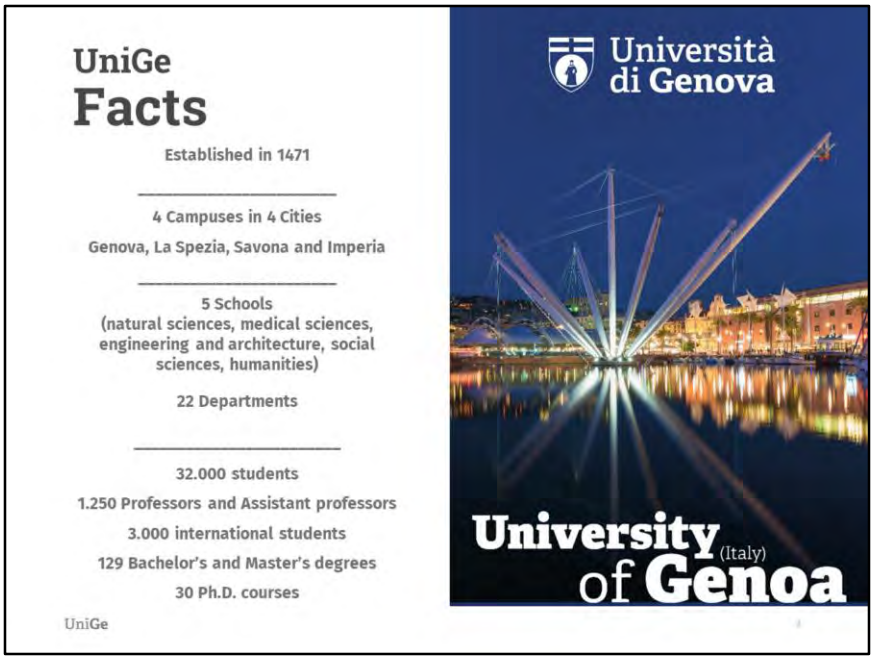
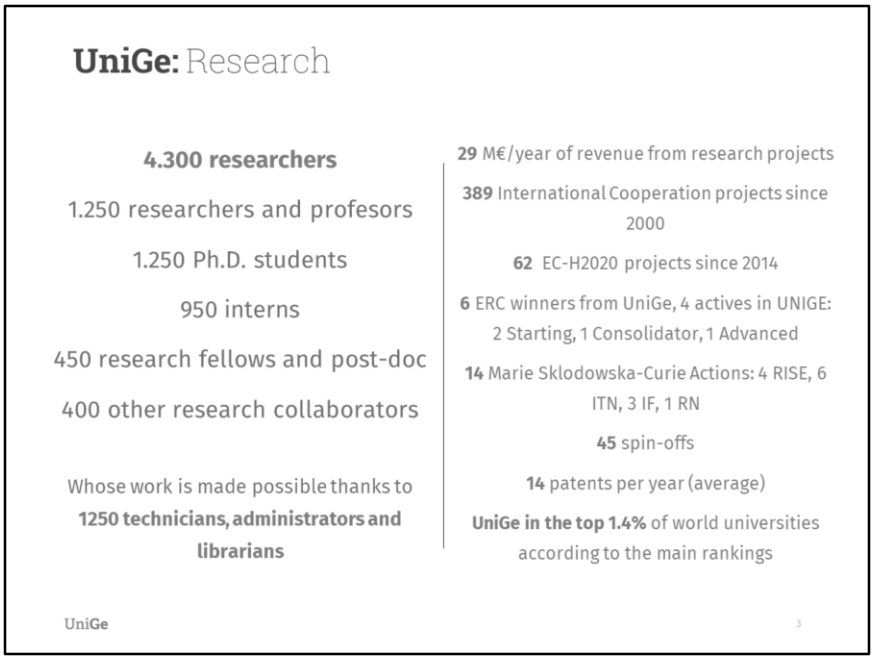

Università
di Genova



The University of Genoa is a generalist university that develops significant teaching and research activities.
Among various facts exposed here we want to emphasize the high number of foreign students who represent around 10% of enrolled students. this makes UNIGE first in Italy among generalist universities as internationalization.



UNIGE collects and manages around 30 million euros of research funding every year from various national and international sources
UNIGE is also strongly involved in technology transfer and counts 45 spin-offs and the registration of an average of 14 patents per year.
All this places it in the first 1.4% of the world's universities in the CWUR ranking.

In the following slides the research activities in the space sector developed at UNIGE are described.
The activities carried out at the Polytechnic School are presented first, followed by the activities carried out at the Science School.
At the Polytechnic School the main activities concern in particular:
Earth Observations from space, related methodologies of data analysis and applications to civil and environmental engineering;
Applications of ICT to the satellite sector;
Space robotics;
Energy technologies for space applications.

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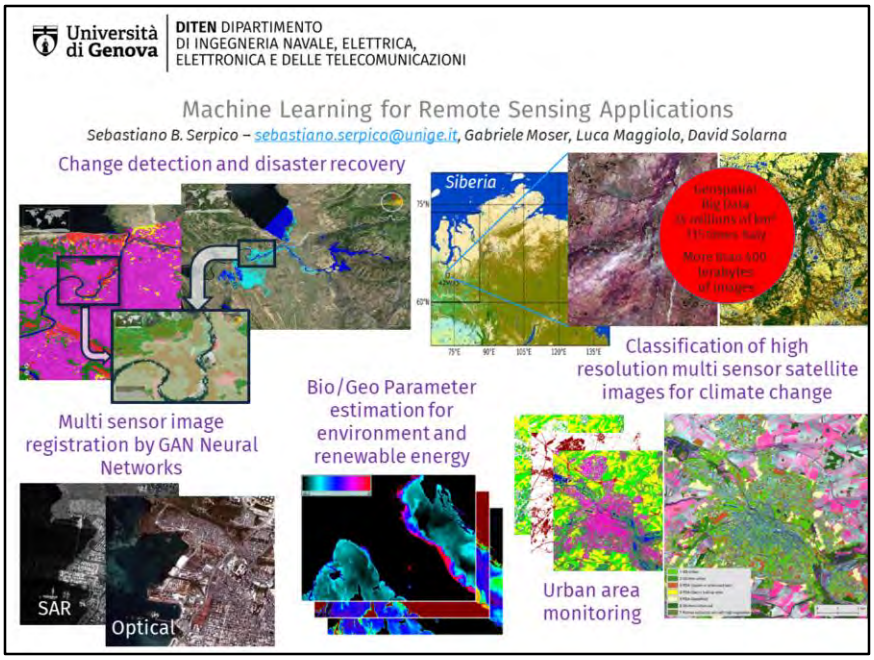
Earth Observation from Space

DITEN - – Dept. of Electrical, Electronic, Telecommunications Eng., and Naval Architecture
DICCA – Dept. Of Civil, Chemical and Environmental Engineering



In the context of the Earth Observation from space, various Machine learning methodologies - such as Neural Networks, Markov Random Fields, and supervised regression - are applied at the DITEN Department to the analysis of remotely sensed images to classify land covers, detecting the related changes and estimate bio- and geo-physical parameters. The applications ranges from the study of climate changes, to post-disaster recovery, from sea water quality analysis to the monitoring of renewable energy sources and of urban areas.

