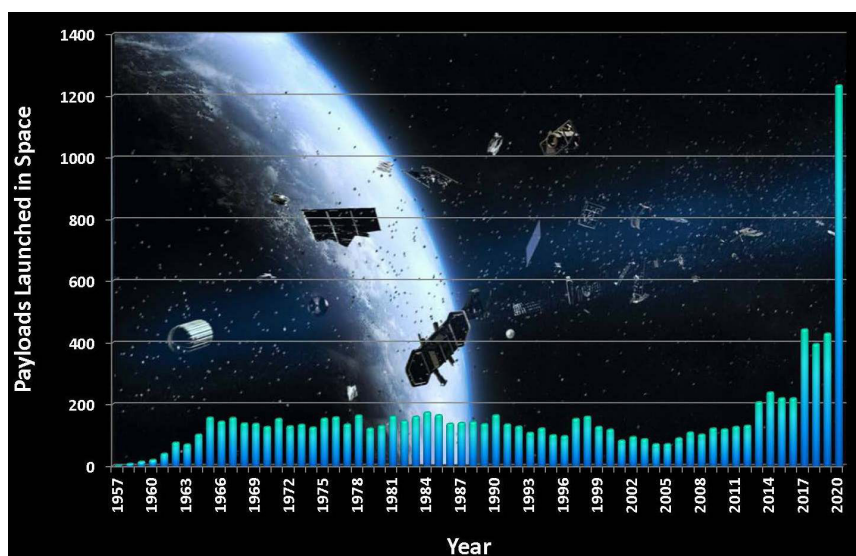# ISTI NEWS

Space Debris

Research and development perspectives in the race for sustainable and safe space activities

Yearly number of satellites launched in space since the beginning of the Space Age.

Space activities are in the midst of an epochal transformation. An enterprise dominated for over half a century, in terms of investments, launches and satellites, by governments and multinational entities is in fact becoming the field of action of a multitude of private companies and operators.

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The Eurographics 2021 award goes to Paolo Cignoni, ISTI-CNR

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Editorial

The times they are a-changin'

The title of this editorial recalls the famous song by Bob Dylan, of the revolutionary sixties. In a similar manner, CNR is currently experiencing a period of strong expectations with determined calls for change.

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National Research Council of Italy

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The times they are a-changin'

The title of this editorial recalls the famous song by Bob Dylan, of the revolutionary sixties. In a similar manner, CNR is currently experiencing a period of strong expectations with determined calls for change. The hope is for a new deal in which some of its long embedded and much-lamented problems can finally be resolved. The reason for this is strongly linked to the appointment of our new President, Prof. Maria Chiara Carrozza. This announcement was delayed considerably (nearly a year due to the Covid emergency), and finally made known in mid-April. The news was extremely well received: for the first time CNR will be led by a woman; Prof. Carrozza is an internationally known scientist with a solid background both as a researcher and a university professor, and also extensive experience in the management of science (previously Rector of the Scuola Superiore Sant'Anna, a university of excellence located in Pisa, and, in 2013-2014, Minister for the Universities and Research).

The general feeling in the Italian scientific community is that we have the right person in the right place.

The appointment of Prof. Carrozza has created great expectations. We badly need change and we feel that Prof. Carrozza is just the person to bring it about. CNR is a vital research institution, with an excellent research staff, however, the position of President is not an easy one. A number of difficult issues, in some cases encrusted and interdependent, need to be tackled urgently. Solving these problems needs vision, capacity to understand the finer details of CNR administrative procedures and its governing rules, and, finally, a strong determination to fight to achieve the necessary results.

The first activity of the new President has been to analyse the status quo. She reported that it was her intention to begin by listening to the opinions of the research community and studying the institution of CNR and its organization. This approach has been appreciated and we are looking forward to a close collaboration and dialogue with Prof. Carrozza, aimed at solving at least some of the current issues. So far, the new president has met and talked with the Directors of the Departments (the diverse scientific areas of CNR are divided into seven distinct departments) and has started to visit the CNR research campuses. We were delighted in Pisa, on May 24, to be the first campus to be visited.

President Carrozza has already received a long list of suggestions with respect to the most urgent actions needed. To mention just a few of the most pressing: a major reduction of the complexity of CNR administrative rules is mandatory, to allow us to act with the speed and effectiveness requested by our international projects; the temporary ban of non-permanent research contracts has to be removed as soon as possible, since it creates major problems in the management of research projects and is reducing the appeal of CNR for young researchers; new rules for recruitment and career evaluations, more in line with those of the international research community, must be drafted.

This May also saw the end of the first term of engagement for the Director of the Department of Engineering, ICT and Technology for Energy and Transport (DIITET), Dr. Emilio Campana. The selection process has now begun, and it is not yet known if Emilio will be selected for a second term. I would like to thank him here for his passion and dedication during this first period, and for the excellent results obtained. I very much hope that this collaboration can continue for a second term.

Times are a-changing at ISTI as well. The editorial of the last issue of this Newsletter already underlined the capacity of ISTI to evolve and innovate. As is well known, Covid caused some major changes in the organization of our research and management. However, judging from the excellent results achieved over the last twelve months, it appears that these have been successful.

A key indicator of the institute's health is its success in securing funds from competitive project calls. We are currently drafting the annual report on the state of the institute and I am proud to announce here the results obtained over the last 12 months: despite the ever-increasing competition for EC and national Calls for projects, ISTI researchers were awarded 12 new EC projects and many others at the national level. This meant that we secured a total of 7.7 MEuro in this period, around 50% of this from EC Calls; well above the average annual funds obtained by ISTI in recent years.

Research is collaboration, exchange of ideas, study and reflection. In these months, we have had more working from home (peaceful study and thought); and more remote meetings (saving time, money, and carbon footprints). The results have been very positive; we need to keep and build on this new organization of our activity, implemented to respond to the Covid emergency.

The times they are a-changin…….

Thus (maybe) the times are changing at the Institute level as well, also concerning the topics of our research activity. I would like to conclude by reporting here a new research topic which brought excellent results.

The Visual Computing (VC) research laboratory has a consolidated expertise in 3D computer graphics and interactive technologies. A few years ago, the VC lab started investigating a relatively new domain, Architectural Geometry, an area of research which combines geometric processing and architecture. This new research domain lies at the core of architectural design and strongly challenges contemporary practice, including the use of modern digital design, structural analysis and fabrication technologies. Several architectural geometry subjects have been studied by the VC lab.

The design of grid shells is one of those activities where the aesthetical value has to be paired with lightness, material-efficiency and fabrication economy, posing engineering challenges related to the material behavior, the global mechanical performance and technical feasibility. Grid shells are discrete single-layer structures that are employed in the realization of complex free-form architectural surfaces. The structural behavior of a grid shell is largely influenced by its underlying tessellation or mesh (a result is presented in the Fig. 1).
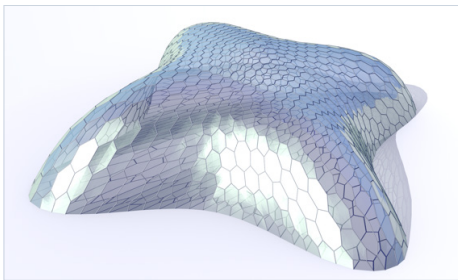

Fig. 1

A second domain of activity deals with the study of tensegrity structures (Fig.2), which are lightweight load-bearing assemblies entirely composed by only two types of elements: struts and cables. The form-finding of these structures is a well-known complex problem, so that most of the existing design methods are based on the repetition of templated modules and are limited to simple shapes.

Conversely, the method proposed creates free-form stable tensegrity configurations that satisfy both fabrication and geometric constraints.

Fig. 2

Moving from form-passive to form-active shapes, the FlexMaps approach explores meta-material computational design to realize challenging free-form bending-active shapes. This approach uses the geometry of modular spiral patterns to achieve any desired flexibility. Once the spiral patches are bent, assembled by hand and tied together the desired shape comes out automatically.

An example of shape designed and fabricated following our FlexMaps approach is the FlexMaps Pavilion (Fig.3), a non-developable twisted-shaped structure. The patches are made out of 20-mm flat plywood and are milled in shop using a CNC cutting machine.

This new activity produced excellent scientific results, published at first-rank venues. Notably, a recognition for the VC lab activity on Architectural Geometry also came from the traditional Architecture community: the FlexMaps Pavilion has been invited to the prestigious 17th International Architecture Exhibition – La Biennale di Venezia 2021, within the Italian Pavilion (22 May-21 November 2021). This is a remarkable success and a milestone for VC Lab.

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Fig. 3

Space debris

Research and development perspectives in the race for sustainable and safe space activities

Space activities are in the midst of an epochal transformation. An enterprise dominated for over half a century, in terms of investments, launches and satellites, by governments and multinational entities is in fact becoming the field of action of a multitude of private companies and operators. Two technological advances, at system level, are making this change viable and very fast: the advent of capable and effective micro and nano-satellites, and the practicability of mega-constellations, comprising several hundreds or thousands of satellites. These relatively recent developments have made the problem of space debris even more urgent; the safe and sustainable use of circumterrestrial space in the long term must be guaranteed.

1978 was a turning point for the emergence of a global awareness of the problem. In January, the Soviet reconnaissance satellite Cosmos 954, equipped with a nuclear reactor, accidentally reentered without control over western Canada, contaminating a large area with radioactive fragments and particulates. In June, Donald J. Kessler and Burton G. Cour-Palais, of NASA, published a seminal paper titled Collision frequency of artificial satellites: The creation of a debris belt, anticipating what later became known as the Kessler Syndrome.

CNUCE, an institute of CNR which later partially merged into ISTI, became involved in reentry predictions of potentially hazardous space objects for the Italian civil protection authorities in 1979, while its involvement in orbital debris analysis and research dates back to the mid-1980s. At that time, a CNUCE researcher was invited as a speaker to the first international workshop on reentry of space debris organized by ESA (1985) and to join the first ESA Space Debris Working Group (1987-1988), which laid the foundations of European activities in this field, defining lines of intervention, research and funding that have been progressively developed and strengthened in the years that have passed since then.

The technical and scientific activities carried out at CNUCE were also instrumental in favoring the admission, in 1998, of the Italian Space Agency (ASI), born from CNR in 1988, in the Inter-Agency Space Debris Coordination Committee (IADC), the main international technical forum of governmental bodies for the coordination of activities related to the issues of human-made and natural debris in space. The primary purpose of the IADC is to exchange information on research activities, to facilitate opportunities for research co-operation, to review the progress of ongoing co-operative actions, and to identify and recommend debris mitigation options.

After many years as an emerging niche theme within the space community, space debris is now gaining a starring role on the stage of space activities. Governments and private operators, civilian and military leaders, business and insurance executives, engineers and scientists, venture capitalists and spin-offs, companies and universities, international organizations and research institutions, investors and lawyers: never, until now, has the topic been so crowded, and by people of such a varied nature. The reason is that not only is so much money at stake, but what risks being questioned is the way, and even the very possibility, of conducting space missions in the relatively near future, at a time when they have become essential to many critical applications.

The global space economy is now valued at around 400 billion euros and its revenue may increase to more than 1000 billion euros by 2040. However, some regions of space are already crowded by operational spacecraft, abandoned satellites and rocket bodies, mission related objects and fragmentation debris, and this overcrowding is now further increasing at an alarming rate due to the launch of a huge number of small satellites and to the deployment of mega-constellations. The U.S. Space Command currently tracks about 32,000 objects in orbit (typically larger than 10 cm), including more than 3,400 active satellites. But during the next 10 years alone, the launch of another 100,000 satellites is planned, which means that the problem can be appreciated even by those who are not experts in orbital dynamics.

This dramatic growth in space activities around our planet will lead to escalating probabilities of catastrophic collisions in orbit and to an enhanced risk of human casualties on earth due to uncontrolled reentries. Trying to deal with and manage this rapidly changing situation, the European involvement has grown a lot in the last fifteen years. Indeed, alongside the decades-long commitment of the European Space Agency and several national governments, the European Union has recognized both the importance of making its growing space infrastructure secure and also that it is largely dependent, in this domain, on the resources and the good will of non-member states.

In 2008, the fifth Space Council meeting confirmed that Europe should develop the capability for the monitoring and surveillance of its space infrastructure and of space debris. It also confirmed that the Union needed to play an active role in the implementation of a space situational awareness system and its governance mechanisms. In Horizon 2020, "space" was identified as a key enabling technology for industrial leadership and competitiveness, stressing the importance of the protection of the space infrastructure and the earth from space hazards, such as orbital debris and uncontrolled reentries.

