Coatings and Industrial Corrosion Control
- Polymers and composites laboratory
- Biomedical Technologies - BIOTech
- Chemistry
- Micro & Structural Analysis
- Materials Characterization
- Processing
- Mechanical Testing

Mechatronics Area

- Control systems
- Fluid mechanics
- Machine tools
- Mechatronic systems
- Product prototyping
- Simulators and virtual reality
- Electronics and embedded system
- Garment based motion capture system
- Measurement instrumentation and robotics
- Metrology
- Space applications

The background of the slide is a composite image. It features a view of the Earth from space, showing the curvature of the planet and swirling white clouds over a blue ocean. Overlaid on this image are vertical columns of binary code (0s and 1s) in a light blue, monospace font. Some of the digits are slightly blurred, creating a sense of depth and digital flow. A dark red banner is positioned across the upper portion of the image, containing the department's name and tagline in white text.

Department of Information Engineering and Computer Science

The right balance between theoretical and applied research

www.disi.unitn.it

The Department of Information Engineering and Computer Science (DISI) of the University of Trento is one of the leaders in research and development in the Information and Communication Technology sector at both Italian and European levels. The research pursued at DISI seeks the right balance between theoretical and applied research, as shown by the strong focus on European as well as industrial projects, and the key role in the initiatives of the European Institute of Innovation and Technology (EIT Digital).

The outreach of DISI is also attested by the many synergies with other research institutions located in Trentino, including Fondazione Bruno Kessler, CoSBI Research Centre, CNR, Create-Net Association and Graphitech Foundation.

Research at DISI is organized into thirteen areas:

Cyber Security

Research activities in Cyber Security cover many areas: from classical computer security (security of the web and mobile phones), to critical infrastructure security (air traffic, energy transmission); from cryptography (Encryption post-Snowden, resistance to hardware Trojan horses) to risk analysis (banking operational IT security in banking).

Research spans different dimensions: technological development (ie development of new solutions, such as a new mechanism to authenticate the speaker to a phone), empirical and experimental studies (ie how a technology actually works in practice when humans use it), adversarial analysis (ie the study of the “bad guys” for example by infiltration into the dark web).

The group has several collaborations with industry and in 2015 the worldwide standard for the assessment of vulnerabilities, e.g. the one used by any company processing a credit card, features a graduate student from Trento among its authors.

Data and Knowledge Management

The research is in the following fields: data management and analysis, view maintenance, caching and prefetching, data mining, personalization technologies, sensor data analytics, streaming data summarization and processing, business process monitoring and analysis, metadata management, schema mapping, data translation and integration, knowledge representation and management, semantic web, contexts and ontologies, user-centric data and knowledge search, XML and P2P data and knowledge management, and game theory in P2P systems.

Deep and Structured Machine Learning

The area is related to the development of machine learning techniques and systems for reasoning over complex domains involving multiple entities, relationships and constraints. The complexity of the information to be processed and of the tasks to be addressed calls for elaborate architectures and advances in fields like deep and statistical relational learning, structured prediction,

multi-task learning, etc. Prototypical domains and main application areas are computer vision and multimedia, natural language processing and bioinformatics.

Embedded Electronics and Computing Systems

Due to the complexity of the distributed embedded systems considered in the research program, research areas cover a large range of fields. Although the main interest remains the embedded electronics and computing systems, great attention is devoted to wireless sensor networks and the communication issues among the nodes of the network. System design methodologies and real-time operating systems are also investigated to implement an efficient software architecture. Machine learning is instead considered for sensor fusion and estimation of the quantities of interest. The efficiency of the solutions proposed is usually proved by simulation and experiments using tools that come from measurement and performance evaluation theory. Due to the nature of the overall system that must deal with continuous quantities and discrete time events (like the node discrete time clock or the communication instants), the loop closure between perception and action is obtained using hybrid control system theory.

Language, Speech and Interaction

The research area is related to speech and language processing, vision, machine learning and interaction. Studies concentrate on how humans process speech, language and vision and the study of mathematical models for automatic processing, suitable for communicating machines.

The research is also oriented towards examining models of interactions in all of the ICT settings, such as, in speech-to-speech, speech-to-web and multimodal interactions. Collaborative systems and web architecture are also studied.

machine Learning and Intelligent Optimization (LION)

The research is into the development of intelligent optimization and reactive-search techniques for solving pertinent problems arising in different applications

areas, including intelligent transportation systems, computer networks and mobility, mobile services and ubiquitous computing, social networks, and clustering and pattern recognition in bio-informatics.

These challenges require an integration of different theoretical and practical tools in a creative environment that eliminates the borders between disciplines.

Multimedia Signal Processing and Understanding

This area is concerned with the whole multimedia content lifecycle, from representation and coding, to processing, storage and retrieval, protection, analysis, and understanding. The main focus is on visual data and, in particular, on the still picture and video. In this field, different fundamental aspects are considered, including: computer vision (visual tracking, action recognition, social interaction analysis, crowd analysis, smart camera repositioning), semantic media retrieval (content and context based indexing, event-based image and video understanding, gamification of media retrieval, social media), multimedia forensics (tampering detection, source identification, CG versus natural discrimination, anti forensics, digital watermarking).

Remote and Distributed Sensing

The research activities focus on airborne and satellite remote sensing technologies and systems for Earth observation (e.g. environmental monitoring, risk and damage assessment in natural disasters, climate change, resource monitoring) and planetary exploration. Key research areas are related to radar and remote sensing systems, image processing, pattern recognition, machine learning, and data fusion methodologies. These areas are complemented by techniques for distributed sensing on the ground (e.g., via wireless sensor networks), which also provides core technologies for several application domains (e.g., energy efficiency and smart city infrastructures at large).

Signal Processing and Recognition

The research activities focus on the design of smart computerized signal/image processing and recognition systems. Research keywords are: computer vision, data mining, image/signal processing, information retrieval, machine learning, neural systems, optimization, and pattern recognition.