Università di Genova | **DITEN** DIPARTIMENTO DI INGEGNERIA NAVALE, ELETTRICA, ELETTRONICA E DELLE TELECOMUNICAZIONI

Machine Learning for Remote Sensing Applications

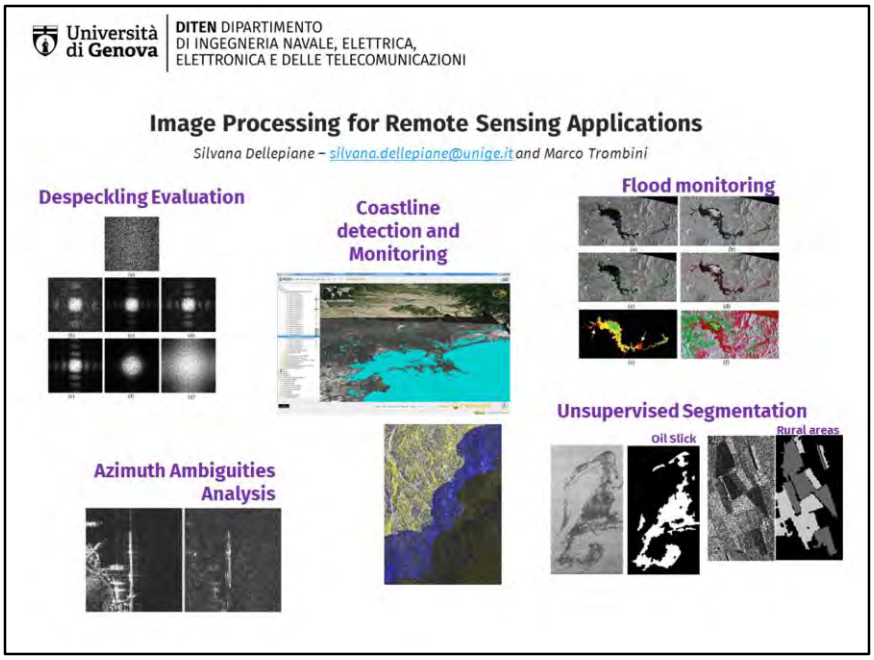
Sebastiano B. Serpico – sebastiano.serpico@unige.it, Gabriele Moser, Luca Maggiolo, David Solarna

A few recent publications

- Solarna, D., Gotelli, A., Moser, G., Le Moigne, J., Serpico, S. B., "Crater detection and registration of planetary images through marked point processes, multiscale decomposition, and region-based analysis," IEEE Trans. Geosci. Rem. Sens. (TGRS), in print (2020)
- Solarna, D., Moser, G., Serpico, S.B., "A Markovian Approach to Unsupervised Change Detection with Multiresolution and Multimodality SAR Data." Rem. Sens. 10, 1671 (2018)
- Akbari, V., Anfinsen, S. N., Doulgeris, A. P., Eltoft, T., Moser, G., Serpico, S. B., "Polarimetric SAR Change Detection With the Complex Hotelling-Lawley Trace Statistic." TGRS 54(7): 3953-3966 (2016)
- Moser, G., De Giorgi, A., Serpico, S. B., "Multiresolution Supervised Classification of Panchromatic and Multispectral Images by Markov Random Fields and Graph Cuts." TGRS 54(9): 5054-5070 (2016)
- Hedhli, I., Moser, G., Zerubia, J., Serpico, S. B., "A New Cascade Model for the Hierarchical Joint Classification of Multitemporal and Multiresolution Remote Sensing Data." TGRS 54(11): 6333-6348 (2016)
- Krylov, V. A., Moser, G., Serpico, S. B., Zerubia, J., "False discovery rate approach to unsupervised image change detection," IEEE Trans. Image Process. 25(10):4704-4718 (2016)

A few recent research projects

- CCI+ – Climate Change Initiative Extension, High-Resolution Land Cover | European Space Agency, 2018-Present
- TIAMO – Tecnologie Iot per l'Ambiente MarinO | POR Liguria, 2018-Present
- CEOS-DRM – Committee on Earth Observation Satellites - Disaster Risk Management | Italian Space Agency, 2017-2020
- URBIS – Urban land recycling information services for sustainable cities | EC, CIP Program, 2014-2017
- PRIN-2012 – Very high spatial and spectral resolution remote sensing: a novel integrated data analysis system | Italian Ministry of Education, University, and Research, 2014-2017



Another research group deals with adaptive processing of remote sensing images (mainly SAR). Among the applied methodologies: Non-linear filtering / despeckling methods and relative evaluation of the quality and of the distortions introduced; Processing for marine SAR applications: identification of azimuth ambiguities, cross-normalization of histogram, etc., detection of spills and other objects/structures at sea. Coastline erosion monitoring. Ground cover segmentation, Data fusion for monitoring

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Image Processing for Remote Sensing Applications

Silvana Dellepiane – silvana.dellepiane@unige.it and Marco Trombini

Main publications

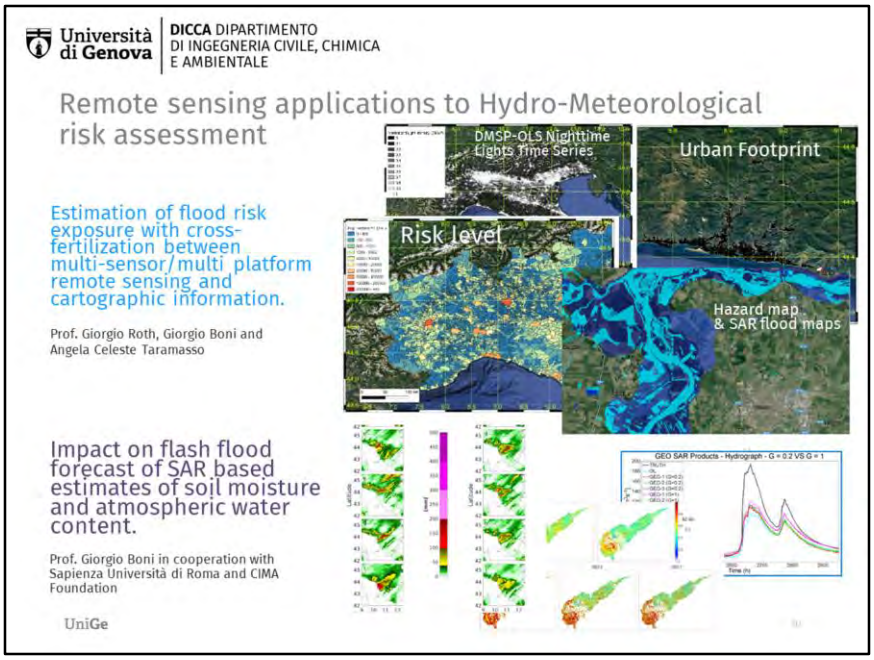
L. Gemme, and S.G. Dellepiane, "An automatic data-driven method for SAR image segmentation in sea surface analysis", IEEE Transactions on Geoscience and Remote Sensing, 56 (5), pp. 2633-2646, 2018.
S. G. Dellepiane and Elena Angiati, "Quality assessment of despeckled SAR Images", IEEE Journal of Selected Topics in Remote Sensing, JSTARS, 7 (2), pp. 691-707, 2014.
S. B. Serpico, S. Dellepiane, G. Boni, G. Moser, E. Angiati, R. Rudari, Information extraction from remote sensing images for flood monitoring and damage evaluation, PROCEEDINGS OF THE IEEE, vol. 100, n. 10, pp. 2946-2970, 2012.
S. G. Dellepiane and Elena Angiati, "A new method for cross-normalization and multitemporal visualization of SAR images for the detection of flooded areas", IEEE Transactions on Geoscience and Remote Sensing, 50 (7 PART 2), pp. 2765-2779, 2012.
R. Vaccaro, P.C. Smits, and S. G. Dellepiane, "Exploiting Spatial Correlation Features for SAR Image Analysis", IEEE Transactions on Geoscience and Remote Sensing, Vol 38, No. 3, May 2000, pp. 1212-1223.
P.C. Smits, S.G. Dellepiane, and R. Schowengerdt, "Quality assessment of image classification algorithms for land-cover mapping: a review and a proposal for a cost-based approach," Int. Journal of Remote Sensing, 20(8), pp.1461-1486, May 99.
S. Dellepiane, R. De Laurentiis, F. Giordano, "Coastline extraction from SAR images and a method for the evaluation of coastline precision", Pattern Recognition Letters, vol.25, pp. 1461-1470, 2004.