In 2014, the European Commission, following a decision of the European Parliament and the Council, established the Space Surveillance and Tracking (SST) Support Framework, with the aim of acquiring the independent capability to detect, catalogue and predict the movements of space objects orbiting the earth. Since 2016, the SST Consortium's member states, including Italy, have networked their assets to provide, through
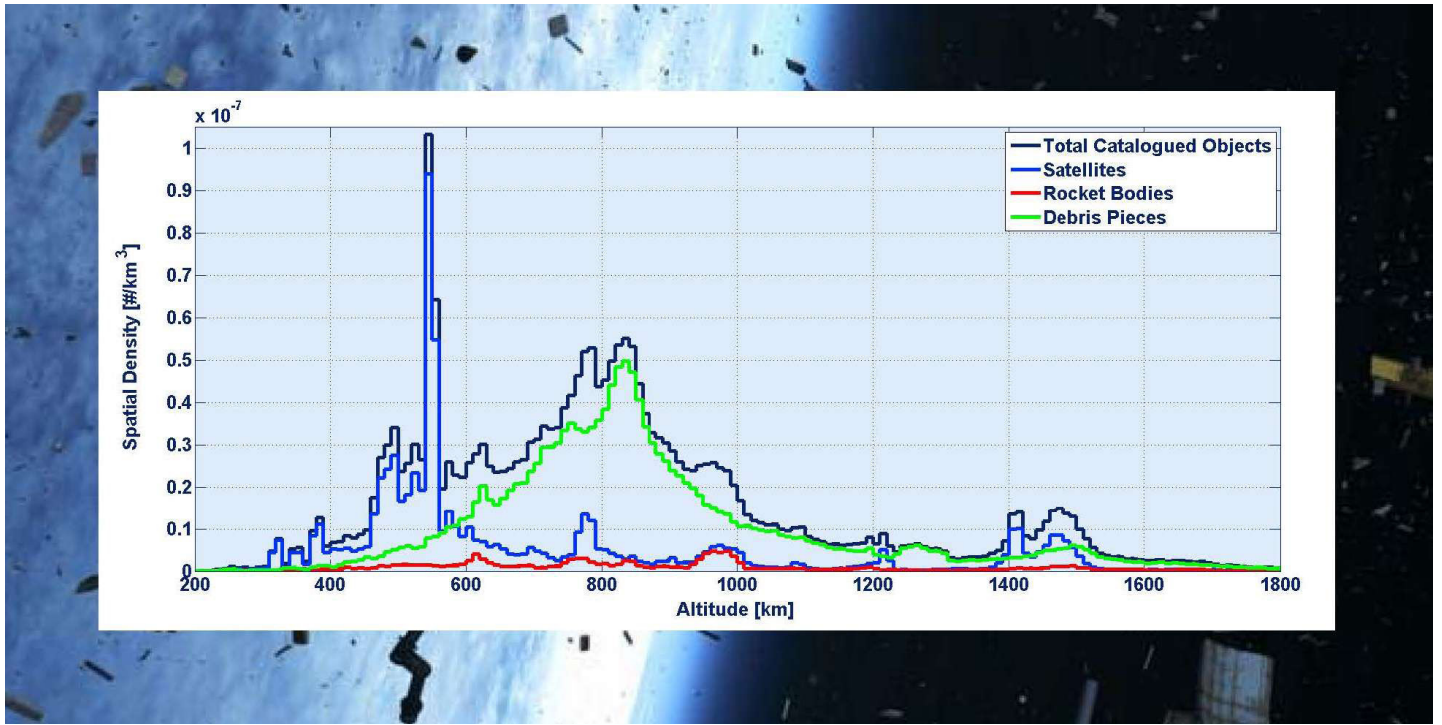
Spatial density of the catalogued objects in orbit below 1800 km, as of 15 March 2021.

the European Union Satellite Centre, a set of SST services to all European Union countries, institutions, spacecraft owners and operators, and civil protection authorities. The current services assess the risk of in-orbit collisions, predict the uncontrolled reentry of large objects into the earth's atmosphere, and try to detect and characterize in-orbit fragmentations.

The new Horizon Europe program will certainly continue to support research, innovation and developments related to the safety and security of space activities, aiming at a clean, responsible and sustainable use of space as a legacy for future generations. The great challenges ahead will probably require research synergy across several disciplines.

For example, the management of the rapidly growing catalogue of tracked orbiting objects will benefit from advanced (distributed) computing and big data; the collision avoidance task will benefit from deep learning, artificial intelligence and automated operations; active debris removal will benefit from emerging enabling technologies and robotics; space surveillance will benefit from new sensor technologies and data analysis techniques. And this is just to name a few of the many possible issues.

It is therefore all too easy to conclude that space debris will offer, in the coming years, many interesting opportunities for research, technological advance and industrial development, including the creation of highly innovative spin-offs, both in Europe and throughout the world. It is truly amazing now to think back to an era, not very long ago, in which all the people who dealt with this topic around the world could be hosted in a large meeting room.

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OpenAIRE-NEXUS

OpenAIRE-Nexus Scholarly Communica ion Services for EOSC users Funded by Horizon 2020
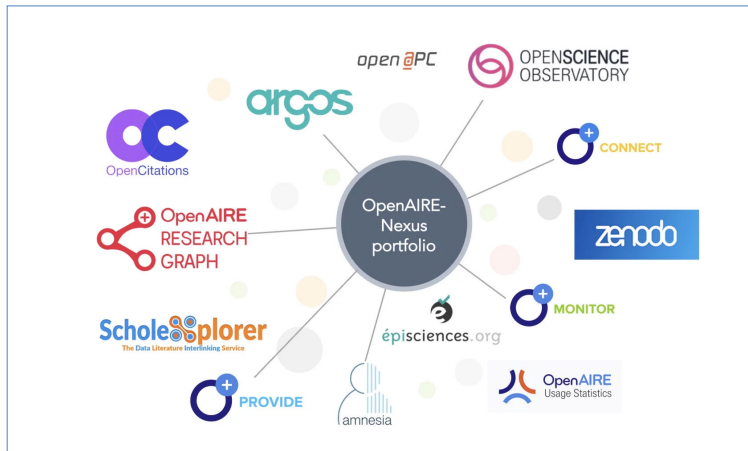
OpenAIRE-Nexus brings a set of services to implement and accelerate Open Science to scientists worldwide, via the European Open Science Cloud (EOSC).

The main objectives are:

- to make it easier for researchers to accept and uptake Open Science practices of openness and FAIRness by embedding these concepts in their workflows; to provide libraries and research communities with the necessary tools to make their content more visible and discoverable;

- to assist policy makers to better understand the impact and ramifications of Open Science in new incentives by proposing scientific reward criteria and impact indicators, thus increasing research and innovation potential;

- to foster innovation by providing SMEs with open data about scientific production.

To this aim, OpenAIRE-Nexus onboards to the EOSC thirteen services, provided by public institutions, e-infrastructures, and companies, structured in three portfolios:

PUBLISH

Zenodo a catch-all publication, data, software repository hosted by CERN.

EpiSciences - a pan-European overlay journal platform, operating on top of OA repositories (e.g. HAL, Zenodo, arXiv), offering free editing of OA journals.

Amnesia - a service to anonymize sensitive research data (GDPR compliant), ready to be embedded in institutional workflows, to remove barriers and facilitate FAIRness of data.

ARGOS - a service for drafting and publishing machine-actionable Data Management Plans.

MONITOR

OpenAIRE Research Graph – one of the largest metadata catalogues world-wide, including publications, data, software, and other research artefacts, interlinked via citations, and linked to researchers, organizations, funders, projects, service providers.

MONITOR Dashboard – providing portals as-a-service to funders, institutions, and EC research infrastructures detailing research throughput, output, collaboration and impact, open science uptake.

OpenCitations - an open database that tracks article-article citations.

ScholExplorer - an open database that tracks article-dataset and dataset-dataset citations.

UsageCounts - an open analytics service aggregating publication-related usage data.

OpenAPC - article and book publishing costs (APC and BPC) from research institutions and funders.

Open Science Observatory - a dashboard for statistics and monitoring information on open science in Europe.

DISCOVER

PROVIDE Dashboard - a bundle of services for content providers to share, validate, and exchange metadata and content using EOSC metadata frameworks and Rules of Participation.

EXPLORE Dashboard - an AI-driven research search engine allowing cross-disciplinary and scientific intent discovery, additionally providing access to the OpenAIRE Research Graph via open APIs.

CONNECT Dashboard - customized discovery gateways for research communities (domain-specific or regional).

The project aims at forming synergies with European e-infrastructures, research infrastructures, Science Clusters, and known scholarly communication services to lead and contribute to the realization of an Open Science interoperability framework for the EOSC, in order to facilitate sharing, monitoring, and discovery of EOSC resources across geographical and disciplinary borders.

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ChAALlenge

Co-funded by Ministry of Economic Development (MISE)

The main goal of ChAALlenge is to improve the quality of life of frail and elderly people in every environment through the Smart Everything Everywhere paradigm. The project aims at:

• anticipating (in order to implement countermeasures) the onset of physical/ health issues that may limit independence;
• enabling distributed and mobile sensing technologies by extending Ambient Assisted Living services beyond the home to provide enhanced and independent mobility for seniors;
• experimenting an age-friendly mobility service that implements the proposed functionalities.

ChAALlenge will investigate the evolution of ambient intelligence systems from detection to prevention through the customization of observation and profiling functionalities.

Signal and image processing methods and techniques will be applied, and innovative approaches of Pattern Recognition and Machine Learning (e.g., Feature Learning) will be evaluated. Particular attention will be given to scene analysis and high-level interpretation of sensory information (e.g., Activity Recognition, Behavior Understanding, Abnormal Event Detection, etc.), such as supervised and unsupervised machine learning methodologies (e.g., Semi/Weakly/ Self-Supervised Learning, Deep/Transfer Learning, Saliency/Attention-based, etc.), machine reasoning (e.g., Role-based, Model-based, Ontology-based, etc.) and computational intelligence (e.g., Bio-Inspired, Evolutionary Computation, Fuzzy Systems, Deep Neural Networks, etc.). Simulations and games that enable automated assessment of sensory and visual-spatial skills will be developed, and a highly personalized user profile (virtual badge) that adapts and updates on the basis of changes that may occur over time will be created.

Home ambient intelligence systems will be integrated with wearable sensors and monitoring systems in public environments, including local public transport. Assisted orientation services providing suggestions/ stimulations as to whether to walk or use public transport will be introduced.

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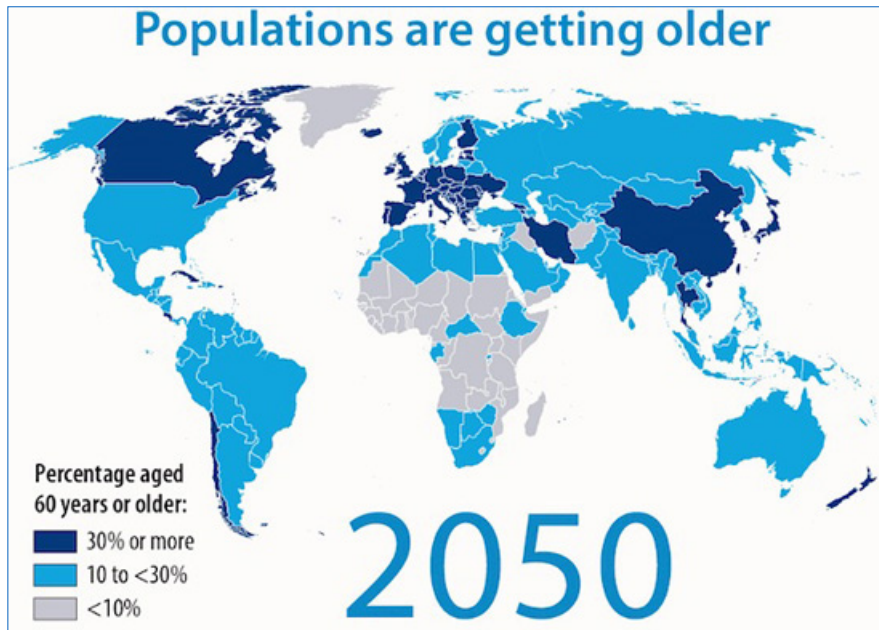
agewyz.com

EOSC-Future

Funded by HORIZON 2020

The vision of EOSC Future is to deliver an operational Platform ('System of Systems') with an integrated execution environment consisting of data, professionally provided services, and open research products and infrastructure that will be accessed and used by European researchers who will be engaged, facilitated, trained and supported to employ the European Open Science Cloud (EOSC) resources and solutions.