Social Informatics

Social Informatics is an emerging part of informatics that studies how information systems can achieve social goals, apply social concepts, and become sources of information relevant for social sciences and for the analysis of social phenomena. It is concerned with

the intersection of social behavior and computational systems, and deals with the interdisciplinary study of the design, uses and consequences of information technologies that take into account their interaction with institutional and cultural contexts.

Software Engineering and Formal Methods

Research is related to the design and deployment of trustworthy and effective socio-technical systems.

The main topics are: goal-oriented requirements engineering, agent-oriented software engineering, security of socio technical systems and formal methods.

Results from the research have been applied to software development, software/protocols/hardware verification, service-oriented architecture design and development, organizational and business process modelling and analysis, and mobile software systems development.

Systems and Networks

The research in this field is concerned with the design and implementation of modern distributed systems and networks, increasingly characterized by strict requirements in terms of high performance, quality of service, and large scale, dynamicity, and security.

The aim of the research is to tackle the challenges of distributed systems at all levels, spanning from the definition of systems, to distributed algorithms, to middleware and language constructs, and to the implementation of application-level protocols and system services. A strong emphasis is placed on validating the research outcomes through implementation of real systems and simulations.

Wireless Networking

The research program embraces several interdisciplinary research areas, ranging from wireless communications and networking to wireless power transmission and energy efficiency, to radar and non-invasive sensing and vision through electromagnetic techniques. The physical layer wireless transmission and reception are jointly studied with those related to communications such as representation of information, modulation and coding, and networking. Practical design and analysis strategies based on meta-heuristic optimization methodologies and advanced resolution approaches, such as hybrid (deterministic and stochastic) techniques, learning-by-example strategies, interval analysis, and compressive sensing are explored for solving optimization problems concerned with wireless systems and networks. Performance-oriented and energy efficient design is the vertical approach in the study, development and testing of novel technologies crossing all layers of the TCP/IP protocol stack.

Office hrs: Thursday 16:00 ÷ 18:00

Tomorrow (here) 08:30 ÷ 10:30
"Computability" replaces "Complexity"

(From yesterday)

We have an effective enumeration of recursive functions
(let's consider just $\mathcal{R}^{(1)}$).

$$\varphi: \mathbb{N} \longrightarrow \mathcal{R}^{(1)}$$

φ is a surjective mapping, so for each $f \in \mathcal{R}^{(1)}$ there exists n such that $f = \varphi(n)$. [We shall write φ_n for $\varphi(n)$].

Indeed, for each $f \in \mathcal{R}^{(1)}$ there exist infinitely many n 's such that $f = \varphi_n$.

Department of Mathematics

Mathematics in its applications: from epidemiology to the nutritional systems, didactics, cryptography... and to its relevance in the industrial field

www.unitn.it/en/dmath

Research at the Department of Mathematics is carried out in the various fundamental sectors of mathematics and its applications in the fields of industry and sciences, interacting with various disciplinary areas, such as physics, biology, engineering and economics.

The Department pivots on numerous, dynamic and productive research teams, and it is marked by fruitful cooperation among its various active members: professors, researchers, PhD students and visiting professors.

The Department encompasses nine research groups and three interdisciplinary laboratories. The research groups are:

Analytic and Algebraic Geometry

The research interests of this group concern the classification of projective varieties (curves, surfaces, higher dimensional varieties and related moduli spaces), real algebraic geometry, analytic geometry and complex and hypercomplex analysis.

Calculus of Variations and Geometric Measure Theory

The main research interests of this group are minimisation of functionals defined on Riemannian manifolds and depending on the areas and curvatures; asymptotic methods for nonlinear problems; issues in geometric measure theory in Carnot-Caratheodory spaces.

Dynamical Systems and Control Theory

Research in Dynamical Systems deals with the period function of plane centers, the limit cycles of planar systems and perturbation problems for hamiltonian systems.

Research in Control Theory is mainly devoted to tackling problems of optimal control of differential equations (in particular, Bellmann/Isaacs equations and systems of differential equations with hysteresis effects) and related problems of differential games.

Lie Algebras, Groups, Cryptography and Codes

The members of this group are mainly interested in group theory, also algebraic; Lie algebras; combinatorial identities; computer algebra; cryptography, codes, and other applications of Algebra. The group collaborates with public and private companies on issues concerning security and data encryption.

Mathematical Logic and Theoretical Computer Science

The research in mathematical logic concerns the application of nonstandard techniques à la A. Robinson to other areas of mathematics (in particular to functional analysis) and the study of non-classical logics (many-valued, modal and temporal logics). The group is active in the popularization of foundational topics in mathematics.

The research in theoretical computer science concerns the theory of programming languages, including its applications to software verification through static analysis. To this aim, process calculi are used to model distributed systems and to study their security properties.

Mathematical Physics and Geometric Methods in Physics

The research interest of this group is twofold. On the one hand it concerns classical mechanics and its interplay with differential geometry. On the other hand, research concerns the mathematical (axiomatic, algebraic, constructive) formulation of quantum theories, and the theory of general relativity and relativistic quantum theory of fields, including the arguments of so-called "quantum gravity."

Nonlinear Partial Differential Equations

The research field of this group (which also involves engineers, physicists and other scientists) is devoted to the study of mathematical models of various physico-engineering phenomena. In particular, (i) phase transitions, (ii) filtration in porous media, (iii) hysteresis phenomena (in the presence of elasto-plasticity, ferromagnetism, etc.), (iv) homogenisation of composite materials, (v) multi-scale phenomena are studied.

Numerical Approximation of Partial Differential Equations

This research group mainly studies approximation methods for partial differential equations, in particular the finite element, finite difference, and finite volume methods. The issues addressed are primarily derived from electromagnetism and fluid dynamics.