Patent

S. Dellepiane, I. Minetti, G. Vernazza, "A method for extracting information of interest from multidimensional, multiparametric and/or multi-temporal datasets", PCT International Patent, Class G06N7, N.: GE2011A000026, 09/03/2011.

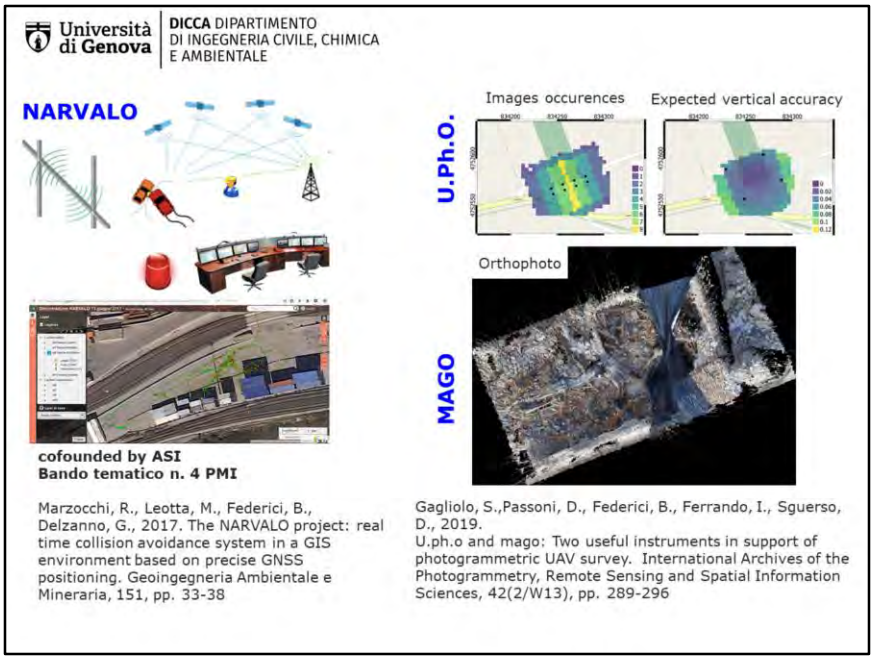
Projects

ASI - 1/R/36/00: Innovative Technologies for radar-interferometric Earth observation
ASI - IR/142/01: X-SAR/SRTM Interferometry
ASI - I/R/158/02: Exploitation of COSMO/SkyMed data for Earth surface monitoring



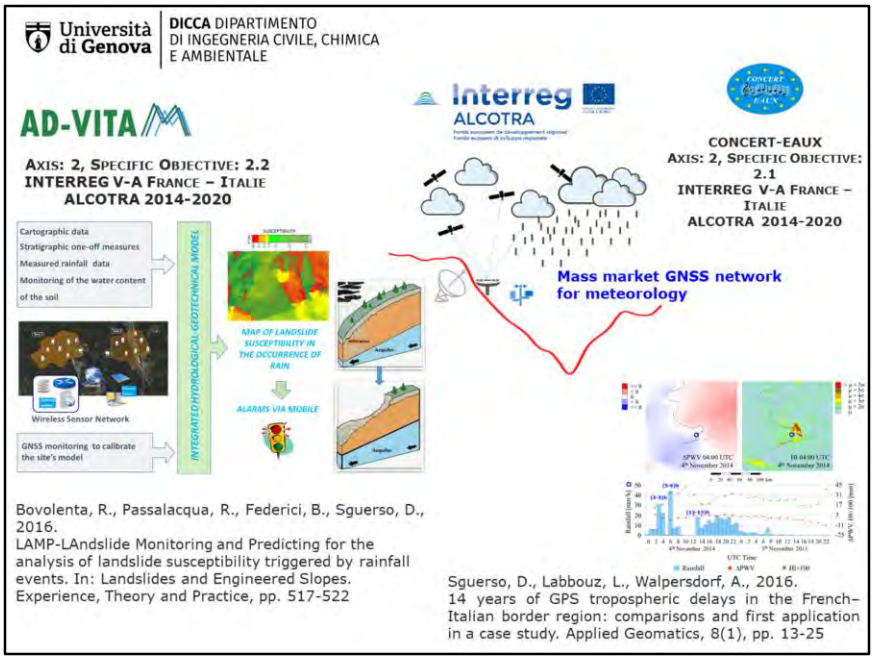
At the Dept. of Civil, Environmental and Chemical Engineering (DICCA), research is carried out on the results of image processing applied to natural risk assessment.
A research line concerns the applications of earth observations for risk assessment, coupled with ground data and classical cartography
Members of the research group participated in the activities of the ASI pilot projects for the application of earth observations to natural hazards as well as in projects for the development of technologies for the use of the Cosmo-SkyMed data for flood monitoring.
A second research line concerns the use of information extracted from satellite images in hydro-meteorological physical modeling for the reduction of uncertainty on the forecasts of extreme events such as floods, heavy rains, wind storms etc.

The Geomatics Laboratory team is composed by few but complementary researchers whose expertises cover almost all the geomatics fields: photogrammetry and remote sensing, GNSS techniques, GIS applications, traditional and innovative survey techniques, measures treatment and analysis.
Concerning the proximity operations and the scientific instruments, two main projects should be mentioned: the Narvalo project (co-funded by ASI) that leaded to develop a real time collision avoidance system in GIS environment based on precise GNSS positioning, and the ongoing GNSS experimentation on smartphones for the estimation of tropospheric delays. On the image and data analysis side, the research topics are focused on the photogrammetric assessment for UAV flights, with a realistic planning and with a check of obtained precisions respectively pre and post-flight (U.Ph.O). The machine learning approach for orthophoto production (MAGO), and the navigation support in safe and precise conditions (UVN), complete the tools that our research field actually offers.
Moreover, a fundamental aspect of the research is the geomatic approach to monitoring, applied to geotechnic, hydro-geologic, fluvial, coastal and urban environments. In these contexts, specific applications deal with the estimation of potential precipitations via GNSS observations, and the assessment of landslide susceptibility.