The EOSC Future vision is centered around three key tenets: a) the realisation of EOSC-Core and EOSC-Exchange with interoperable data and resources; b) the integration of data and resources from the Science Cluster communities into the EOSC Platform; c) the direct involvement of users in the co-design and implementation of the EOSC Platform.

EOSC is envisioned to create a web of scientific resources that are open and/or Findable, Accessible, Interoperable, and Reusable (FAIR) equipped with suitable services allowing their exploitation. On this respect, EOSC Future will:

• Foster the Open Science vision in Europe, by delivering a paradigm shift in the way scientists can create, share, and reuse open and FAIR data, research services, and other research products;

• Extend the current EOSC model aiming at integrating and exposing the numerous resources available within the scientific community, under a common interoperable platform, by making them discoverable, accessible, and composable.

European researchers will be able to share, access, and analyse open and FAIR data, services, and research products or in general resources from various scientific domains allowing them to reproduce results or combine data for new, potentially cross-disciplinary research activities.

To achieve this, EOSC Future will aggregate services provided by the e-infrastructures OpenAIRE, GEANT, EGI, and EUDAT, the Research Infrastructures, the Science Clusters and research organisations leveraging, enhancing, expanding, integrating, and optimising, where necessary and possible, the outputs of past and current EOSC projects.

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MobiDataLab

MobiDataLab - Labs for prototyping future mobility data sharing solutions
Funded by HORIZON 2020

The High Performance Computing Lab of ISTI is participating in the Horizon 2020 EU Research and Innovation programme by contributing to the 3-year MobiDataLab project, coordinated by AKKA Technologies and launched on February 1st, 2021.

The MobiDataLab project aims to foster digitalisation for mobility stakeholders through the development of a worldwide data sharing culture, starting with Europe. The research programme will help mobility stakeholders to optimize the use of data for the improvement of their operations and services by proposing a replicable methodology and sustainable tools. The MobiDataLab project is based on a continuous co-development of knowledge and technical solutions for data sharing in the transport and mobility sectors. This will be

put into action through problem-solving oriented Living Labs, the collection and analysis of advice and recommendations of experts, and the support of stakeholders like cities/regions/clusters/associations.

These Living Labs will be aided by the incremental construction of a cross-thematic knowledge base, and of a cloud-based service platform, which will coordinate access and usage of data sharing resources.

The MobiDataLab consortium is composed of 10 partners across Europe from various sectors (Industry, Research, Academia, Consultancy and Governance). The consortium shares a common view on

the values and benefits of open data and open-source principles for fostering independence and uptake by communities. The role of the HPC Lab is to participate in the Open Knowledge Base (WP2) and in the Transport Cloud architecture definition (WP4).

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CHARITY

Cloud for Holography and Cross Reality
Funded by Horizon 2020

On January 2021, the H2020 project CHARITY (Cloud for HologrAphy and Cross RealITY) was launched with the aim of leveraging the benefits of intelligent, autonomous orchestration of a heterogeneous set of cloud, edge, and network resources, to create a symbiotic relationship between low and high latency infrastructures that will facilitate the needs of emerging applications.

The project will equip application providers with adaptive, end-to-end lifecycle management tools, and will provide continuous integration and delivery techniques in support. A Virtual Network Function (VNF) repository will be developed to assist applications to benefit from the compute and network continuum management environment.

The key activity of CHARITY will be focused on infusing intelligence at the resource management strategies. The provision of solutions and approaches that enable the efficient and seamless management of heterogeneous computing and network resources will be of paramount importance.

CHARITY has the potentiality to tackle any kind of highly-interactive class of services and applications, and will be validated against a wide class of applications, characterized by extreme levels of interaction and data exchange between the end users and application components, such as Augmented Reality, Virtual Reality and Holography.

In summary, the main outcome of CHARITY will be a community-driven, open source framework consisting of:

• A system for the autonomous orchestration, life cycle management and efficient exploitation of a wide range of compute and network resources, and infrastructures.
• A collection of tools, mechanisms and algorithms enabling the efficient, contextualized and network-aware exploitation of edge resources and application reconfiguration.
• A set of VNFs along with a VNF repository that will support highly interactive applications leveraging tools, technologies and platforms for fields such as big data.

• Tools for application providers to simplify the deployment and management of application components, targeting mainly the needs of SMEs (DevOps automations, specifications, APIs and best practices).

CHARITY is coordinated by Uwe Herzog (EURESCOM) while Tarik Taleb (ICTFICIAL) is serving as technical manager for the project. ISTI-CNR is participating with two of its laboratories: Visual Computing Lab and High Performance Computing Lab, and leads WP3: Energy, data and computational-efficient mechanisms supporting dynamically adaptive and network-aware services.

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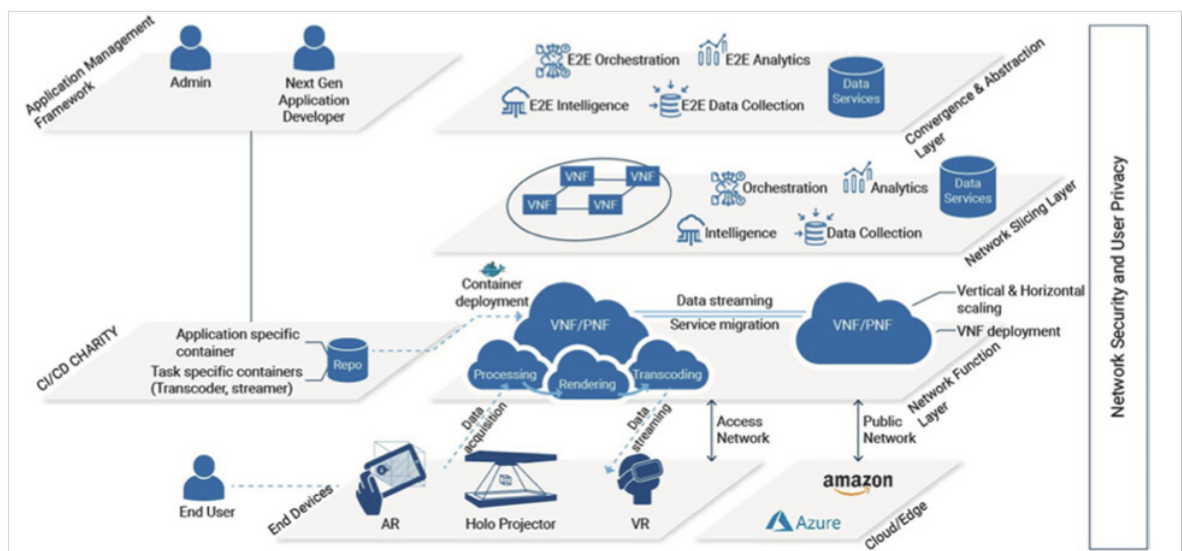
LeADS

Legality Attentive Data Scientists
Funded by Horizon 2020

The emergence of data science has raised a wide range of concerns regarding its compatibility with law, creating the need for experts who combine a deep knowledge of both data science and legal matters. The LeADS project, funded by the EU under the MSCA-ITN-2020 programme, will train early-stage researchers to become legality attentive data scientists (LeADS), a new but much-needed interdisciplinary profession.

An expert in data science and law is expected to work within and across the two disciplines, becoming a leader in bridging scientific skills with the ethical-legal constraints of the operating environment. LeADS will develop a data science capable of maintaining innovative solutions within the borders of the law and of helping to expand legal frontiers in line with the needs of innovation, e.g. by preventing the enactment of technologically unattainable legislation. LeADS research will

define the theoretical framework and the practical implementation of a common language for co-processing and controlling key notions for data scientists and jurists. A comparative and interdisciplinary lexicon will be created that draws experts from both fields to define important crossover concepts. Through a broad inter-sectoral network of academic and non-academic partners, LeADS will provide cross-disciplinary training to ESRs who will work as data scientists, researchers, or managers at private agencies (tech companies, consultancies and legal advisories) and public institutions (research centers, universities and government).

Overall, LeADS research and training aims at changing the regulatory and business approach to information, while training experts able to drive the processes needed by data driven societies.

The project is coordinated by the Scuola Normale Sant'Anna of Pisa. CNR will host an ESR focused on the legal implications of the "provision of personal data" in the exchange of digital content and on investigating how the existing European legal contract framework for the supply of digital content (considering the new proposed EU directive in this field) can coexist with the principles of personal data protection (data minimisation, purpose limitation, etc). A complete list of the available positions is available here: https://euraxess.ec.europa.eu/jobs/619114

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MedicalWasteTreating 4.0

Innovative automated system for the treatment and ennobling of medical waste in an End-of-Waste perspective
Co-funded by POR RS 2020

Medical waste constitutes a significant percentage, over 20%, of special waste produced in Italy for a total of over 140,000 tons per year. Despite this, there are currently no rationalized recovery procedures. The most commonly adopted practice is incineration, using specialized plants, within a predetermined time window (typically equal to 5 days, in the absence of waste refrigeration systems). This disposal method involves high costs for health facilities, a loss of material and a non-negligible environmental impact.

However, due to the presence of large fractions of virgin raw materials, often used for disposable medical devices and other valuable materials, medical waste has considerable potential for inclusion in sustainable and profitable cycles of material regeneration and refinement.

Recent events connected with the Covid-19 pandemic also lead to a deeper reflection concerning waste that may have been exposed to a biological risk. When there is a health emergency, even traditional waste produced by infected people can represent a significant risk for the community and special mechanisms for its treatment are necessary. In such situations, we can witness an exponential growth in waste. Therefore, there is a need to develop and rationalize alternative and sustainable strategies for managing medical waste, which are scalable in the event of health emergencies.

The MedicalWasteTreating 4.0 project fully recognizes these needs, going far beyond the provisions of the law and clearly surpassing the national and international state of the art. MedicalWasteTreating 4.0 proposes an integrated system for the treatment and ennobling of medical waste in an end-of-waste philosophy: the expected outcome, therefore, is not so much the conversion of medical waste into a less dangerous class of waste, but rather the identification of paths that enable sanitary waste to lose the qualification of waste, transforming it into new valuable raw material.

Identifying such paths with characteristics of sustainability and scalability would represent an absolute novelty, prospecting a radical change of perspective in the processes of medical waste management.

The foundations for the feasibility this proposal have been identified in the convergence of technological developments in three areas of industrial interest, namely advanced materials, advanced automation and ICT.

ISTI-CNR will concentrate its efforts in the project by contributing to advanced automation aspects in parallel with innovative ICT-based solutions; this activity will intervene in numerous points of the design activities. Systems based on advanced sensors and artificial intelligence will assist operators in the primary sorting phases, supporting them in their choices and reducing possible human error. In addition, an information system will grant holistic tracking and the integrity of the processes. Furthermore, the physical prototype development will be accompanied hand in hand by the creation of a digital twin, according to the Internet of Things (IoT) and cyber-physical paradigms. Among other features, the twin will provide forecasting models for predictive maintenance and post-market surveillance.

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LIFE DeMo

Low Impact Fully Enanched DEsign MOdeling for modern housing
Co-funded by POR RS 2020

With a very good evaluation score among the proposals in response to the call for "Strategic Research and Development Projects" of the Toscana region (POR-FESR 2014-2020), the CNR-ISTI-participated project Low-Impact Fully Enhanced Design Modeling for Modern Housing (LIFE DeMo) has been funded with € 850,000 vis-à-vis a total investment of about € 2,500,000. The project consortium is led by Siram-Veolia, a large company devoted to limiting the environmental effects of human activities through a multi-faceted expertise in very diverse fields. Besides CNR-ISTI, three SMEs based in Toscana form the partnership: "Vivere il Legno", active in timber construction, Thermocasa, specializing in water and heating systems, and Elettro D, developing and deploying sustainable energy and domotic systems.