Stochastic Processes

The researchers of this group study the theory of evolution equations whose characteristic parameters vary randomly. To study this kind of problem tools of Functional Analysis and Infinite-dimensional Analysis are exploited, in particular the recent “Malliavin Calculus”. Along with these “theoretical” issues various applications to neuroscience, networks, financial models, quantum mechanics and diffusion in materials with memory are analysed. The interdisciplinary Laboratories are:

Laboratory of Didactics and Communications of Mathematics

Within this laboratory we perform both research and experimentation of methodologies for the teaching and learning of mathematics. Materials, text, software designed for those purposes are produced.

Laboratory of Industrial Mathematics and Cryptography

The Laboratory activities (internships, research and development, consultancy, organization of courses) concern cryptography and computer security topics such as ciphers of the SSL/TLS protocol, strong authentication and transaction signing for online banking, recognition of digitized signatures, erasable biometrics, advanced electronic payment systems and coding for passports.

Laboratory of Mathematical and Computational Biology

The main areas of research of this laboratory are the spread of infectious diseases, ecology, nutrigenomics (interaction of molecular physiology and the external environment, such as diet) and the dynamics of molecular networks. The methods range from analytical and numerical study of ordinary differential equations and partial differential stochastic simulation to advanced statistical techniques in bioinformatics.

The Department is part of the interdepartmental research project (2015-2017)

OptHySYS – Optimization techniques for hybrid dynamical systems: from theory to applications

Collaboration with other national and international research centres is crucial. In particular, the Department cooperates with:

CIRM: International Centre for Mathematical Research of the Bruno Kessler Foundation

CoSBI: Computational Systems Biology Centre, Microsoft / University of Trento

INdAM: National Institute of Advanced Mathematics “Francesco Severi”, Research Unit, University of Trento

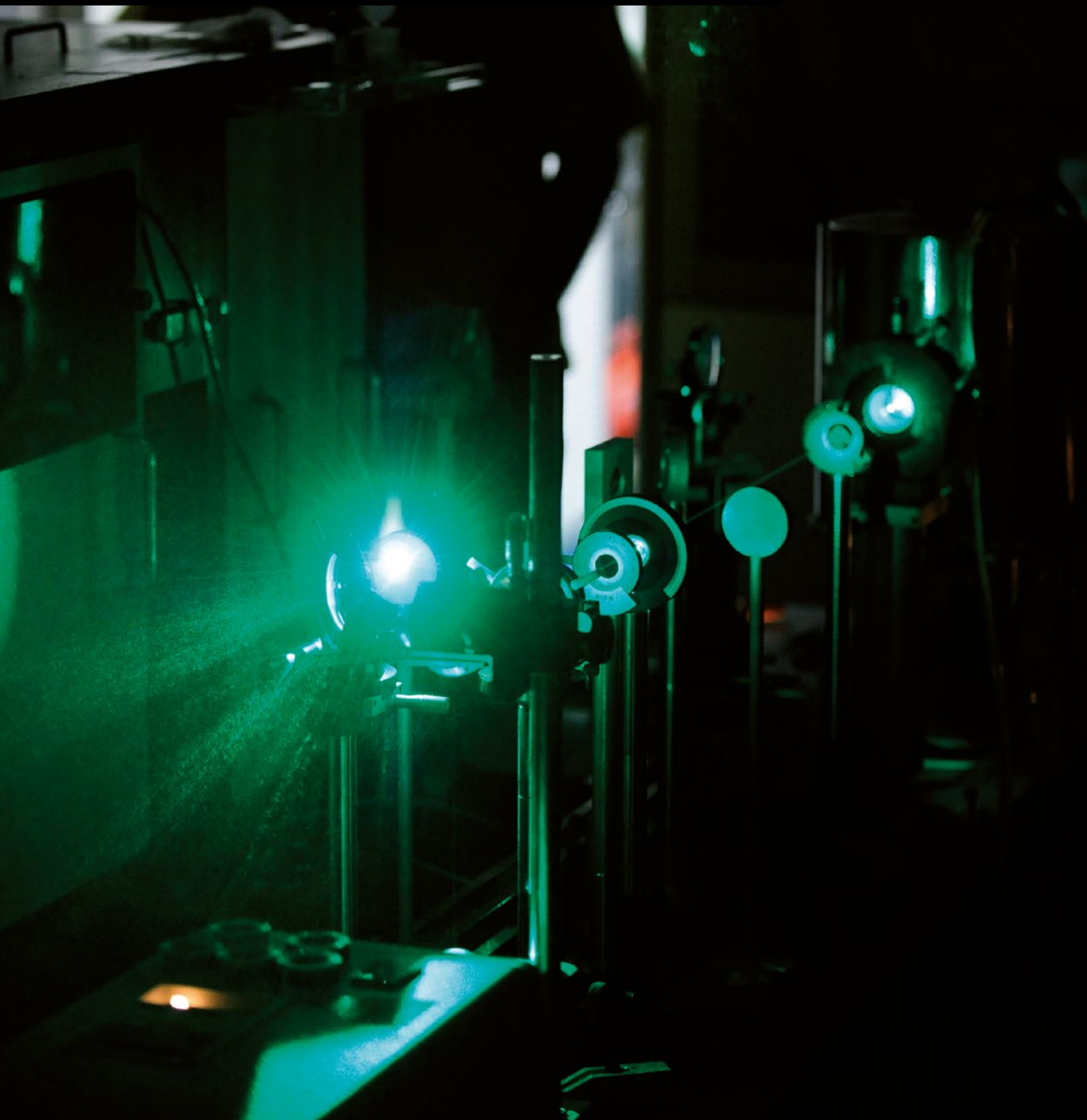
matematita: Inter-University Research Centre for informal communication and learning of mathematics

TIFPA (Bell Project): Fundamental Problems in Quantum Physics

Department of Physics

Cosmology, gravitational physics, cold gasses, photonics, complex systems, materials science, molecular, atomic and nuclear physics, nanoscience, biophysics and medical physics, supercomputing and research in science education.

www.unitn.it/en/dphys



Research in the Department spans from theoretical investigations of fundamental interactions, gravitational physics and cosmology, to nuclear and sub-nuclear physics, quantum many body systems, ultracold gases and Bose Einstein condensation; and from experimental gravitation to molecular and atomic physics, biophysics, biochemistry, energetics, research in education; and from material sciences to nanoscience, photonics and complex systems.