The Narvalo project (co-funded by ASI) leaded to develop a collision avoidance system for logistic platform areas that detects possible dangerous situations, which could lead to accidents, and consequently alerts vehicles and people involved. The system is based on the real time knowledge of precise position, speed and acceleration of the monitored vehicles and operators using ad-hoc GNSS – IMU receivers, the “Narvalo box”. The control center consists of a GIS collision avoidance algorithm and a server responsible for the scheduling of the algorithm, the management of real time communications with the mobile devices and the storage of historical data in a geoDB. The key feature of the “Narvalo box” is a specific tool for the recognition and mitigation of multipath effect, which highly affects the confined environments.

U.Ph.O. and MAGO are two useful instruments to support a photogrammetric UAV survey. U.Ph.O is employed to obtain a navigation supports in safe and precise conditions (UVN), in order to properly plan the UAV flight and to verify after the survey their coherence with the obtained precisions. MAGO has a machine learning approach using an adaptive triangulated mesh for the reconstruction of orthophotos at the maximum possible resolution, i.e. the image resolution.



The Geomatics Laboratory is involved in two Interreg Alcotra 2014-2020 projects: AD-VITAM and Concert-Eaux. In AD-VITAM project a method to monitor and predict susceptibility of rainfall-induced landslides is developed and applied to several pilot-sites. It involves a hydrological-geotechnical model in GIS, integrated with in-situ sensors to observe superficial soil water content, rainfall and air temperature, so to monitor the local hydrogeological conditions of the ground. Low-cost GNSS sensors are added to validate the model results.

Concert-Eaux project is mainly focused on the water cycle monitoring and management. In this context, a mass-market GNSS network is installed in the Bendola pilot-basin to monitor the water vapor content and to estimate the potential precipitation, through a proprietary procedure, called Gnss for Meteorology (G4M), which is able to produce 2D maps of precipitable water vapor from GNSS observations integrated with environmental parameters.

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Applications of ICT to the Satellite Sector

DITEN – Dept. of Electrical, Electronic, Telecommunications Eng., and Naval Architecture

At Dept. of Electrical, Electronic, Telecommunications Eng., and Naval Architecture (DITEN) the Digital Signal Processing laboratory has over ten years of experience in communications and satellite networks. Activities have recently focused on the concept of an Internet of Things that also interconnects objects through satellite connections as well as with terrestrial mobile communication systems such as 5G.

The research contributions and results concern distributed signal processing techniques, adaptive coding, resource allocation and optimization and application of machine learning techniques applied to the research channels listed on the slide.

This research is carried out at national and international level through collaborations with prestigious bodies in the sector in which both thesis specialists and members of the Digital Signal Processing laboratory carried out visiting periods.

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Digital Signal Processing Laboratory (DITEN)

Prof. Igor Bisio was Chairman of the IEEE Satellite and Space Communications Technical Committee of the IEEE Communications Society from 2012 to 2016.

Main publications

- I. Bisio, T. de Cola "QoS Optimisation of eMBB Services in Converged 5G-Satellite Networks" IEEE Transactions on Vehicular Technologies, to appear.
- G. Araniti, I. Bisio, M. De Sanctis, F. Rinaldi, A. Sciarrone "Joint Coding and Multicast Subgrouping over Satellite-eMBMS Networks", in IEEE Journal on Selected Areas in Communications (JSAC), Article in Press.
- Igor Bisio, Fabio Lavagetto, and Giulio Luzzati, "Cooperative Application Layer Joint Video Coding in the Internet of Remote Things", IEEE Internet of Things Journal, vol. 3, no. 6, pp. 1418-1426, Dec. 2016.
- Giuseppe Araniti, Igor Bisio, Mauro De Sanctis, Antonino Orsino, John Cosmas, "Multimedia Content Delivery for Emerging 5G-Satellite Networks", IEEE Transactions on Broadcasting, vol. 62, no. 1, pp. 10-23 (Part: 1), March 2016.
- Igor Bisio, Stefano Delucchi, Fabio Lavagetto, Mario Marchese, "Lp-problem based Transmission Rate Allocation with Packet Loss and Power Metrics over Satellite Networks", IEEE Trans. on Vehicular Technol., vol. 65, no. 5, pp. 3312-3325, May 2016.
- M. De Sanctis, E. Cianca, G. Araniti, I. Bisio, R. Prasad "Satellite Communications Supporting Internet of Remote Things", IEEE Internet of Things Journal, vol. 3, no. 1, pp. 113-123, Feb. 2016.
- G. Araniti, N. Bezirgiannidis, E. Birrane, I. Bisio, S. Burleigh, C. Caini, M. Feldmann, M. Marchese, J. Segui, K. Suzuki "Contact Graph Routing in DTN Space Networks: Overview, Enhancements and Performance", Communications Magazine, IEEE vol. 53, no.3, pp. 38-46, March 2015.

DITEN DSPLAB

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Satellite Communications and heterogeneous Networking Laboratory

www.scnl.diten.unige.it

Prof. Mario Marchese - mario.marchese@unige.it

Most of the scientific activity is in the field of **QoS-based and secure solutions for heterogeneous networks**, composed of Satellite but also Vehicular, Wireless Sensor, Electrical Grid, Critical Infrastructures and Aerial Systems.

A list of the research topic includes:

- Network and Cyber Physical Security;
- Anomaly detection in Industrial Control Systems;
- Internet of Things (IoT);
- Integrated Satellite-terrestrial networks in 5G;
- Smart Satellite Gateways Diversity;
- Routing in nanosatellite-DTN (Delay and Disruption Tolerant Networking) networks

A historical laboratory at the University of Genoa tackling satellite research issues is represented by the SCNL (Satellite Communications and heterogeneous Networking Laboratory) founded by Prof. Mario Marchese in 1999. Main research activity concerns “QoS-based and secure solutions for heterogeneous networks”, composed of Satellite but also Vehicular, Wireless Sensor, Electrical Grid, Critical Infrastructures and Aerial Systems. The slides report part of the research issues, publications, and research projects.