Within 2022, LIFE DeMo will be studying and experimenting best practices for the integrated design of buildings and technological facilities aimed at satisfying the needs of the real users rather than the ones of supposedly "average" people. This entails a series of new approaches to design, as well as choice of materials and construction practices, in the light of the recent European and National rules and the standard Building Information Modeling (BIM), which provides various computer-assisted tools to manage a building throughout its entire lifecycle. ISTI's Center for Living Quality Technologies (TQV), a unit of the Signals and Images Laboratory, features a longtime expertise in these fields, conducting research, training and technology transfer towards professionals, companies and institutions.

An important part of the project is a real, completely autonomous, zero-emission demonstrator building, being currently designed and to be located within the premises of the CNR campus in Pisa. This "LIFE" demonstrator will be equipped with advanced facility management and assistive technologies, but its cost is expected to be comparable to the current prices in the building market. A "digital twin" of it will be developed, useful to foresee the effects of all the maintenance and repair interventions, thus helping management, reduction of off-duty periods and energy consumption monitoring. LIFE will survive the financed project, and will be used for the normal activities of TQV as well as to provide a platform for future collaborations with interested companies and institutions.

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projects?layout=edit&id=222

The project partners attending the project press conference.

Smart Converting 4.0

Artificial intelligence at the service of advanced automation, integration and security of tissue and nonwoven converting assembly lines
Co-funded by POR RS 2020

Converting represents a very relevant segment of activity within the paper industry. The raw materials processed include tissue paper and a wide range of nonwoven fabric. The converting business area is currently characterized by a high degree of technological and competitive turbulence, depending both on the evolution of international markets and the technologies incorporated in the plants. In recent years, the converting assembly lines have been progressively equipped with elements of automation to optimize the processes employed, acting mainly at the single machine level. However, the potential for Industry 4.0 philosophy and technologies in the converting sector is still largely unexplored. The Smart Converting 4.0 R&D project aims to fill the gap by developing disruptive technology to create innovative tissue and nonwoven converting lines that are more "intelligent", automated, integrated, reliable

and also safer than the current national and international state of the art. To this end, the project, coordinated by Futura Converting -a global leader in the converting domain- will introduce Artificial Intelligence (AI) as an ubiquitous methodology to promote the development of innovative solutions based on advanced automation and collaborative robotics. The aim is to maximize self-regulation capacities, and the interaction and increased safety of assembly lines, as well as optimizing their predictive maintenance systems.

The new prototypes that will be designed and developed will also be produced as digital twins and will offer innovative features, anticipating emerging demands in the international market. A holistic integration of the production and converting lines (corresponding with the principles of the fourth industrial revolution) will be provided, thus

obtaining a sustainable competitive advantage in the long-term.

The ISTI-CNR team is mainly involved in the study of models for Acoustic AI. These models will be deployed either locally and in the cloud, in line with the AI as a Service (AIaaS) paradigm. Besides contributions to the creation of digital twins, another activity will regard the development of intelligent agents for processing indoor trajectories (recorded by a Ultra Wide Band localization system) with the ultimate goal of providing advanced safety and social distancing features in the work environment.

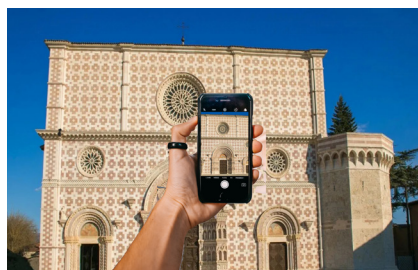**Contact: Davide Moroni, SI Lab**
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http://si.isti.cnr.it/index.php/hid-project-category-list/209-project-smartconverting

EXTENSION

Co-funded by ESA

The purpose of EXTENSION, co-funded by the ESA (European Space Agency) and coordinated by Carsa S.r.l, is to create an end-to-end service for the City of L'Aquila that enables users to acquire more information on places, monuments, churches, and artworks, thanks to AR (Augmented Reality) and through the accurate and detailed localization that the next-gen satellites constellation will provide. For example, tourists will be able to point their smartphone at the Basilica di Santa Maria di Collemaggio and see 3D animations in AR that describe it in an engaging way. These functionalities will be achieved by combining visual object recognition, artificial intelligence, and 3D augmented reality visualization with access to databases

containing information on and descriptions of cultural heritage artefacts in the city. They will be obtained using smart communication devices of the latest generation. With this operating mode, the 5G network will be used in downlink to transfer content from remote repositories to computational nodes and to transfer information with low latency from the devices to the nodes. The system can be used outside in ar-

eas of cultural interest or inside museums. In this case, it will work as a sort of smart audio guide where, simply pointing the device at the object of interest, for example, a painting or a statue, a multimedia presentation in AR is triggered. This platform for engagement with cultural heritage in augmented reality can also be used to provide tourists with the opportunity to access cultural itineraries with a gaming paradigm. Urban games can be organized as visual treasure hunts in augmented reality, following a paradigm like that used in successful games such as Pokemon Go or Minecraft Earth.

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TiAssisto

Solutions for the clinical monitoring of Covid-19 positive patients, with or without associated chronic diseases and frailty situations, in trustee isolation at home
Co-funded by Bando Ricerca COVID-19 Regione Toscana

TiAssisto is a research and development project that aims at the design, development, and validation of an innovative and intelligent service platform to improve early diagnosis and quality of life in Covid-19 patients who may also have multiple chronic pathologies.

The platform will be based on telemedical solutions to enable high-quality treatment, using ICT and Artificial Intelligence technologies to reduce hospital access drastically.

TiAssisto will provide:

- integrated services for healthcare professionals, including telemonitoring, signal and image processing, notification;

- clinical decision support based on artificial intelligence algorithms, knowledge extraction and inference on clinical data;

- algorithms to evaluate cardiac and lung echo images acquired directly at the patient's home.

A group of randomized patients will be followed at home using the telemedicine platform and teleconsultation facilities. Vital parameters will be monitored daily via medical devices used by the patients themselves, relatives or caregivers. Automatic notifications will advise patients and alert doctors, appropriately.

A virtual panel, accessible via the Web from the doctor's office and powered by machine learning methods, will provide real-time status information about patients displayed in order of severity.

The TiAssisto platform will allow integration between the data already held by general practitioners and that acquired through the telemedicine platform, in line with the Tuscany Region's health system and its electronic health records. TiAssisto will go beyond mere data aggregation by proposing an Intelligent Clinical Decision Support System and Artificial Intelligence algorithms to interpret ultrasound images automatically.

This project will contribute to research and create a sustainable and self-financing service for the public health system.

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SPaCe

Smart Passenger Center
Co-funded by POR RS 2020

The SPaCe project proposes a multimodal supervision and mobility orchestration solution, using artificial intelligence to provide operators and transport authorities with advanced passenger flow management tools. This proposal would make it possible to satisfy, easily and in real time, the various social distancing and public collection requirements that have arisen in public transport due to the Covid-19 pandemic. Thanks to big data management and machine learning, SPaCe offers operators greater control of the distribution and flow of passengers on vehicles and in stations, and also improves forecasting capabilities. This equates with the ability to anticipate and check passenger density and operations in real time, adapting vehicle frequency, capacity and number, as well as passenger flow. The combination of the SPaCe solution with demand optimizes operating conditions, including costs, and is particularly useful for managing fluctuating pressure, such as during peak hours or with special events or particular mobility restrictions. The implementation of SPaCe aggregates information on passenger data from sensors already installed on board the vehicle (e.g. weight sensors), ticket and validating machines, traffic signs, management systems, surveillance cameras and mobile networks, in order to provide a real-time picture of passenger flows. "To foresee is to prevent" and SPaCe's ability to analyze millions of pieces of data in real time makes it an indispensable ally for operators at all times, but above all in the current context. SPaCe is based on four main functions: multimodal supervision, traffic management, coordination of operations, and predictive analysis. These functions are highly configurable and can be combined according to the needs of the operators in the environment of the global mobility network. SPaCe acquires data from information and control systems through secure connections. It is flexible, scalable and adaptable to different transport networks of any size. It can be extended to include new lines or additional means of transport.

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NAUSICAA

NAUtical Safety by means of Integrated Computer-Assistance Appliances
Co-funded by POR RS 2020

The NAUSICAA 4.0 projects aim at creating a system for medium and large boats in which conventional control, propulsion, and thrust systems are integrated with a series of latest generation sensors, such as lidar systems, cameras, radar, marine drones, and aircraft, in order to provide complementary assistance during navigation and mooring. The idea is to develop a solution aimed at increasing safety in the nautical sector through the development, integration, and validation of innovative technologies for the reconstruction and visualization of the surrounding environment.

In recent years, a series of new technologies have become available at affordable costs but are not yet used on a large scale in the nautical sector. The goal of the proposed system is to provide a realistic view of the external nautical environment during operations carried out by the command station. The data and information collected will be made available in contextualized mode to the different maneuvering activities of the vessel and visualized through specific human-machine interfaces based on Augmented Reality and Virtual Reality technologies. The system will assist the crew in mooring maneuvers, man overboard actions, seabed monitoring, and general boat safety.

The project coordinator, TEAM Italia, has been operating globally for over 20 years within the mega and maxi yachting sector, specializing in the integration and functional optimization of navigation, telecommunications, security, and data transmission equipment. The other partners are Genesys, AM Testing, ISTI-CNR, and the University of Pisa.

Two ISTI laboratories are involved: Artificial Intelligence for Media and Humanities, responsible for vision; Visual Computing, responsible for augmented reality.

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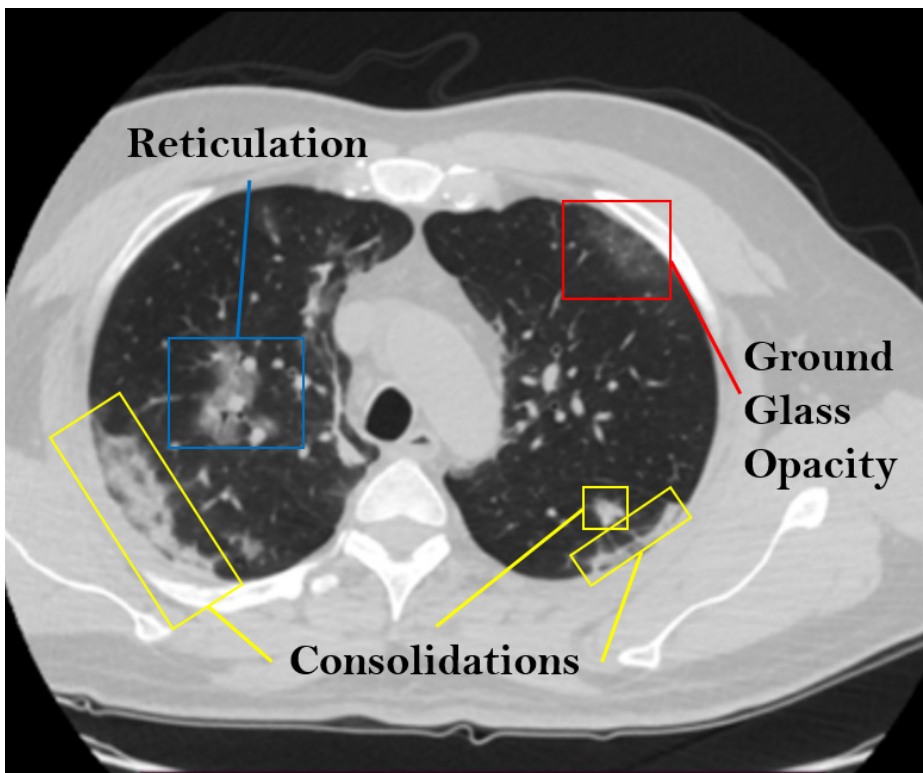fabrizio.falchi@isti.cnr.it

OPTIMISED

Co-funded by Bando Ricerca COVID-19 Regione Toscana

The uniqueness and complexity of the SARS-CoV-2 disease pose many challenges to the clinical care and management of COVID-19 patients. Many hospitals have struggled to find effective approaches to treat the infected, as they lacked tools to predict the evolution and the impact of the disease. The diagnostic test based on the detection of the viral RNA (RiboNucleic Acid) by real-time

Centro), clinical and laboratory evaluation has been coupled with a standard chest X-ray, whilst in other sites, as for instance the University Hospital of Pisa, patients were also subjected to a chest computed tomography and a lung ultrasound exam. These diverse diagnostic approaches have jeopardized the collection of data at the regional level, thus evidencing the need for a careful

of COVID-19 patients, based on a careful analysis of retrospective imaging and clinical data. The analysis will serve to determine the potential and the limits of the different imaging techniques employed and will assess the role of innovative blood parameters. The knowledge acquired during the project will lead to a prognostic model based on risk stratification. This will be formalized in recommendations for healthcare professionals for the most suitable patient management procedures.