The Department effectively collaborates with many research centres and universities and, specifically, with the Italian and European Space Agency (ASI and ESA), the National Research Council (CNR), at a local level, it shares research projects and programmes with the Bruno Kessler Foundation (FBK), the Edmund Mach Foundation (FEM) and the Regional Healthcare Organization (APSS). Worth mentioning is the fact that the Department hosts the Trento Institute for Fundamental Physics and Applications (TIFPA) – a joint initiative including INFN, University, FBK and APSS –, the LISC-FBK units of the European Centre for Theoretical Studies in Nuclear Physics and Related areas ECT and the Trento sections of INO-CNR and IFN-CNR institutes.

Research is carried out in nine laboratories:

Atomic and Molecular Physics

The research activity is devoted to the investigation of the dynamics of atomic and molecular systems. The main research lines concern experimental astrochemistry and physics and chemistry of cold atmospheric plasmas. The principal experimental techniques are mass spectrometry, gas chromatography and optical spectroscopy.

Bio-organic Chemistry

The main focus of the research activities is the use of modern methods of organic chemistry in order to understand and solve problems lying at the interface between chemistry and biology or physics, in all the cases where the knowledge of molecular detail is essential. In particular, the research topic, broadly named “Natural Product Chemistry”, requires a strong interdisciplinary approach, providing the basic information on some interesting natural products, a condition necessary for their exploitation in applied fields, like medicine, biotechnology, agronomics, environmental sciences and ecology. Advanced NMR and mass spectrometric measurements are carried out daily in this laboratory.

Biophysics and Biosignals

Within the Laboratory, the structure and dynamics of biological systems are investigated at multiple scales, by using an experimental and application-oriented interdisciplinary approach. Modern techniques of optical and functional imaging, quantitative modelling and computer simulation are applied to study the human cardiovascular system and, in collaboration with CIMEC, neural systems of different complexity. The research objectives range from biophysical aspects to biomedical applications. Translational research is carried out in collaboration with several medical institutions and biomedical companies.

Communication of Physical Science

In addition to the traditional areas of experimental research in the fields of mechanics, fluid mechanics, electromagnetism and optics, work in the Laboratory is also focused on the new context of information and multimedia technologies, aiming, in particular, at a renewed teaching of quantum and matter physics. The Laboratory is also the reference point for the design and implementation of training programs for students and teachers of schools at all levels.

Experimental Gravitation

The research is mainly dedicated to the development, realisation, and operation of gravitational wave astronomical observatories, both ground-based and spaceborne. Additional activities include the development of high-sensitivity experiments and low-temperature detectors in fundamental physics.

The group, from the beginning, participated in the core scientific team that studied the spaceborne laser interferometer antenna known as LISA and it is currently involved in its evolved version eLISA, which is the reference gravitational wave observatory now adopted by ESA for their third large-class mission.

The group is part of the international collaboration Virgo, that runs a ground-based gravitational wave detector. Advanced Virgo will resume joint observation with LIGO detectors in 2016. Trento is involved in the data analysis of the detector network, in the squeezed-light sensitivity enhancement for Advanced Virgo and in developing instrumentation working near the quantum limit.

IdEA (Hydrogen, Energy, Environment)

The IdEA (Hydrogen, Energy, Environment) Laboratory brings together specific expertise in: 1) material science, for the production and study of new materials (nanocatalysts, photocatalysts, membranes), relevant in the energy (hydrogen production by water splitting) and environmental fields (water purification, gas separation); 2) radiation interaction with surfaces and molecules. Some parts of the research activity are carried out in cooperation with the Department of chemical science and materials technology of CNR (the National Research Council).

Nanoscience

The main fields of research are in nanophotonics, silicon photonics and nano-biotechnologies. The mission of the Laboratory is to generate new knowledge and understanding of physical phenomena which occur when the matter is of nanometer size. In particular, the aim of the research is to apply the nanoscience paradigm to silicon or silicon compatible materials in order to enable new applications of this key material, and to develop nanosystems, compatible with the main driving silicon technologies.

Topics include on-chip optical network, integrated quantum optic circuits, nonlinear optics, photonic sensors and biosensors, drug delivery systems, nanocellulosa.

Structure and Dynamics of Complex Systems

The research activities are focused on the study of the interplay of structural and dynamical properties of a class of materials including: liquids and glasses, soft matter, ceramics and disordered photonic systems. The aim is to achieve an in-depth understanding and, possibly, a tailored design of materials with predefined properties. The structural and dynamical properties of these materials are investigated in the laboratory using different techniques including X-ray diffraction, Raman and Brillouin scattering spectroscopy, luminescence and dynamic light scattering. These experiments are complemented by X-ray spectroscopic studies carried out at synchrotron radiation sources (e.g. Elettra at Trieste and the ESRF at Grenoble, France) and free electron laser centres (e.g. Fermi at Trieste and LCLS at Stanford, USA).

Theoretical and Computational Physics

Within the Laboratory, research is carried out in various fields of theoretical physics, using also advanced computational techniques. The main areas concern: astrophysics, gravitational physics, field theory and particle physics, nuclear physics, quantum fluids and solid-state physics, Bose-Einstein condensation and ultracold atomic gases, and statistical physics of biomolecules.

The research activities benefit from important national and international collaborations with other institutes and research centres. At a local level, there are collaborations with the Trento Institute for Fundamental Physics and Application (TIFPA), the European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT*), the INO-CNR Centre on Bose-Einstein Condensation (BEC), and the Interdisciplinary Laboratory for Computational Science (LISC).