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Satellite Communications and heterogeneous Networking Laboratory

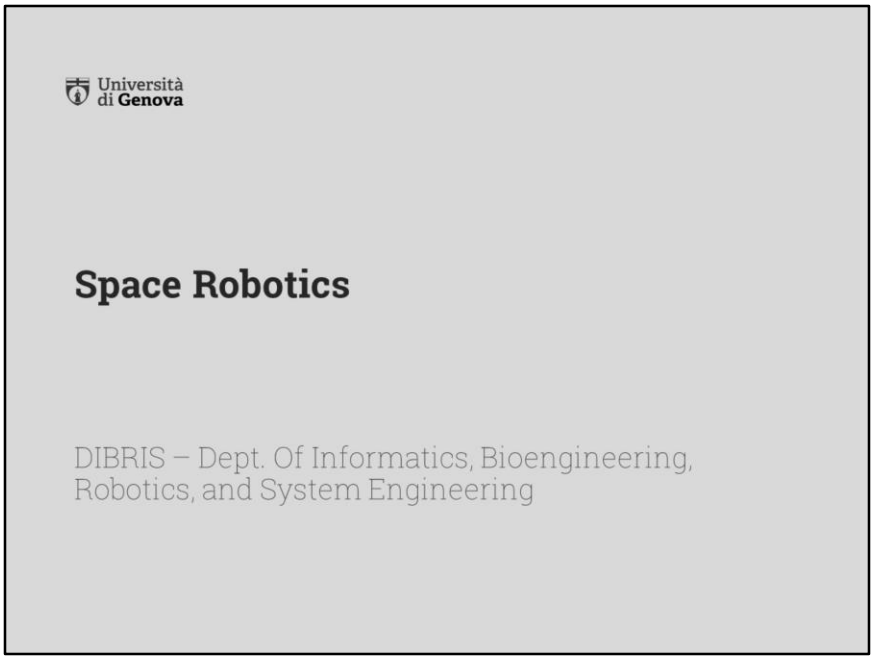
www.scnl.diten.unige.it

Main recent publications:

- M. Marchese, F. Patrone, "*E-CGR: Energy-aware Contact Graph Routing over Nanosatellite Networks*", IEEE Transactions on Green Communications and Networking, 10.1109/TGCN.2020.2978296, in print.
- C. Sacchi, M. Ruggieri, K.-M. Cheung, M. Marchese, F. Granelli, V. Popescu, M. Rice, M. Murroni, N. Conci, C. Schlegel, M. Noble, "*Glue Technologies for Space Systems: An Introduction to a New AESS Technical Panel*", IEEE Aerospace and Electronic Systems Magazine, vol. 35, no. 1, pp. 46 - 54, 2020.
- F. Babich, M. Comisso, A. Cuttin, M. Marchese, F. Patrone, "*Nanosatellite-5G Integration in the Millimeter Wave Domain: A Full Top-Down Approach*", IEEE Transactions on Mobile Computing, vol. 19, no. 2, pp. 390 - 404, 2020.
- M. Marchese, A. Moheddine, F. Patrone, "*IoT and UAV Integration in 5G Hybrid Terrestrial-Satellite Networks*", Sensors, vol. 19, no. 17, pp. 3704 - 3722, 2019.
- M. Bacco, L. Boero, P. Cassarà, M. Colucci, A. Gotta, M. Marchese, F. Patrone, "*IoT Applications and Services in Space Information Networks*", IEEE Wireless Communications, vol. 26, no. 2, pp. 31-37, 2019
- YF. Davoli, C. Kourogiorgas, M. Marchese, A. Panagopoulos, F. Patrone, "*Small satellites and CubeSats: Survey of structures, architectures, and protocols*", International Journal of Satellite Communications and Networking, vol. 37, no. 4, pp. 343 - 359, 2019.

Main recent research projects:

- "*Innovative Networking Solutions for SatCom in 5G and beyond*", ESA research project within the Satellite Communications Network of Excellence (SatNEx) IV CoO 2 part 2, 2019-2020.
- "*Analysis of the future 5G application scenario and of the communication protocols' security level*", research contract within the Italian 5G sperimentation campaign, 2017-2021.
- "*Alternative security schemes for integrated satellite terrestrial networks*", ESA research project within the Satellite Communications Network of Excellence (SatNEx) IV CoO 2 part 1, 2017-2018.
- "*Multi homed network architecture for flying ad hoc networks (FANETs) and nano satellite swarms*", ESA research project within the Satellite Communications Network of Excellence (SatNEx) IV CoO 1 part 2, 2016-2017.



Space robotics topics are dealt with by a research group active at the the DIBRIS department

At the Dept. of Informatics, Bioengineering, Robotics, and System Engineering DIBRIS, the Robotics and Autonomous Systems Group deals with research and technological development activities on issues relating to control and navigation systems for mobile, underwater, aircraft, manipulators and mechatronic robots.
Over the years the group has carried out research activities in the field of space technologies, also in collaboration with Thales-Alenia, on planning and control problems for vehicles for planetary exploration, and on technologies for the development of tactile sensors for manipulating robots.
The group also has consolidated experience in the field of underwater robotics which has strong similarities with applications in the space sector.

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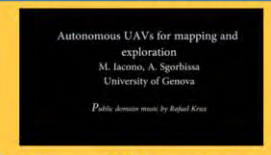
Space Robotics at DIBRIS (Università di Genova)

Robotics and Autonomous Systems Group

Cooperative robot control



Autonomous UAVs for mapping and exploration

Tactile based control

Vision based control

Mechatronic robot eyes

Human Robot Interaction

Scientific and Technical Capabilities

- GNC for AGVs, AUVs, UAVs, UUVs
- Control of robot manipulators and exoskeletons
- Control of Human-Robot interaction
- Control architectures for robots
- Control of autonomous systems
- Tactile sensor technologies (hw/sw
- Mechatronics

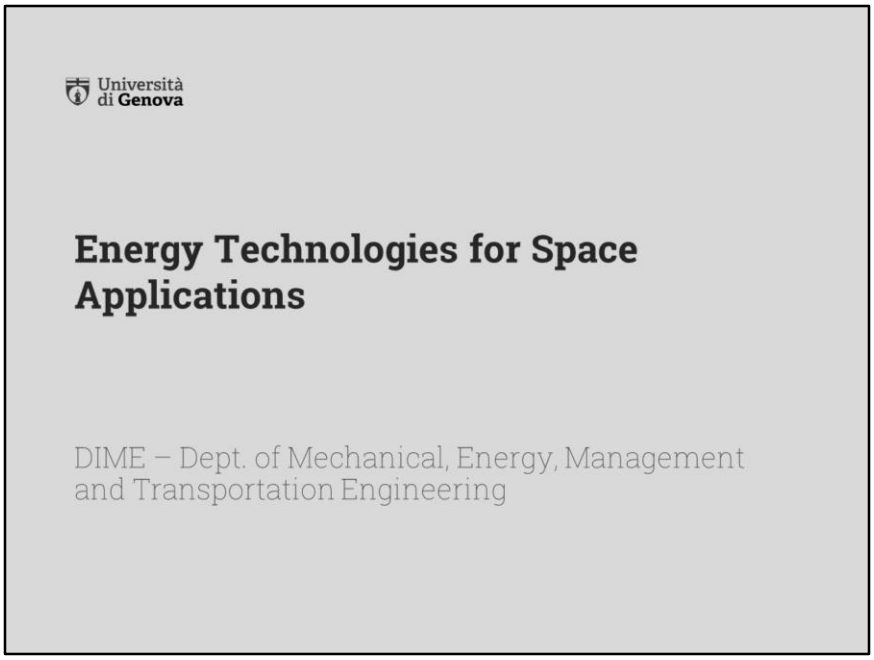
Staff

Prof. Marco Baglietto
Prof. Giorgio Cannata
Prof. Giovanni Indiveri
Prof. Fulvio Mastrogiovanni
Prof. Antonio Sgorbissa