The OPTIMISED path will be easily exportable to other hospitals in both Tuscany and the rest of Italy, thus supporting the management of current peaks in COVID-19, and also increasing preparedness for eventual future pandemics.


The project is coordinated by Radiodiagnostica 2 of the Azienda Ospedaliera Pisana and involves ISTI-CNR, IFC-CNR, University of Pisa and the University of Florence. ISTI-CNR contributes with a team of researchers from the Signals & Images Lab, who will work to design and train deep learning models to segment and label computed tomographic images of COVID-19 patients (see Figure). The SI Lab team will also contribute to the radiomics analysis of the imaging data and to the definition of the risk stratification model.

PCR does not provide any information on the severity and the effects. In addition, the lack of "solid" information on the pathology has led to fragmented and uneven patient management. In some sites, such as the Emergency Department of the central Tuscany Health Agency (Azienda USL Toscana

analysis of the most effective procedures with respect to the clinical manifestation of the disease and a subsequent homogeneity of approach.

In this complex scenario, OPTIMISED aims at creating a path to manage the data flow

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Discovering location based services: a unified approach for heterogeneous indoor localization systems

F. Furfari, A. Crivello, P. Baronti, P. Barsocchi, M. Girolami, F. Palumbo, D. Quezada-Gaibor, G.M Mendoza Silva, J. Torres-Sospedra
Internet of Things, vol. 13. Elsevier, 2021.

The technological solutions and communication capabilities offered by the Internet of Things paradigm, in terms of raising availability of wearable devices, the ubiquitous internet connection, and the presence on the market of service-oriented solutions, have allowed a wide proposal of Location Based Services (LBS). In a close future, we foresee that companies and service providers will have developed reliable solutions to address indoor positioning, as basis for useful location based services. These solutions will be different from each other and they will adopt different hardware and processing techniques. This paper describes the
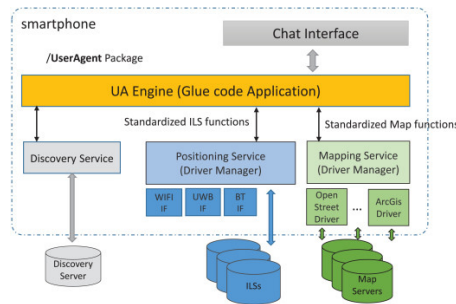
User Agent abstract architecture.

proposal of a unified approach for Indoor Localization Systems that enables the cooperation between heterogeneous solutions and their functional modules. To this end,

we designed an integrated architecture that, abstracting its main components, allows a seamless interaction among them. Finally, we present a working prototype of such architecture, which is based on the popular Telegram application for Android, as an integration demonstrator. The integration of the three main phases –namely the discovery phase, the User Agent self-configuration, and the indoor map retrieval/rendering– demonstrates the feasibility of the proposed integrated architecture.

Floor identification in large-scale environments with wi-fi autonomous block models

W. Shao, H.Luo, F.Zhao, H. Tian, J. Huang, A. Crivello
IEEE Transactions on Industrial Informatics. IEEE, 2021.
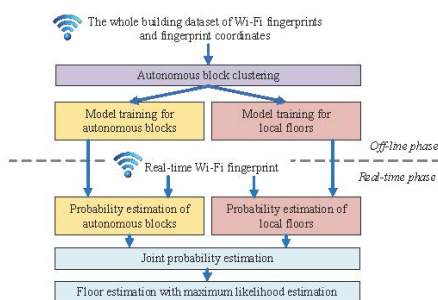
Overview of the proposed system.

Wi-Fi is the technology most adopted for smartphone-based floor identification in multi-storey context, due to its widespread deployment. Despite several Wi-Fi based methods for floor identification have been proposed, they have mainly been examined

in small experimental scenarios and, generally, their accuracies levels drop significantly when applied in real large-scale environments. The main challenge emerges when the complexity of Wi-Fi signals on the same floor exceeds the complexity between the floors along the vertical direction, leading to a reduced floor distinguishability. A second challenge regards the complexity of Wi-Fi features in complicated and large-scale environments, including hollow areas and crowded signal channels. To achieve accurate floor identification in these environments, we propose an adaptive Wi-Fi based floor identification algorithm. We have conducted extensive experiments in a real large-scale building greater

than 60,000 m2. Experimental results confirm that our proposal exhibits remarkable improvement in accuracy, robustness, and heterogeneous device adaptability.
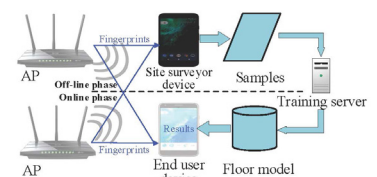
The data flow of off-line and online phases.

Natural language processing for requirements engineering: a systematic mapping study

L. Zhao, W. Alhoshan, A. Ferrari, K.J. Letsholo, M.A. Ajagbe, E.V. Chioasca, R.T. Batista-Navarro
ACM Computing Surveys, vol. 54. ACM, 2021.

Natural Language Processing for Requirements Engineering (NLP4RE) is an area of research and development that seeks to apply natural language processing (NLP) techniques, tools, and resources to the requirements engineering (RE) process, to support human analysts to carry out various linguistic analysis tasks on textual requirements documents, such as detecting language issues, identifying key domain concepts, and establishing requirements traceability links. This article reports on a mapping study that surveys the landscape of NLP4RE research to provide a holistic understanding of the field. Following the guidance of systematic review, the mapping study is directed by five research questions, cutting across five aspects of NLP4RE research, concerning the state of the literature, the state of empirical research, the research focus, the state of tool development, and the usage of NLP technologies. Our main results are as follows: (i) we identify a total of 404 primary studies relevant to NLP4RE, which were published over the past 36 years and from 170 different venues; (ii) most of these studies (67.08%) are solution proposals, assessed by a laboratory experiment or an example application, while only a small percentage (7%) are assessed in industrial settings; (iii) a large proportion of the studies (42.70%) focus on the requirements analysis phase, with quality defect detection as their central task and requirements specification as their commonly processed document type; (iv) 130 NLP4RE tools (i.e., RE specific NLP tools) are extracted from these studies, but only 17 of them (13.08%) are available for download; (v) 231 different NLP technologies are also identified, comprising 140 NLP techniques, 66 NLP tools, and 25 NLP resources, but most of them—particularly those novel NLP techniques and specialized tools—are used infrequently; by contrast, commonly used NLP technologies are traditional analysis techniques (e.g., POS tagging and tokeniza-tion), general-purpose tools (e.g., Stanford CoreNLP and GATE) and generic language lexicons (WordNet and British National Corpus). The mapping study not only provides a collection of the literature in NLP4RE but also, more importantly, establishes a structure to frame the existing literature through categorization, synthesis and conceptualization of the main theoretical concepts and relationships that encompass both RE and NLP aspects. Our work thus produces a conceptual framework of NLP4RE. The framework is used to identify research gaps and directions, highlight technology transfer needs, and encourage more synergies between the RE community, the NLP one, and the software and systems practitioners. Our results can be used as a starting point to frame future studies according to a well-defined terminology and can be expanded as new technologies and novel solutions emerge.
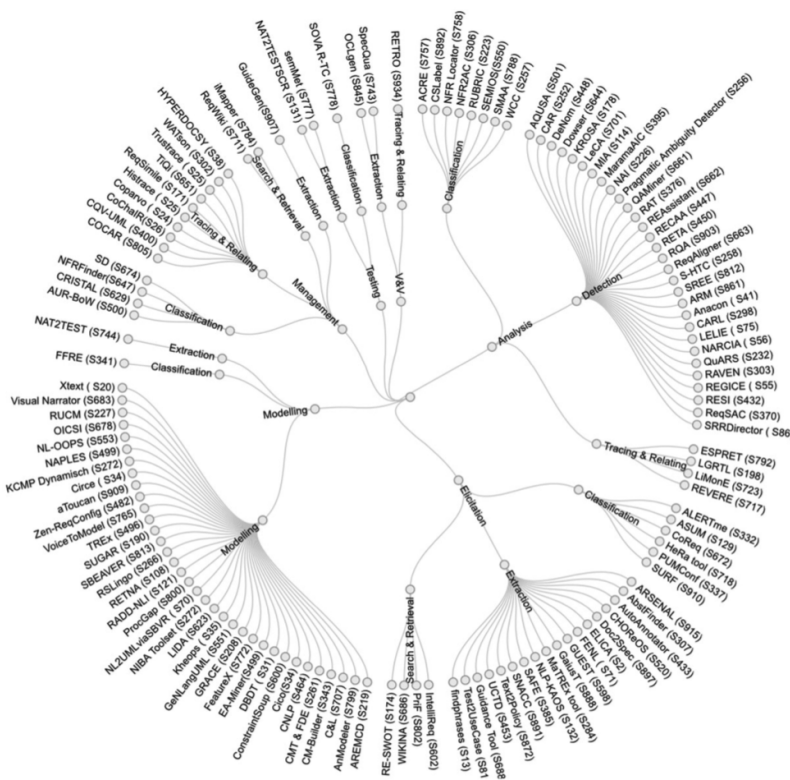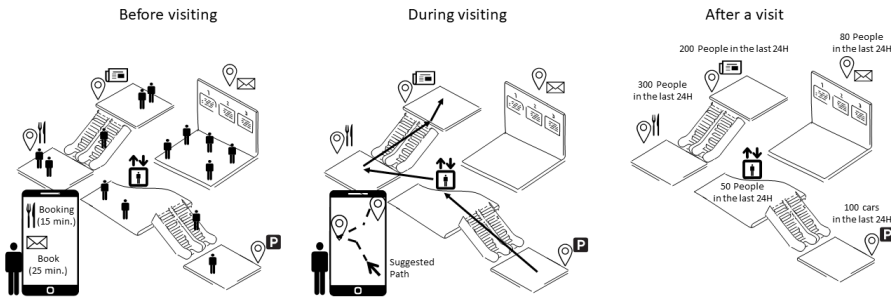
The 130 NLP4RE tools clustered by NLP4RE tasks and then by RE phases.

COVID-19 & privacy: enhancing of indoor localization architectures towards effective social distancing

P. Barsocchi, A. Calabrò, A. Crivello, S. Daoudagh, F. Furfari, M. Girolami, E. Marchetti

How information about social distance can be used before, during and after visiting a generic indoor environment.

The way people access services in indoor environments has dramatically changed in the last year. The countermeasures to the COVID-19 pandemic imposed a disruptive requirement, namely preserving social distance among people in indoor environments. We explore in this work the possibility of adopting the indoor localization technologies to measure the distance among users in indoor environments. We discuss how information about people's contacts collected can be exploited during three stages: before, during, and after people access a service. We present a reference architecture for an Indoor Localization System (ILS), and we illustrate three representative use-cases. We derive some architectural requirements, and we discuss some issues that concretely cope with the real installation of an ILS in real-world settings. In particular, we explore the privacy and trust reputation of an ILS, the discovery phase, and the deployment of the ILS in real-world settings. We finally present an evaluation framework for assessing the performance of the architecture proposed.

A survey of field-based testing techniques

A. Bertolino, P. Braione, G. De Angelis, L. Gazzola, F. Kifetew, L. Mariani, M. Orrù, M. Pezzè, R. Pietrantuono, S. Russo, P. Tonella

Field testing refers to testing techniques that operate in the field to reveal those faults that escape in-house testing. Field testing techniques are becoming increasingly popular with the growing complexity of contemporary software systems. In this paper, we present the first systematic survey of field testing approaches over a body of 80 collected studies, and propose their categorization based on the environment and the system on which field testing is performed. We discuss four research questions addressing how software is tested in the field, what is tested in the field, which are the requirements, and how field tests are managed, and identify many challenging research directions.
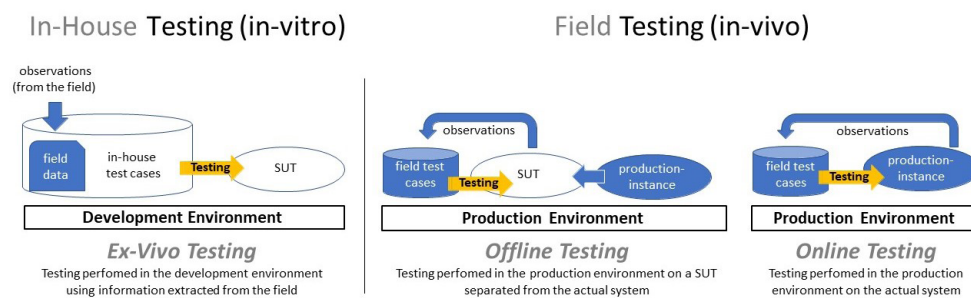
Classes of field testing approaches.