Department of Psychology and Cognitive Science

The scientific study of the human brain: from the models of the cognitive processes to the development of applications in the fields of health care, education, work and social organization

www.unitn.it/cogsci



The Department's core research focuses on the creation of models of human brain functioning, both in normal and in pathological conditions, by employing empirically-verifiable scientific methods and rigorous multidisciplinary approaches. This is possible thanks to the interplay of different skills and knowledge and of the numerous research perspectives pertaining to experimental and applied psychology, such as, linguistics, pedagogy, mathematics, statistics, and neurosciences. These models and approaches are applied to various fields: psycho-diagnosis, social and psychological rehabilitation, neurology, education, forensics, the management of groups and organisations, and the analysis of working and social environments.

The Department's key research areas are:

Social Mind

The research group on Social Mind investigates the cognitive and social processes involved in language and communication, in the ascription to, and understanding of, states of mind, in the relationships among individuals and groups, and in socio-cultural and institutional settings.

The main areas of investigation refer to the cognitive and social processes underlying human behavior seen as a multi-faced, multidimensional structure in which e.g. language, memory, communication interact with interpersonal and intergroup relationships in shaping individual and collective behavior. Examples of the topics addressed are moral judgment and moral decisions in both adults and children, the relationship between cognition and technology linked to the users' belief systems, the cognitive mechanisms underlying complex social phenomena such as social cohesion, homophobia, social exclusion, inter-generational conflicts, and so on.

Clinical Neurosciences

Basic and applied research is carried out in three areas: the neurophysiological bases of cognitive, affective and behavioural disorders resulting from neurological and mental pathologies; the impact on families and on society of these disorders; the development of diagnostic, testing, and therapeutic methodologies aimed at evaluating and treating cognitive, affective and behavioural deficits in patients suffering from neurological and mental pathologies. These fields of investigation can be fully explored thanks to the Department's numerous experimental laboratories, equipped with tools and software for collecting behavioural and physiological data (including psychophysics, kinematics, EEG, eye-tracking, and multisensory laboratory equipment).

Moreover, our researchers actively and effectively cooperate with local healthcare services and providers, in order to carry out studies on patients suffering from neurological and psychiatric illnesses, as well as studies on functional and structural neuroimaging.

Organisation, education, and identity

This research area focuses on the processes of reciprocal influence among individuals, groups, and organisations, as far as behaviours are concerned and, in particular, on motivation and learning in individuals, seen as members of specific social groups. Thus, it is possible to explore the individual's wellbeing in his/her social and working environments; the degree of efficiency in the construction of forms of collective identities; the management of human resources; goal achievement in organizational structures; the teaching and professional methodologies applied in pedagogical activities and settings; and the development of personal and professional identities.

Labs devoted to the research goals of specific themes are:

Laboratory of Efficient Communication and Narrative Psychology

The laboratory is dedicated to the analyses of children's acquisition of symbolic, textual, and narrative skills. This laboratory is equipped with video-recording devices and allows for data collection about, and investigation of, the relationship between narrative skills and conceptual knowledge, with a focus on meta-cognition. The research is mainly based on a qualitative approach and makes use of action-based research methodologies.

Affiliative Behavior & Physiology Lab

In the Affiliative Behaviour and Physiology Lab we apply physiological, genetic, neuroimaging and behavioral protocols in the context of social interactions. Our strategy consists of assessing participants' psychological traits and stratifying them based on physiological responses during some social interaction task. We also focus on the comparative physiology across mammalian species of mother-offspring interactions (which is the first and most important social interaction and set the neural pathways that moderate all the other social interactions) and their implication on psychopathology.

Research Summary

Parent-Infant Interaction; Typical and Atypical Development; Autism Spectrum Disorders; Post partum Depression; Human electrophysiology (EEG); Human and Animal Physiology (ECG, EMG, GSR, sAA); Neuroimaging (fNIRS, fMRI)

Neurocognitive Development Laboratories

This laboratory is equipped with video cameras, monitors and laptops, used to create visual and auditory stimuli to test babies and children and to record their looking behaviour and other motor or verbal reactions. A set of tests to measure children's communication skills and their verbal and non-verbal intelligence is also available in the laboratory. The investigations have, so far, mainly focused on communicative and conceptual development in the domain of causality, theory of mind and moral cognition.

Observation, Diagnosis and Education Laboratory (ODFLab)

The ODFLab is devoted to the study of emotional and cognitive development in neurotypical individuals and in individuals with special needs. Cutting-edge research and golden standard clinical practices make ODFLab one of the best-known university centres in Italy for the diagnosis and the treatment of Autism Spectrum Disorders (ASDs). The ODFLab collaborates with prestigious national research centres (e.g. IRCSS Stella Maris, Pisa, Ospedale Bambin Gesù, Rome) and international research institutes (NICHD – NIH, USA; University of Florida; Georgia State University; Riken BSI; Nagasaki University, Japan). The identification of the early markers of ASDs, as well as the study of social and emotional skills of individuals with atypical development, are among the main research lines of the ODFLab. Observation methods represent the signature of the ODFLab and have been recently complemented by the use of TMS and fMRI. Of great importance is the fact that the ODFLab has achieved recent significant results in the study of the neurobiological correlates of emotional processing of individuals with ASD.

Department of Sociology and Social Research

Studying social and political life in a globalizing world

www.unitn.it/en/sociologia



The Department of Sociology and Social Research is the oldest Sociology Department in Italy. It is consistently ranked among the very best Social Science departments in Italy. It has a strong inter-disciplinary character: sociologists, political scientists, historians, economists and anthropologists work daily together in their teaching and research. It encourages its members and students to work using a wide variety of conceptual traditions and approaches, all having as their common core the practice of theoretically oriented empirical research. The Department has a strong international profile: it has recently launched the first Italian Sociology MA program taught entirely in English. Moreover, a large share of the research carried out within the department appears in international peer-reviewed journals and books. Within the Department, there are several research units, each providing students and colleagues with a specialized forum for their research interests.

Center of Interdisciplinary Gender Studies – CSG

Its researchers adopt gender differences as key to interpretation - and as an instrument in research and interdisciplinary practices - involving all spheres of social life.