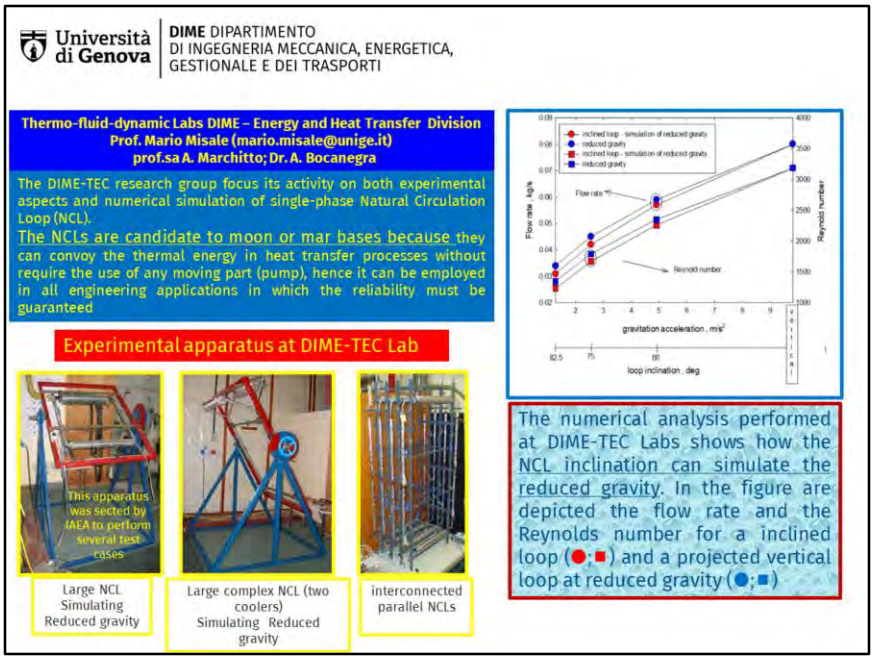
Recent Projects

- EU-H2020 COLLABORATE – human-robot interaction
- EU-H2020 DexROV – ROV control through satellite
- EU-FP7 CLOPEMA – manipulation of limp materials
- EU-FP7 ROBOSKIN – tactile sensing technologies
- EU-FP7 EYESHOTS – robot vision and perception
- EU-FP6 ROBOSWARM – control of swarms of robots

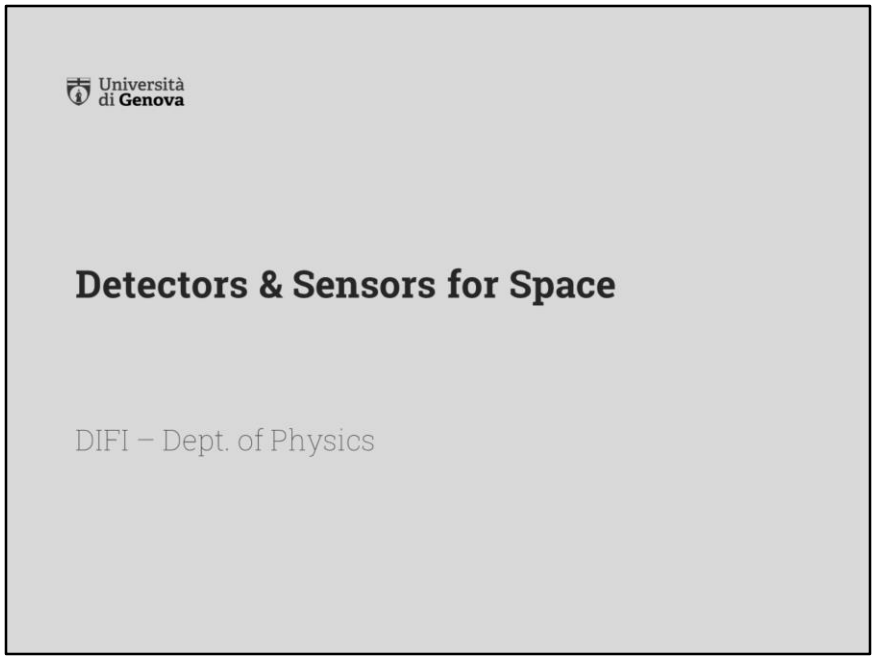
Contacts: robotunige@unige.it



At the DIME department, there's a UNIGE research group that deals with energy technologies for space applications



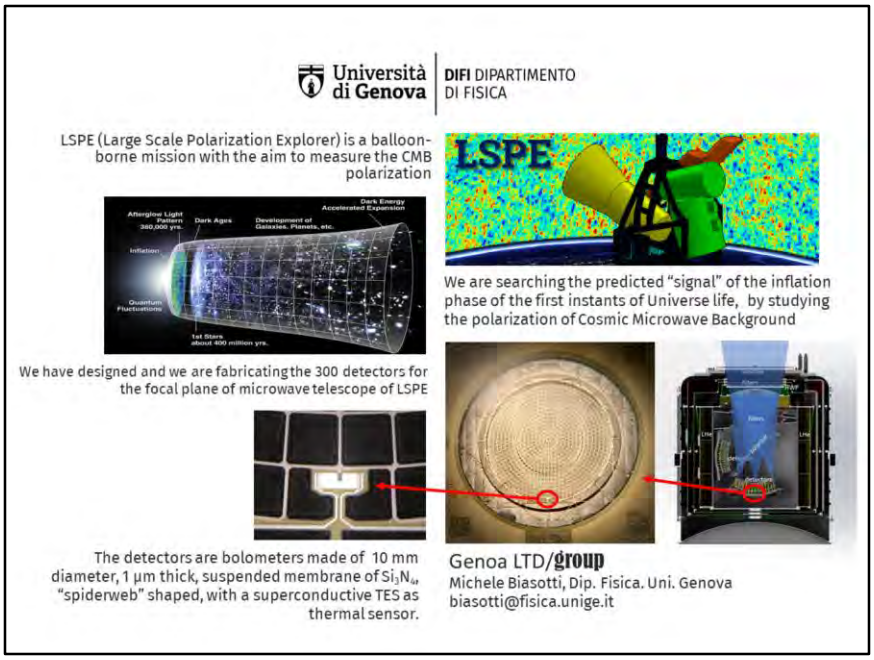
The DIME (Dept. of Mechanical, Energy, Management and Transportation Engineering)-TEC research group is working on the topic of "single-phase natural circulation loop" by several years. We work especially on experimental aspects of this topic. This laboratory can be considered as a reference among the international scientific community. In fact, the IAEA selected the DIME-TEC Lab to construct a data base shared with a lot of international numerical research groups, to investigate the possibility to predict the flow reversal in NCLs. Our experimental activities changed the approach to study the experimental aspects of the NCLs. We were the first Lab that pointed out the possibility to "simulate" experimentally the reduced gravity (corroborated by numerical simulations) on the earth varying the NCL inclination as well as the influence of heat sink temperature. After the publication of our research results, many research groups have adopted our approach. Moreover, we were the first Lab that investigated the thermo-hydraulic behaviour of the mini NCLs as well as we were pointed out the influence of parameters such as material of the tubes, presence of pressure drops and so on. We analysed the influence of various working fluid, i.e., water, FC43, and nanofluids. Finally, a new aspect of NCLs under analysis is the thermo-fluid- dynamic behaviour of interconnected parallel NCLs. All the above aspects were first investigated at DIME-TEC Labs and they became points of reference for the scientific community.