Enhancing sustainability of the railway infrastructure: trading energy saving and unavailability through efficient switch heating policies

S. Chiaradonna, G. Masetti, F. Di Giandomenico, F. Righetti, C. Vallati
Sustainable Computing: Informatics and Systems, vol. 30. Elsevier, 2021.

Railway is currently envisioned as the most promising transportation system for both people and freight to reduce atmospheric emission and combat climate change. In this context, ensuring the energy efficiency of the railway systems is paramount in order to sustain their future expandability with minimum carbon footprint. Recent advancements in computing and communication technologies are expected to play a significant role to enable novel integrated control and management strategies in which heterogeneous data is exploited to noticeably increase energy efficiency. In this paper, we focus on exploiting the convergence of heterogeneous information to improve energy efficiency of railway systems, in more detail on the heating system for the railroad switches, one of the major energy intensive components. To this aim, we define new policies to efficiently manage the heating of these switches exploiting also external information such as weather and forecast data.

In order to assess the performance of each strategy, a stochastic model representing the structure and operation of the railroad switch heating system and environmental conditions (both weather profiles and specific failure events) has been developed and exercised in a variety of representative scenarios. The obtained results allow to understand both strengths and limitations of each energy management policy, and serves as a useful support to make the choice of the best technique to employ to save on energy consumption, given the system conditions at hand.
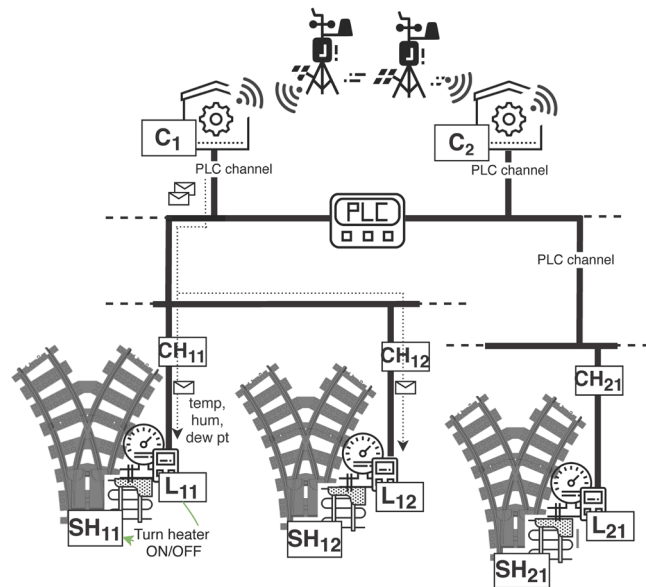
High level organization of the considered railroad switch heating system.
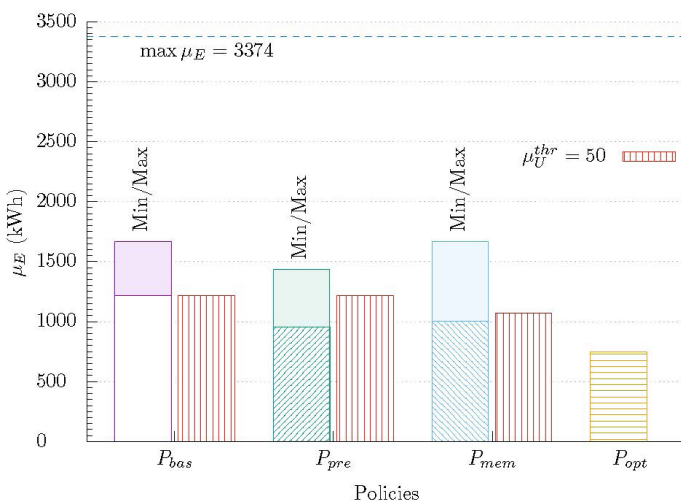
Energy consumption without unavailability constraints (minimum and maximum) and when μ^{thr}_U is min for the different policies and the weather scenario (0, 1, 1, 10).

Word-class embeddings for multiclass text classification

A. Moreo, A. Esuli, F. Sebastiani
Data Mining and Knowledge Discovery, vol 35. Springer, 2021.

Pre-trained word embeddings encode general word semantics and lexical regularities of natural language, and have proven useful across many NLP tasks, including word sense disambiguation, machine translation, and sentiment analysis, to name a few. In supervised tasks such as multiclass text classification (the focus of this article) it seems appealing to enhance word representations with ad-hoc embeddings that encode task-specific information. We propose (super-vised) word-class embeddings (WCEs), and show that, when concatenated to (unsuper-vised) pre-trained word embeddings, they substantially facilitate the training of deep-learning models in multiclass classification by topic. We show empirical evidence that WCEs yield a consistent improvement in multiclass classification accuracy, using six popular neural architectures and six widely used and publicly available datasets for multiclass text classification. One further advantage of this method is that it is conceptually simple and straightforward to implement. Our code that implements WCEs is publicly available at https://github.com/AlexMoreo/word-class-embeddings.

Solving the same-different task with convolutional neural networks

N. Messina, G. Amato, F. Carrara, C. Gennaro, F. Falchi
Pattern Recognition Letters, vol. 143. Elsevier, 2021.
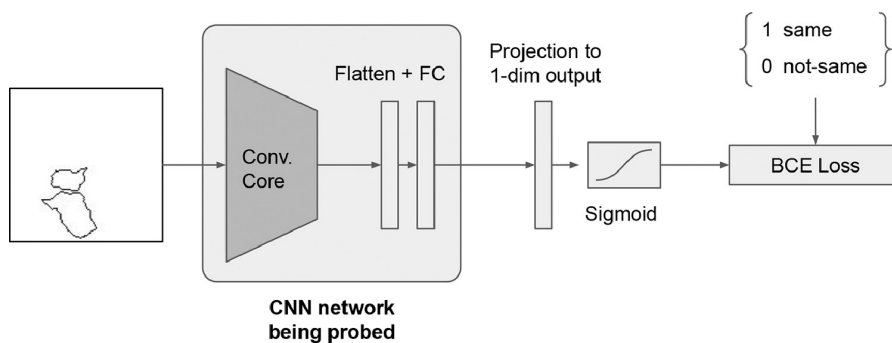
Overview of the network for training on the same-different problems. The architecture of the network in the large light-gray box depends on the specific convolutional network being probed. It is usually composed of a core built of CNN layers plus final FC layers with ReLU activations outputting a fixed-sized vector. We linearly project the output to a single scalar value using a single FC layer. We then normalize this value in the range (0, 1) with a sigmoid activation function before computing the Binary Cross-Entropy (BCE) loss.

Deep learning demonstrated major abilities in solving many kinds of different real-world problems in computer vision literature. However, they are still strained by simple reasoning tasks that humans consider easy to solve. In this work, we probe current state-of-the-art convolutional neural networks on a difficult set of tasks known as the same-different problems. All the problems require the same prerequisite to be solved correctly: understanding if two random shapes inside the same image are the same or not. With the experiments carried out in this work, we demonstrate that residual connections, and more generally the skip connections, seem to have only a marginal impact on the learning of the proposed problems. In particular, we experiment with DenseNets, and we examine the contribution of residual and recurrent connections in already tested architectures, ResNet-18, and CorNet-S respectively. Our experiments show that older feed-forward networks, AlexNet and VGG, are almost unable to learn the proposed problems, except in some specific scenarios. We show that recently introduced architectures can converge even in the cases where the important parts of their architecture are removed. We finally carry out some zero-shot generalization tests, and we discover that in these scenarios residual and recurrent connections can have a stronger impact on the overall test accuracy. On four difficult problems from the SVRT dataset, we can reach state-of-the-art results with respect to the previous approaches, obtaining super-human performances on three of the four problems.
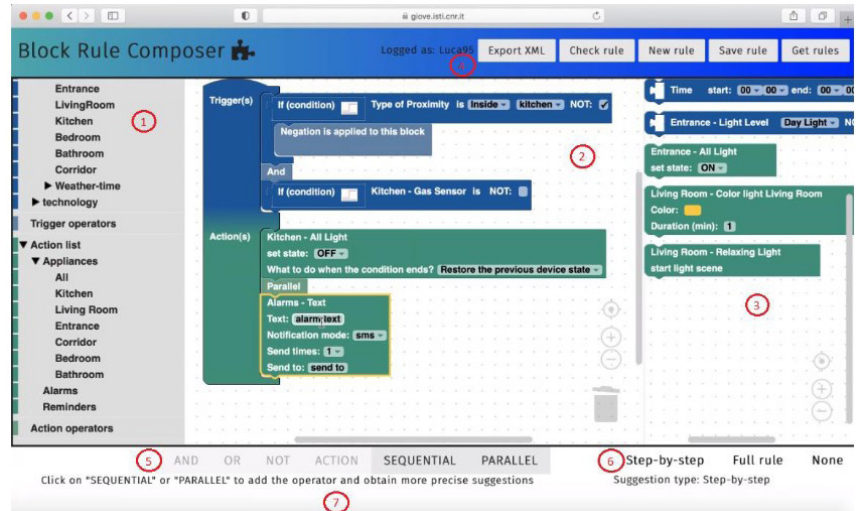
Recommendations for creating trigger-action rules in a block-based environment

A. Mattioli, F. Paternò
Behaviour & Information Technology. Taylor&Francis, 2021.

Given the growing adoption of Internet of Things (IoT) technologies, several approaches have been presented to enable people to increase their control over their smart devices and provide relevant support. Recommendation systems have been proposed in many domains, but have received limited attention in the area of End-User Development (EUD). We propose a novel approach for formulating recommendations in this area, based on deconstructing trigger-action rules into sequences of elements and the links between them. For this purpose, we propose a solution inspired by methods aimed at addressing the sequence-prediction problem. We have used this approach to provide users with two different types of recommendations: full rules for the one being edited, and parts of rules relevant for the next step to take in order to complete the current rule editing. In this paper, we present the design and a first evaluation of the

The main interface of the application with a rule under composition.

two different possibilities to generate and display recommendations in a block-based EUD environment for creating automations for IoT contexts.

DOI: 10.1080/0144929X.2021.1900396

Remote monitoring of end-user created automations in field trials

M. Manca, F. Paterno, C. Santoro
Journal of Ambient Intelligence and Humanized Computing. Springer, 2021.
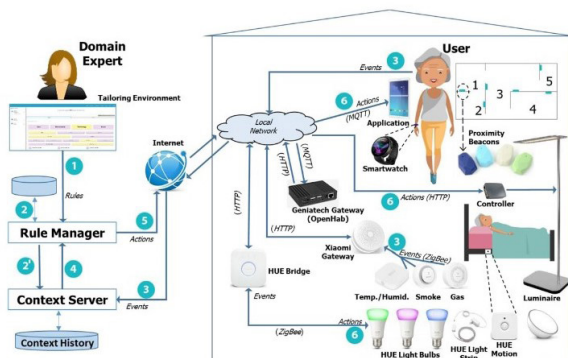
Platform configuration used in deployment.

This paper presents how the TAREME (Trigger-Action Rule Editing, Monitoring, Executing) platform provides support for executing and analysing personalized automations in Internet of Things scenarios. The platform allows the creation and execution of trigger-action personalization rules that can change the state of connected smart objects and de-

vices, send alarms or reminders, and modify applications' state depending on contextual events. This paper focuses on how the platform supports analytics about the actual use of the rules and provides associated information, which can be useful to better understand users' personalization needs. Such features have been deployed in a first round of six trials, which have shown the feasibility of the approach and reported fruitful feedback.