Center for Social Inequality Studies – CSI

The Center studies social inequalities, their relation to institutions and their change over time and across generations.

Democracy and Global Governance – DEMOGLOB

It contributes to the development of theories concerning the processes of Europeanisation, internationalization, and globalization.

Età della Vita – eVita

Its main research focus is on the interactions among youth, adults and seniors together with the long-term outcomes arising from these interactions.

Local Development and Global Governance – LoG

It investigates in which ways institutions, both formal and informal, interact in order to promote the development of local areas.

Migration Scenarios and Social Change – SMMS

It studies international migration and geographical mobility migration as a factor of social change, both in sending and receiving contexts.

Research Unit on Communication, Organizational Learning and Aesthetics – RUCOLA

It explores the practices of organizing with a focus on knowing and learning as a collective, social, affective accomplishment.

Science and Technology in Society – STSTN

It provides a platform for discussions on issues concerning the relationship between science and society, within the university and in the local community.

VADem – Values, Belonging and Democracy

It studies the connections between socio-cultural change, particularly in the area of values, political culture and the transformation of democratic institutions.



Centre for Integrative Biology

*An integrative view of biological processes and
their derangement in disease*

www.cibio.unitn.it

The Centre for Integrative Biology – CIBIO promotes the idea of merging the classical cellular and molecular biology perspective with the new effective approaches provided by systems and synthetic biology, placing also strong emphasis on integration with chemistry, physics, informatics, mathematics and engineering.

CIBIO Principal Investigators pursue their goals in the frame of a holistic view of basic biological processes and of their derangement in disease, with the aim of establishing a “double- edge” model to biomedical research – in which basic science co-exists with translational approaches.

Research at CIBIO covers a number of topics, all emphasizing experimental analysis at various levels of biological organization, and they are largely focused on four major Research Programmes:

Cancer Biology & Genomics

The CBG Programme is characterized by a strong focus on fundamental studies, directed towards molecular determinants of altered gene expression control in cancer, conducted also with a network-oriented approach. The goal of this research is the description of pathways involved in cancer onset and progression, and the identification of bioactive molecules in a drug-screening setting.

The CBG Laboratories are:

- Armenise-Harvard Cancer Biology & Genetics
- Computational Oncology
- Experimental Cancer Biology
- Transcriptional Networks
- Genomic Screening
- Translational Genomics
- Gene Expression
- Molecular Cancer genetics

Cell & Molecular Biology

The CMB Programme addresses research topics, such as intracellular trafficking, host-virus interaction, RNA and protein homeostasis, and molecular mechanisms controlling the turnover of nucleic acids and proteins.

The CMB Laboratories are:

- Molecular Virology
- RNA Biology and Biotechnology
- Molecular and Cellular Neurobiology
- Dulbecco Telethon Neurodegenerative Diseases
- Dulbecco Telethon Prions and Amyloids
- Virus-Cell Interaction

Microbiology & Synthetic Biology

The MSB Programme associates the identification of genes and small molecules involved in the virulence of pathogenic microorganisms and the mechanisms of their action with the experimental investigation of the first phases of protocell evolution.

The MSB Laboratories are:

- Microbial Genomics
- Armenise-Harvard Synthetic and Reconstructive Biology
- Computational Metagenomics
- Synthetic and Structural Vaccinology
- Artificial Biology

Neurobiology & Development

The aims of the NBD Programme are to identify and distinguish genetic determinants of the central nervous system (CNS) development, which contribute to the onset and progression of CNS pathologies and might be used to develop possible innovative therapies.

The NBD Laboratories are:

- Molecular Neuropathology
- Transcriptional Neurobiology
- Developmental Neurobiology
- Armenise-Harvard Axonal Neurobiology
- Stem Cell Biology
- NeuroEpigenetics
- Dulbecco Telethon Stem Cells and Regenerative Medicine
- Dulbecco Telethon Biology of Synapses
- Neurogenomic Biomarkers

The Research Programmes established at CIBIO are interconnected by a high degree of internal co-operation, in the setting of a dynamic experimental environment – characterised by the coordinated work of young independent group leaders and advanced postdoctoral fellows. CIBIO has acquired state-of-the-art equipment, comprising all the tools necessary for biomedical projects to be carried out with the required high level of technological sophistication (www.cibio.unitn.it/42/core-facilities). Researchers at CIBIO have full access to shared instrumentation facilities operated by dedicated and highly-qualified staff scientists.

Center for Mind/Brain Sciences

Interdisciplinary research in cognitive neurosciences, animal cognition, computational linguistics, experimental psychology and neuroimaging acquisition methods

www.unitn.it/en/cimec



Research at the CIMeC (Center for Mind/Brain Sciences) is conducted in several areas that range from experimental psychology, to neuroimaging acquisition methods, cognitive neurosciences and animal cognition, as well as in computational linguistics.

The Center consists of six interdisciplinary Laboratories:

Functional Neuroimaging Laboratories (LNiF)

The Laboratories for Functional Neuroimaging (LNiF) are committed to developing new techniques for imaging human brain and supporting their applications towards a more comprehensive understanding and better care of the human mind and body. This involves the development and continued improvement of new hardware, software and procedures for data acquisition, visualization and statistical analysis, and the application of these advancements to medically-relevant investigations (with CeRiN).

Neuropsychology Laboratory (NP)

The Neuropsychology Laboratory is dedicated to investigating the nature of the cognitive, linguistic, perceptual, motor, and emotional deficits that result from brain damage or other forms of neurocognitive dysfunction in adults and children. There are two main objectives in the Laboratory.

The first is to understand the functional organization of the human brain and how damage to its various parts leads to cognitive disorders; the second is to use knowledge of the working of the brain in order to develop better tools for the assessment of cognitive disorders and better rehabilitation techniques.

Animal Cognition and Comparative Neuroscience Laboratory (ACN)

The main goal in the ACN Laboratory is the study of cognitive processes and their neurobiological bases in a comparative perspective. Research is mainly focused on the mechanisms of cerebral representation of physical and social objects, numbers, time and space.