In the Science School, the current space activities with ASI/ESA and those having a potential space application can be grouped in 4 main lines: detectors and sensors, mission data analysis, magnets for space, study of materials for extreme conditions.

Introduction: cryogenics and superconductivity researches in Genova dates back to the ’60 and have generated research groups studying new superconducting materials, superconducting devices and sensors, cables and magnets at the University, CNR and INFN and in the local Industry.

The LTD/group at the Dept. of Physics designs and manufactures the only European focal plane detector for the XIFU instrument of ESA's ATHENA telescope (Phase B1). It is a superconducting cryogenic detector at that will operate at 50mk, coupled to that of NASA GSFC. Currently its Demonstration Model (shown in figure) is integrated with the NASA GSFC detector in the test setup at SRON-Utrecht for joint tests, which perhaps have had good success.



The same group designs and is building the superconducting focal plane detectors and the associated SQUID-based electronics of Large Scale Polarization Explorer (LSPE). They operates at 300 mk, on the focal plane of microwave of LSPE telescope, aiming to measure the polarization of the cosmic background between 145 and 250 GHz. LSPE is a ASI project that foresees a flight aboard a stratospheric balloon in circumpolar flight in the Arctic night, to identify signatures that date back to the inflationary phase of the primordial universe.

Groups at Physics Department have a considerable skills for the development of sensors and devices with nanostructured materials suitable for space applications. These include devices with transition metal compounds for actuators and energy harvesting, plasmonic antennas from UV to IR range. Studies of the radiation effect on the devices in conditions of LEO orbits are done.

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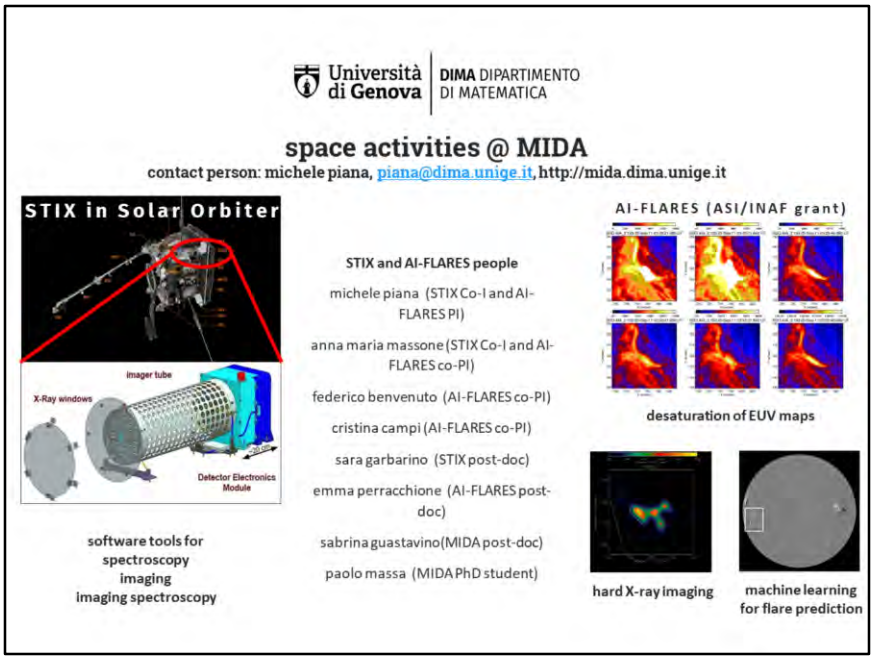
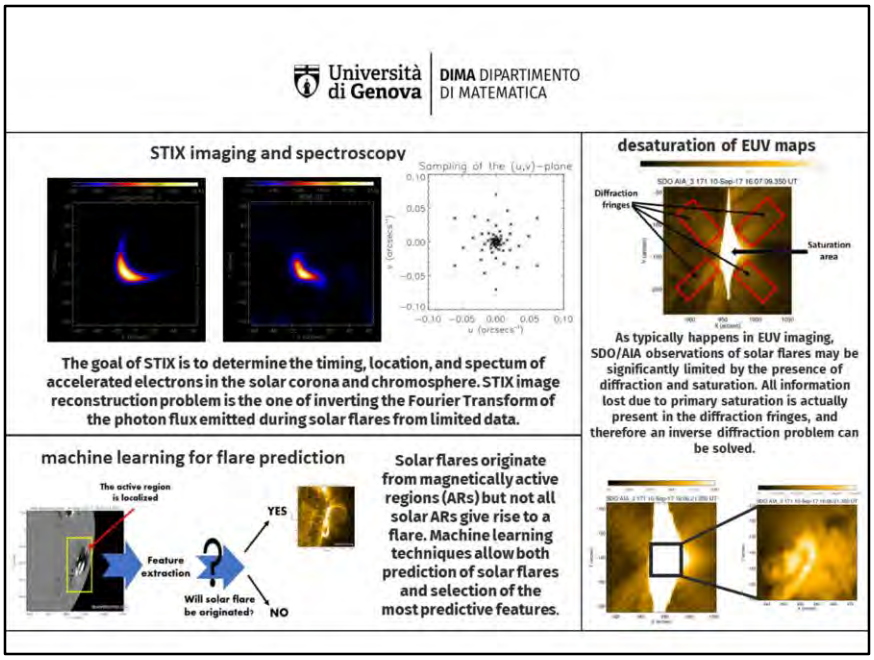
Mission Data Analysis

DIMA - Dept. of Matematics



At the Department of Mathematics the 'Methods for Images and Data Analysis (MIDA) Group', carries out activities concerning: (1) Hard X-ray solar physics - spectroscopy, imaging and spectroscopic imaging from instruments such as STIX on SOLAR ORBITER- and (2) Artificial Intelligence and Solar Flares which includes “machine learning” methods for predicting solar flares, or desaturation of EUV images, as main examples.



The goal of STIX is to determine the timing, location, and spectum of accelerated electrons in the solar corona and chromosphere. STIX image reconstruction problem is the one of inverting the Fourier Transform of the photon flux emitted during solar flares from limited data. Solar flares originate from magnetically active regions (ARs) but not all solar ARs give rise to a flare. Machine learning techniques allow both prediction of solar flares and selection of the most predictive features.

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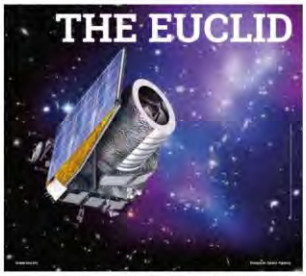
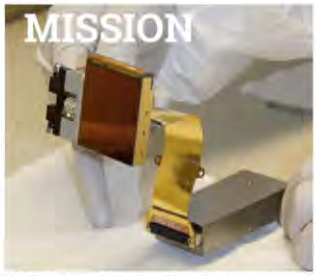


Euclid is an ESA mission to be launched in 2022. Two instruments: a CCD for the optical band (VIS) and a near-infrared spectro-photometer (NISP)

The group of INFN and Università di Genova was founded in 2018 and is working on: development of the software unit test for the instrument control unit of NISP, forecasts of cosmological parameters, spectroscopic simulations and reconstruction, set-up of a common computing facility. In the future, also multi-wavelength and multi-messenger combined analyses with other space- or ground-based experiments.