DOI: 10.1007/s12652-021-03239-0

ReLock: a resilient two-phase locking RESTful transaction model

L. Frosini, P. Pagano, L. Candela, M. Simi, C. Bernardeschi
Service Oriented Computing and Applications, vol. 15. Springer, 2021.
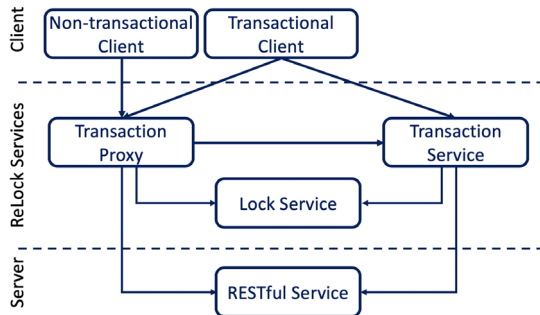
ReLock Transaction Model Architecture.

is gaining momentum thanks to its features making it suitable for cloud computing and microservices-based contexts. This paper introduces ReLock, a resilient RESTful transaction model introducing general purpose transactions on RESTful services by a layered approach and a two-phase locking mechanism not requesting any change to the RESTful services involved in a transaction.

Service composition and supporting transactions across composed services are among the major challenges characterizing service-oriented computing. REpresentational State Transfer (REST) is one of the approaches used for implementing Web services that

An intelligent and cost-effective remote underwater video device for fish size monitoring

G. Coro, M. Bjerregaard Walsh
Ecological Informatics, vol. 63. Elsevier, 2021.

Monitoring the size of key indicator species of fish is important to understand ecosystem functions, anthropogenic stress, and population dynamics. Standard methodologies gather data using underwater cameras, but are biased due to the use of baits, limited deployment time, and short field of view. Furthermore, they require experts to analyse long videos to search for species of interest, which is time consuming and expensive. This paper describes the Underwater Detector of Moving Object Size (UDMOS), a cost-effective computer vision system that records events of large fishes passing in front of a camera, using minimalistic hardware and power consumption. UDMOS can be deployed underwater, as an unbaited system, and is also offered as a free-to-use Web Service for batch video-processing. It embeds three different alternative large-object detection algorithms based on deep learning, unsupervised modelling, and motion detection, and can work both in shallow and deep waters with infrared or visible light.
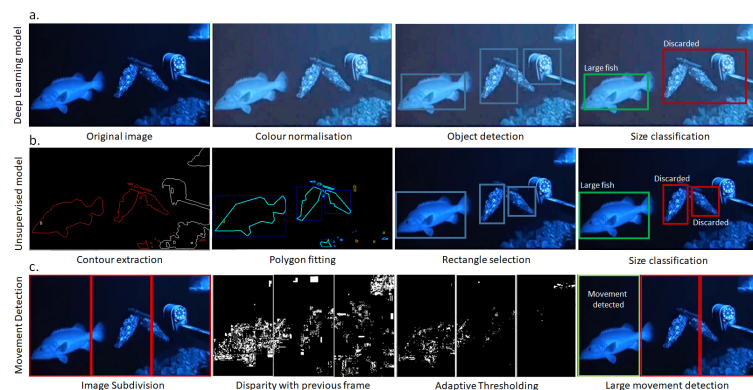
Comparison between the three workflow variants of our methodology to detect large fishes: a) Deep Learning-based object detection pipeline with distance and size classification; b) Unsupervised model with distance and size classification; and c) movement detection model with temporal adaptive threshold.

NLPHub: an e-infrastructure-based text mining hub

G. Coro, G. Panichi, P. Pagano, E. Perrone
Concurrency and Computation: Practice and Experience, vol. 33. Wiley, 2021.

Text mining involves a set of processes that analyze text to extract high-quality information. Among its large number of applications, there are experiments that tackle big data challenges using complex system architectures. However, text mining approaches are neither easy to discover and use nor easily combinable by end-users. Furthermore, they should be contextualized within new approaches to science (eg, Open Science) that ensure longevity and reuse of methods and results. This article presents NLPHub, a distributed system that orchestrates and combines several state-of-the-art text mining services that recognize spatiotemporal events, keywords, and a large set of named entities. NLPHub adopts an Open Science approach, which fosters the reproducibility, repeatability, and reusability of methods and results, by using an e-Infrastructure supporting data-intensive Science. NLPHub adds Open Science-compliance to the connected services through the use of representational standards for services and computations. It also manages heterogeneous service access policies and enables collaboration and sharing facilities. This article reports a performance assessment based on an annotated corpus of named entities, which demonstrates that NLPHub can improve the performance of the single-integrated processes by cleverly combining their output.

Web interface of the NLPHub. The top image reports the initial selection panel, where the user indicates the text or file to process and the annotations to detect. The lower image reports the result, with all the detected annotations highlighted with colors in the right-hand side panel. The words corresponding to the selected annotation are highlighted in the text in the left-hand panel. By pressing the "Algorithms" bar, the methods that identified the selected annotation are highlighted and can be selectively disabled together with their related annotations.

Psycho-acoustics inspired automatic speech recognition

G. Coro, F.V. Massoli, A. Origlia, F. Cutugno
Computers & Electrical Engineering, vol. 93. Elsevier, 2021.

Understanding the human spoken language recognition process is still a far scientific goal. Nowadays, commercial automatic speech recognisers (ASRs) achieve high performance at recognising clean speech, but their approaches are poorly related to human speech recognition. They commonly process the phonetic structure of speech while neglecting supra-segmental and syllabic tracts integral to human speech recognition. As a result, these ASRs achieve low performance on spontaneous speech and require enormous costs to build up phonetic and pronunciation models and catch the large variability of human speech. This paper presents a novel ASR that addresses these issues and questions conventional ASR approaches. It uses alternative acoustic models and an exhaustive decoding algorithm to process speech at a syllabic temporal scale (100-250 ms) through a multi-temporal approach inspired by psycho-acoustic studies. Performance comparison on the recognition of spoken Italian numbers (from 0 to 1 million) demonstrates that our approach is cost-effective, outperforms standard phonetic models, and reaches state-of-the-art performance.
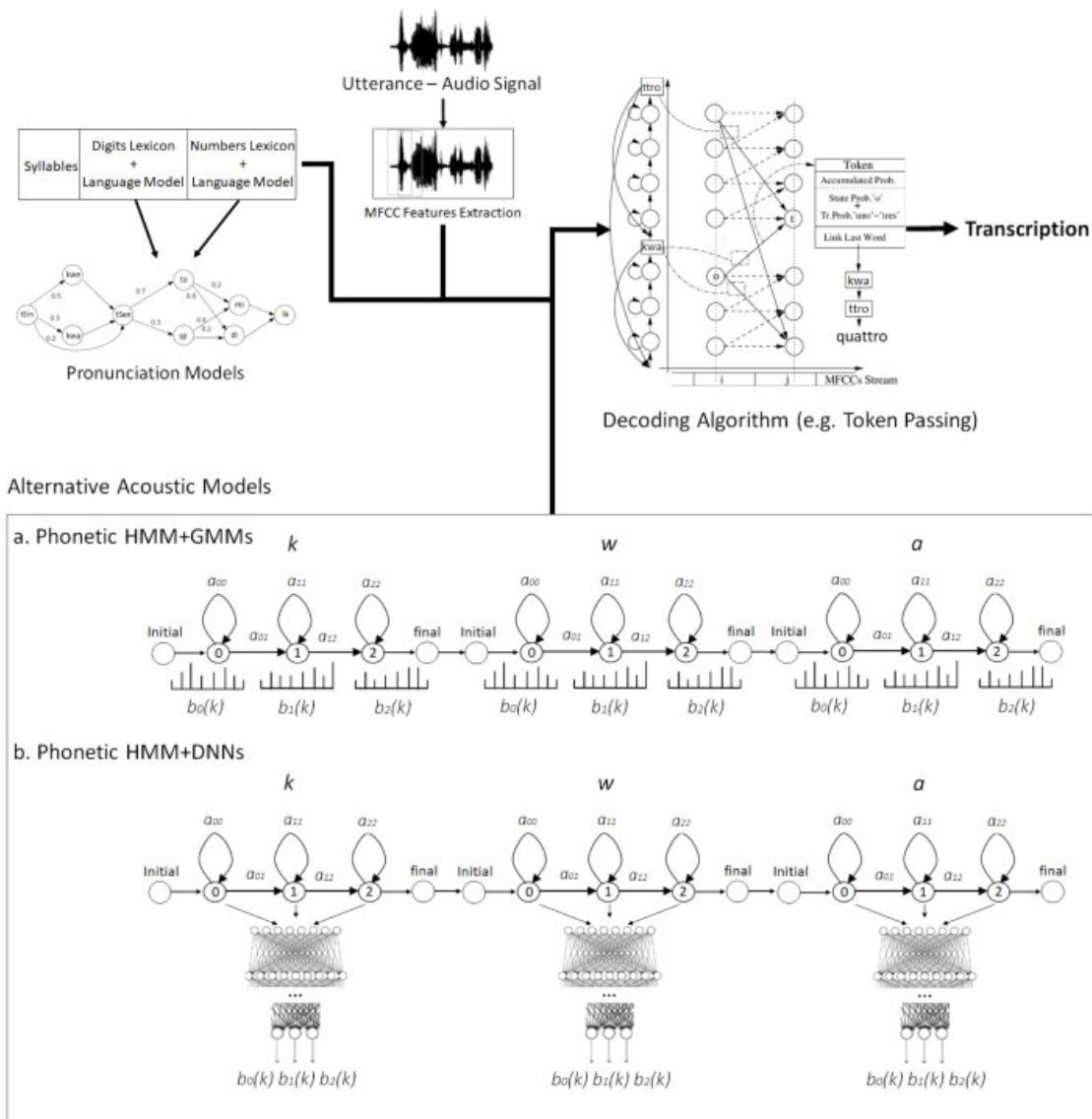
Diagram of a standard ASR with alternative acoustic models: (a) tri-phonetic HMMs using GMM emission probabilities, (b) tri-phonetic HMMs using a DNN to simulate emission probabilities.

GLocalX - from local to global explanations of black box AI models

M. Setzu, R. Guidotti, A. Monreale, F. Turini, D. Pedreschi, F. Giannotti
Artificial Intelligence, vol. 294. Elsevier, 2021.

Artificial Intelligence (AI) has come to prominence as one of the major components of our society, with applications in most aspects of our lives. In this field, complex and highly nonlinear machine learning models such as ensemble models, deep neural networks, and Support Vector Machines have consistently shown remarkable accuracy in solving complex tasks. Although accurate, AI models often are "black boxes" which we are not able to understand. Relying on these models has a multifaceted impact and raises significant concerns about their transparency. Applications in sensitive and critical domains are a strong motivational factor in trying to understand the behavior of black boxes. We propose to address this issue by providing an interpretable layer on top of black box models by aggregating "local" explanations. We present GLocalX, a "local-first" model agnostic explanation method. Starting from local explanations expressed in form of local decision rules, GLocalX iteratively generalizes them into global explanations by hierarchically aggregating them. Our goal is to learn accurate yet simple interpretable models to emulate the given black box, and, if possible, replace it entirely. We validate GLocalX in a set of experiments in standard and constrained settings with limited or no access to either data or local explanations. Experiments show that GLocalX is able to accurately emulate several models with simple and small models, reaching state-of-the-art performance against natively global solutions. Our findings show how it is often possible to achieve a high level of both accuracy and comprehensibility of classification models, even in complex domains with high-dimensional data, without necessarily trading one property for the other. This is a key requirement for a trustworthy AI, necessary for adoption in high-stakes decision making applications.

Conformity: a path-aware homophily measure for node-attributed networks

G. Rossetti, S. Citraro, L. Milli
IEEE Intelligent Systems, vol. 36. IEEE, 2021.
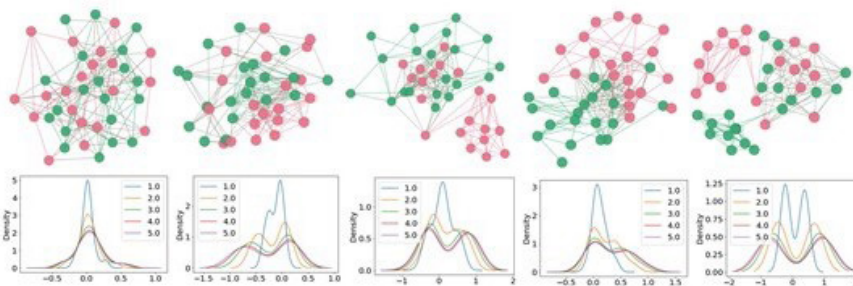
Peel's quintet toy example. KDE's distributions of several local mixing patterns according to Conformity, for different values of a: the higher the value, the less the contribution of distant nodes to the target final score—as shown by the progressive amplification of the distributions toward close-to-bound values.