In particular, special attention is given to animal models, characterized by having cerebral architectures that are simpler than (or otherwise different from) those of mammals, in order to provide support for comparative research and investigations into basic neurological mechanisms.

Language, Interaction and Computation Laboratory (CLIC)

In the CLIC Laboratory, the interest is in studying verbal and non-verbal communication. Research in the Laboratory uses both computational and cognitive methods and is focused on the following

areas: the use of semantic and encyclopedic knowledge in communication; classical questions in theoretical linguistics and, in particular, semantics with computational and experimental methods; multimodal communication, in which agents communicate, using a variety of expressive means that go from verbal expressions to gestures, as well as in the direction of a look, and that can also use images and diagrams; extraction and integration of semantic information from different multimodal sources; adaptive interfaces.

Center for Neurocognitive Rehabilitation (CeRiN)

This structure is dedicated to the diagnosis and treatment of the cognitive, linguistic, neurobehavioral and motor-sensory problems in brain damaged adult subjects, in collaboration with the local medical infrastructures. The activity of CeRiN is founded on the inseparable coexistence of clinical, educational and research (clinical and basic) activity in the cognitive neurosciences, as such coexistence guarantees constant innovation in clinical practice. Outcomes of research projects increase our knowledge of mind/brain relationships. They are transposed to clinical practice, and become part of the educational activity.

Experimental Psychology Laboratories (EPL)

In the EPL, human cognitive functions are studied by means of different techniques and experimental methods. The unit consists of five different laboratory areas and adopts EEG, Eye Tracking, Kinematics, Multisensory and Psychophysics research tools.

Other laboratories have become part of CIMeC, thanks to the collaboration with other local and national research entities: the NeuroInformatics Laboratory (in collaboration with the Bruno Kessler Foundation); the Insect Neurobiology and Neuroecology Laboratory (in collaboration with the Research and Innovation Centre of the Edmund Mach Foundation); and the Ethology, ecology and evolution Lab (in collaboration with the Museo Civico in Rovereto).

Since 2010, the Center also collaborates with the Center for Neuroscience and Cognitive Systems (Italian Institute of Technology, IIT) established in Rovereto.

A low-angle, upward-looking photograph of numerous tall, silver flagpoles against a clear, bright blue sky. The flagpoles are arranged in a radial pattern, creating a sense of height and grandeur. Various national flags are flying from the poles, including the Italian flag (green, white, and red), the Swiss flag (red with a white cross), the Spanish flag (red, yellow, and red with the national coat of arms), and the flag of Hungary (red, white, and green). The flags are captured in motion, with some appearing slightly blurred, suggesting a breeze. The overall composition is dynamic and celebratory, symbolizing international unity and global studies.

School of International Studies

Institutional change, economic growth and social development

www.unitn.it/en/ssi

The School of International Studies (SIS), founded in 2001, is a Graduate School and an advanced institute of interdisciplinary studies. In few years since its inception, it has become an established institution in Europe for graduate teaching and research in economics, law, politics, sociology, history, philosophy. The School has undertaken and funded three interdisciplinary research projects which fall within the more general topic of interest **“Institutional change, economic growth and social development”** co-funded by the Autonomous Province of Trento.

The reform of the Chinese growth model: economic, political and institutional issues

This research project focuses on the evolution of the Chinese growth model. Despite the remarkable economic performance attained so far, the Chinese socio-economic model has, in fact, been characterised by significant macroeconomic imbalances and serious social problems that need to be urgently addressed. The Chinese élite is aware of the need of such a wide range of reforms, but the required corrective actions appear to be politically, institutionally and socially challenging. The research aims to develop some theoretical macroeconomic models to study the transition path and the long-term implications on growth of various reform scenarios, taking fully into account the complex balance of power between the dominant social groups and the élite that governs the country. The project also aims to address the impact of the transformation of the Chinese socio-economic model on the international relations that China maintains with Western countries and its Asian neighbours. This research is also related to the study of the Chinese institutional framework through an interdisciplinary analysis of the links between the legal, social, economic and political aspects.

A Legal Analysis of the Financial and Economic Crisis Management in the European Union: Intergovernmentalism and its Implications

The economic and financial crisis that has hit economies around the world in the last few years has highlighted an overall lack of tools addressing market turbulence at European level. Against this background, default risks and fears of contagion throughout Europe urged EU Member States to set up effective mechanisms to cope with national vulnerabilities. This happened mostly through the conclusion of international agreements outside the EU Treaties framework. Such an approach gives rise to a number of crucial legal questions, not only as to the limits of the current legal framework, but also as to the relationship between the instruments that have been established and the EU founding Treaties system.

It also further reflects on the current and future role of the Union in global economic governance and the possible evolution of its normative framework.

The overall purpose of the project is to investigate in a multidisciplinary manner the causes that led to an intergovernmental approach to crisis management by EU Member States, assess its impact on the EU legal system and discuss possible future developments.

Crisis in the European Union: between Transnational Integration and National Disintegration

This research is focused on the definition of crisis in the European system, as it evolved historically in its various components (institutional, political, economic, social, and moral), discussing the outcome of crisis and the integrative and disintegrative pressures generated by it.

The project is multidisciplinary and it is structured in several more specific interconnected areas of research.

The historical dimension revolves around the comparison of the features of the crisis in the 1970s and the current one, reflecting on relevant factors that push towards opposite responses - more Europe vs less Euro(pe).

The research analyses also the impact of the crisis and the institutional changes introduced to overcome it. The crisis has a significant impact on the political actors involved and on the mechanisms of political accountability, which is changing the model of democracy in Europe. The problem of the democratic deficit in the European Union is also related to the mechanism of participation of civil society in decision-making, which starts at the local level but is increasingly relevant also at the European level.

The serious problems of the European Union today are both economical and institutional, and their depth endangers the very existence of the integration process and the stability of the member States.