Main goals of the experiment: measure weak lensing and redshift of 10 billion galaxies. This will allow to improve the knowledge of the dark universe (dark matter, dark energy) and other cosmological quantities, such as the total neutrino mass.

Web site: https://www.difi.unige.it/it/ricerca/fisica-delle-astroparticelle/euclid

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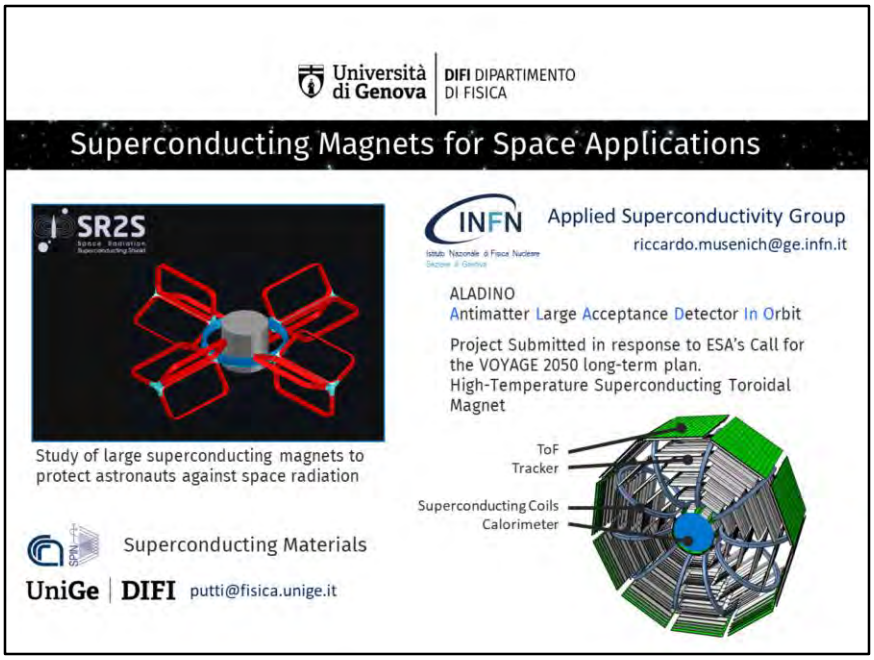
Stefano Davini, INFN-Genova, stefano.davini@ge.infn.it

The Euclid Mission Group at the Dept. of Phyiscs, develops the "software unit test" for the "instrument control unit of NISP" and deals with cosmological forecasts, simulations and reconstruction of the spectroscopic data.

Università di Genova

Magnet and Materials for Space

DIFI – Dept. Of Physics,
DICCI - Dept. Of Chemistry of and Industrial Chemistry



Power superconductivity activities for Magnets involve three groups, form university and CNR, for the development of low and high Tc materials and cables, from INFN, for the design and development of magnets for space. Examples are: SR2S, a study for the magnetic shielding of astronauts in long duration missions, and ALADINO, a high Tc toroidal magnet for the study of energetic particles of cosmic rays in space.

Università di Genova | DCCI DIPARTIMENTO DI CHIMICA E CHIMICA INDUSTRIALE

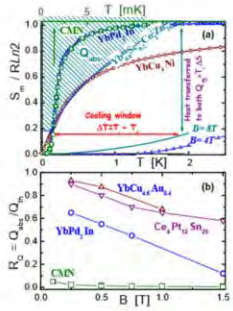
NEW-CRYOGEN-FREE COOLERS

Our group aims at improving the performances of current ADR paramagnetic salts for adiabatic refrigeration processes at the sub-Kelvin range

Very low-T coolers (T < 1K) are essential to present and future space missions. A large effort is required to develop closed-loop, space qualified coolers (specially cryogen free such as ADR), offering realible perforrmance and long lifetime.

Current ADR use paramagnetic salts due to the their large MCE. However their poor thermal conductance prevents an effective low-T heat transport.

We obtained strong enhancement of MCE in certain intermetallic compounds exploiting strong correlation between electrons (SCES). Therefore we are able to produce metals for realizing efficient magnetic cooling with a good performance and high thermal conductance



SCES/group

Mauro Giovannini, DCCI, Uni. Genova

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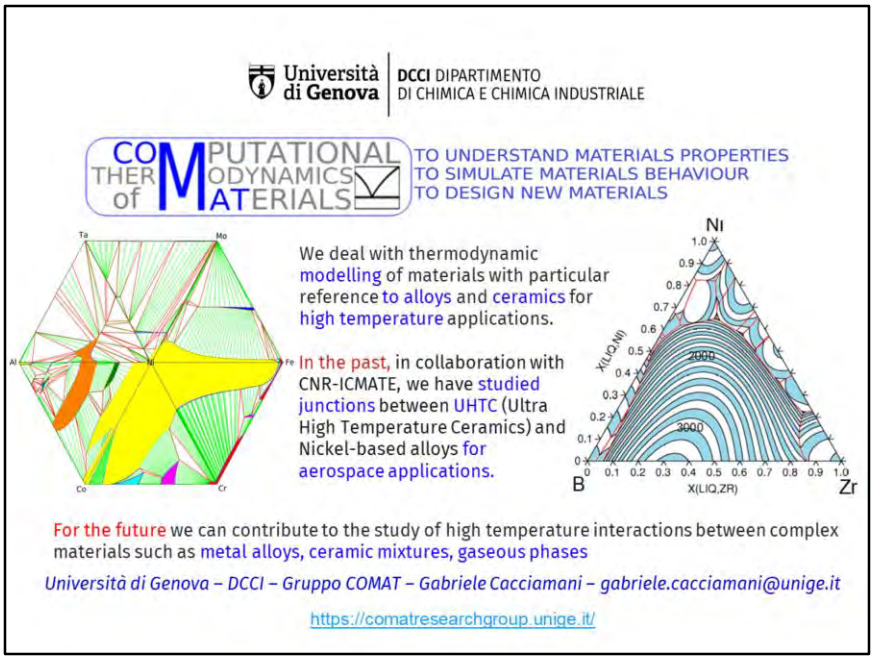
The performance of magnetic refrigerators at temperatures of Kelvin and below, already designed for some missions, can be greatly improved with the use of metallic paramagnetic materials instead of the current saline compounds.The SCES/group of the Chemistry Dept. studies rare earth metallic compounds with unique combination of High Cooling Capacity and High Thermal Conductance at Low Temperature.

Università di Genova

Materials for Space

DiCCI – Dept. of Chemistry, and Industrial Chemistry



The COMAT group at the Chemistry Department studies ceramic compounds for extreme UHT applications such as those for wing profiles and thruster components.