Specific issues analysed are the changes in some fundamental elements of European integration, particularly the national dimension of redistributive policies, the development of technocratic transnational networks and specialised systems of knowledge, the definition of European citizenship and the entitlement to differentiated degrees of protection

of rights, the perception of a democratic deficit and possible solutions, the increasing complexity of legal rules and their interaction with national law.

The global virtual-water network: social, economic and environmental implications

(funded by the Italian Ministry of Research)

and

CLIMatic – Change Impacts on Future Availability of WATER RESources and Hydro-Geological Risks

(UniTrento project, in cooperation with DICAM, Department of Civil, Environmental and Mechanical Engineering)

A group of researchers at the SIS is currently involved in two research projects, which have a common aim: understanding and management of the climatic, economic, legal and societal challenges associated with an increasingly lower availability of water resources, from different perspectives and through an interdisciplinary approach. The specific areas of expertise range from hydro-climate and water-science issues to economic and legal aspects.

The first project (The global Virtual-WATER Network: social, economic, and environmental implications - **ViWaN**), funded by the Italian Ministry of Research, studies the main drivers and implications of the international virtual water flows (i.e., the transfer of water virtually embedded into the exchanged products), and aims at better understanding the global dynamics in virtual water flows via the international food trade network and the evaluation of the impact of such flows on food security. In particular, it investigates the complex relationships between climatic, agronomic and socio-economic factors and how they shape the evolution of the worldwide trade of virtual water.

The second project (CLIMatic change impacts on future Availability of WATER RESources and hydro-geological risks - **CLIMAWARE**), funded by the University of Trento, focuses on the interactions between climate change and human activities related to water, embracing physical, social, legal and economic processes. The project studies how changes in water cycle components related to extremes affect the society and some contiguous sectors (like agriculture, tourism, and energy production), and analyses the role played by social behaviour, economic processes and legal instruments in managing the availability of freshwater.

Differences, migration, integration: education to citizenship in the age of legal pluralism

(funded by Fondazione Cassa di Risparmio Trento e Rovereto - Caritro)

The project is carried out with the synergic contributions of the Faculty of Law (Centro di Ricerche sulla Metodologia Giuridica, CERMEG, of the University of Trento), local Istituti Scolastici Comprensivi and Centro Intercultura della P.A.T.

The research focus on the working out of an original model of argumentation & education in the context of the current law and values' pluralism. The aim is to enhance intercultural dialogue and stimulate - since the first cycle of tuition - those skills required to get acknowledged with European and transnational sources of law, as well as being able to play an active citizenship, suited to the needs of the local school scenario.

In addition, the project aims at developing a tool fostering key competences in the European context of the qualifications for life-long learning, related to self-fulfilment, active citizenship and social cohesion. The use of fundamental argumentation techniques will enable first cycle students to learn concepts and sources of law (local, national, European and international) and, above all, develop cognitive skills in data analysis (legal, political, social) in the evaluation of controversial situations, in clear and proper presentation of individual requests, in reducing aggressive attitudes. The project will also include meta-didactic exercise in class.

War and Post-War: States and Societies, Cultures and Structures. Reflections from A Centenary"

(Research project carried out by the Department of Humanities, the School of International Studies, the Department of Economics and Management, the Faculty of Law and the Department of Sociology and Social Research, in cooperation with PAT, FBK, Società di Studi Trentini di Scienze Storiche, Museo della guerra di Rovereto and academic institutions at European level)

The project focuses on the periods of transition from war to peace. It is structured in different units, each of which will deal with a specific aspect, both from local-regional and international perspectives. The project addresses topics such as mobilization and de-mobilisation processes, the role of historians and the legitimization of war, the role of the press, the school system, the new institutions, the birth of the new global asset, the beginning of the sponsorship of war prevention and the ways to safeguard peace

at a global level. Other topics which are investigated are the birth of transnational networks in the spurts of globalization, the history and evolution of the League of the Nations, the development of a legal language as a social phenomenon influencing public opinion, legitimisation through legal norms.

The project aims at rethinking in a critical perspective the meaning of war and its impact on post-war strategies aiming to economic, social and cultural reconstruction. It also analyses the outcomes of war on global scale, going beyond the traditional approach focused on the relationship between States, the proclamation of winners and losers and the displacement of borders. The project analyses the impact of these key aspects also in the background of the local historical dimension.

International Politics and Conflict Resolution AND International Relations and Technologic Innovation

(in cooperation with CeRPIC of the Fondazione Bruno Kessler – FBK)

The research addresses topics such as security and conflicts, International studies, through the cooperation of scholars of FBK and SIS. In the current international context, which is highly globalised, integrated and deeply interconnected, security is a collective and indivisible goal, which oversteps borders. Threatens to safety, as well as responses to safeguard it, have a deep transnational nature, in an interplay where international, national and local actors play a role.

In the framework of agreements between UniTrento, the University of Bologna and FBK-CeRPIC, IRTECH (International Relations and Technologic Innovation) is a joint project on the relationship between international relations and technologic innovation.

The project focuses upon the relationship between technology and international politics, developing new means of dissemination of research results, concerning topics such as mass destruction weapons proliferation, new technologies (drones, cybernetic war, space platforms), new actors (racketeering and terrorist groups), new threatens (food and energetic shortage, epidemics, failed States).

The research network works for the creation and updating of a virtual space systematically collecting research briefs on frontier topics falling within the international relations' and technologic innovation scenarios.

The Challenges of the Multilingual and Multicultural Learning Space in the International University – The INTL-UNI Project

(funded by EU Commission)

In the process of internationalisation, universities are faced with new challenges and opportunities for maintaining and improving the quality of their programmes. Students and lecturers alike form much more heterogeneous groups than ever before, speaking a wide spectrum of languages and representing a wide spectrum of cultural backgrounds in what may be termed the Multilingual and Multicultural Learning Space (M&MLS). This three-year EU funded project aims to identify ways of addressing these challenges and making the most of the opportunities to eventually produce a series of quality criteria for international programmes.

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