Unveiling the homophilic/heterophilic behaviors that characterize the wiring patterns of complex networks is an important task in social network analysis, often approached studying the assortative mixing of node attributes. Recent works have underlined that a global measure to quantify node homophily necessarily provides a partial, often deceiving, picture of the reality. Moving from such literature, in this work, we propose a novel measure, namely Conformity, designed to overcome such limitation by providing a node-centric quantification of assortative mixing patterns. Different from the measures proposed so far, Conformity is designed to be path-aware, thus allowing for a more detailed evaluation of the impact that nodes at different degrees of separations have on the homophilic embeddedness of a target. Experimental analysis on synthetic and real data allowed us to observe that Conformity can unveil valuable insights from node-attributed graphs.

Rank/Select queries over mutable bitmaps

G.M. Pibiri, S. Kand

The problem of answering rank/select queries over a bitmap is of utmost importance for many succinct data structures. When the bitmap does not change, many solutions exist in the theoretical and practical side. In this work we consider the case where one is allowed to modify the bitmap via a flip (i) operation that toggles its i-th bit.

Our solution to the problem builds on two main ingredients: (1) a space- efficient bitmap index that leverages SIMD instructions and other optimizations for fast query evaluation, and (2) efficient algorithms to solve the problem of rank/select over small, immutable, bitmaps. Regarding point (1), we adapt and extend a recent result about the b-ary Segment-Tree, and show that SIMD is very effective to search and update the data structure. We describe two variants of the data structure, tailored for both the widespread AVX2 instruction set and the new AVX-512 one. As per point (2), we review, extend, and compare all existing approaches to perform rank/select over small bitmaps (e.g., 256 and 512 bits). These approaches include broadword techniques, intrinsics, SIMD instructions, or a combination of them. The results of the comparison may be of independent interest and relevant to other problems.

The best results for the two previous points are then combined to tune a mutable bitmap data structure with support for rank/select queries, with the aim of establishing new reference trade-offs. Compared to the state-of-the-art, our solution is faster and consumes a negligible amount of extra space. We also compare the data structure against several other solutions for the immutable setting: our data structure is competitive with the fastest indexes and takes less space, while allowing clients to alter the bitmap as needed.
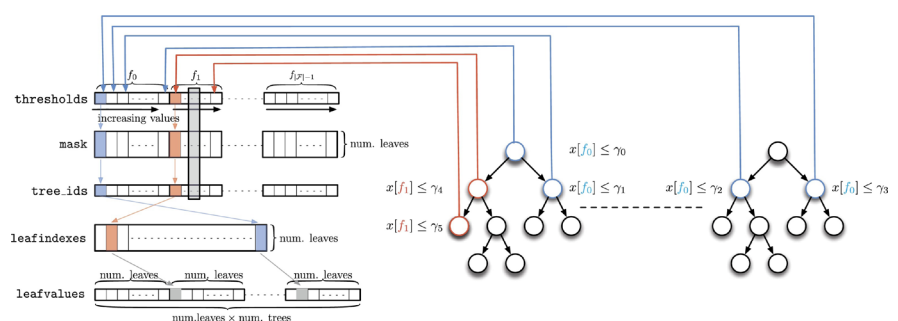
Efficient traversal of decision tree ensembles with FPGAs

R. Molina, F. Loor, V. Gil-Costa, F. M. Nardini, R. Perego, S. Trani

Field Programmable Gate Arrays (FPGAs) provide a hardware acceleration technology that can be rapidly deployed and tuned, thus providing a flexible solution adaptable to specific design requirements and to changing demands. In this paper, we present three System-on-Chip (SoC) FPGA designs for speeding-up inference tasks based on machine-learned ensembles of decision trees. We focus on QuickScorer, the state-of-the-art algorithm for the efficient traversal of tree ensembles and present the issues and the advantages related to its deployment on two SoC FPGA devices with different capacities.

Data layout of the QS algorithm.

The results of the experiments conducted using publicly available datasets show that the proposed SoC implementations achieve nearly constant execution times as we increase the number of instances predicted until the capacities of the hardware resources are reached and the memory available is saturated. Similarly, also the number of trees in the ensemble impacts only slightly the inference time. Scaling on both these dimensions is very important when the inference has to be performed on very large batches of items and large ensemble models have to be used for prediction accuracy. Our solution provides almost constant and predictable inference time can thus impact application scenarios (e.g., Web or product search, social media ranking or recommendation, on-line advertisement, etc.) where engineers have to satisfy strict and contrasting requirements on latency, prediction accuracy and hardware cost.

A system for neuromotor based rehabilitation on a passive robotic aid

M. Righi, M. Magrini, C. Dolciotti, D. Moroni
Sensors, vol. 21. MDPI, 2021.

The body of the passive robotic arm called Track-Hold.

In the aging world population, the occurrence of neuromotor deficits arising from stroke and other medical conditions is expected to grow, demanding the design of new and more effective approaches to rehabilitation. In this paper, we show how the combination of robotic technologies with progress in exergaming methodologies may lead to the creation of new rehabilitation protocols favoring motor re-learning. To this end, we introduce the Track-Hold system for neuromotor rehabilitation based on a passive robotic arm and integrated software. A special configuration of weights on the robotic arm fully balances the weight of the patients' arm, allowing them to perform a purely neurological task, overcoming the muscular effort of similar free-hand exercises. A set of adaptive and configurable exercises are proposed to patients through a large display and a graphical user interface. Common everyday tasks are also proposed for patients to learn again the associated actions in a persistent way, thus improving life independence. A data analysis module was also designed to monitor progress and compute indices of post-stroke neurological damage and Parkinsonian-type disorders. The system was tested in the lab and in a pilot project involving five patients in the post-stroke chronic stage with partial paralysis of the right upper limb, showing encouraging preliminary results.

Integrating wearable haptics and obstacle avoidance for the visually impaired in indoor navigation: a user-centered approach

F. Barontini, M.G. Catalano, L. Pallottino, B. Leporini, M. Bianchi
IEEE Transactions on Haptics, vol. 14. IEEE, 2021.

Recently, in the attempt to increase blind people autonomy and improve their quality of life, a lot of effort has been devoted to develop technological travel aids. These systems can surrogate spatial information about the environment and deliver it to end-users through sensory substitution (auditory, haptic). However, despite the promising research outcomes, these solutions have met scarce acceptance in real-world. Often, this is also due to the limited involvement of real end users in the conceptual and design phases. In this manuscript, we propose a novel indoor navigation system based on wearable haptic technologies. All the developmental phases were driven by continuous feedback from visually impaired persons. The proposed travel aid system consists of a RGB-D camera, a processing unit to compute visual information for obstacle avoidance, and a wearable device, which can provide normal and tangential force cues for guidance in an unknown indoor environment. Experiments with blindfolded subjects and visually impaired participants show that our system could be an effective support during indoor navigation, and a viable tool for training blind people to the usage of travel aids.

The use of saliency in underwater computer vision: a review

M. Reggiannini, D. Moroni

Underwater survey and inspection are tasks of paramount relevance for a variety of applications. They are usually performed through the employment of optical and acoustic sensors installed aboard underwater vehicles, in order to capture details of the surrounding environment. The informative properties of the data are systematically affected by a number of disturbing factors, such as the signal energy absorbed by the propagation medium or diverse noise cate-gories contaminating the resulting imagery. Restoring the signal properties in order to exploit the carried information is typically a tough challenge. Visual saliency refers to the computational modeling of the preliminary perceptual stages of human vision, where the presence of conspicuous targets within a surveyed scene activates neurons of the visual cortex, specifically sensitive to mean-ingful visual variations. In relatively recent years, visual saliency has been exploited in the field of automated underwater explora-tion. This work provides a comprehensive overview of the computational methods im-plemented and applied in underwater com-puter vision tasks, based on the extraction of visual saliency-related features.

The natural frequencies of masonry beams

M. Girardi

The measurement of ambient vibrations has become a standard procedure in Civil En-gineering. In fact, these vibrations contain
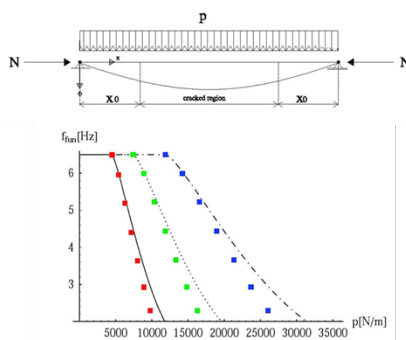
Fundamental frequency of the beam vs. the magnitude of the transverse load, for different values of the normal force. The boxes represent the FE simulation.

precious information on both the structural behaviour and the health status of buildings. Moreover, the dynamical properties mea-sured via vibration tests can allow estimating the mechanical properties and the boundary conditions of such structures, while long-term measurements can help revealing the onset of structural damage, through damage detection procedures: in fact, modal proper-ties are damage-sensitive features.

With regard to heritage masonry structures, the assumption of linear elasticity, which usually underlies the study of their ambient vibrations, may lead to errors. In fact, such structures are unable to withstand large tensile stresses and are usually affected by crack patterns. These nonlinear effects have in general a non negligible influence on the structural stiffness and should not be disre-garded in the analysis: the dynamical behav-iour of these structures should be analyzed taking into account the existing cracks.

The present paper aims at analytically eval-uating the natural frequencies of cracked slender masonry elements. The problem is dealt with in the framework of linear per-turbation, and the small oscillations of these structures are studied under loaded condi-tions, after the equilibrium for permanent loads has been achieved. A masonry beam element made of masonry-like material is considered, and some explicit expressions of the beam's fundamental frequency as a function of the external loads and the ampli-tude of imposed deformations are derived. The analytical results are validated via finite element analysis, by using a beam element equipped with cubic polynomial shape func-tions.

Many empirical formulations have been proposed to evaluate the fundamental fre-quency of masonry towers and buildings. Nevertheless, the simple case presented in the paper turns out to be of interest, since at the best of the Author's knowledge the literature do not furnish yet explicit expres-sions to estimate the effects of cracking on the modal properties of masonry structures.

Augmented virtuality using touch-sensitive 3D-printed objects

G. Palma, S. Perry, P. Cignoni
Remote Sensing, vol. 13. MDPI, 2021.

Virtual reality (VR) technologies have become more affordable and popular in the last five years thanks to hardware and software advancements. A critical issue for these technologies is finding paradigms that allow user interactions in ways that are as similar as possible to the real world, bringing physicality into the experience. Current literature has shown, with different experiments, that the mapping of real objects in virtual reality alongside haptic feedback significantly increases the realism of the experience and user engagement, leading to Augmented Virtuality.

(Left) Photos of the hardware of the system: HTC Vive, LeapMotion, Vive Tracker, the 3D-printed support with the replica that hosts the controller for capacitive touch sensing. (Right) Example of a painting session.

This paper presents a system to improve user engagement in a VR experience using physical copies of 3D scanned authentic artifacts. The physical copies are made with low-cost 3D fabrication technologies, which allow the inexpensive production of multiple copies. The proposed VR system is based on a combination of off-the-shelf hardware components and custom electronic circuitry connected by specially developed software libraries. In particular, we use a commercial HMD (HTC Vive) and its extension for the tracking of real objects (ViveTracker) integrated with a consumer device for real-time hand tracking (LeapMotion) and a custom electronic controller for capacitive touch sensing to transform the 3D-printed replica into a tangible interactive user interface. The proposed setup gives the user the possibility to interact in a new way with the virtual environment and the physical replica.

The approach allows seeing more faithfully the original artefact's appearance, thanks to the rendering quality of the HMD, overcoming the current limitations of low-cost 3D fabrication technologies. Moreover, with its real-time hand tracking and capacitive touch sensing, the system detects when and where the user touches the replica. This system permits the creation of virtual experiences where the user, with their hands, can change the virtual appearance of the object using a set of personalization actions selectable from a physical 3D-printed palette (Figure 1), such as, for example, to paint over the object surface or to attach additional virtual objects.

To summarize, the most important result in our work is the design and implementation of an innovative, touch-enabled 3D-printed interface, using off-the-shelf components and low-cost custom electronics, that is easy to integrate into VR applications. The paper describes the technical design of the system, highlighting the strong points and the limitations. Up to now, no other devices allow physical interaction with accurate 3D printing replicas in VR, computing when and where the user touches the replica surface. Then, we present a simple cultural heritage application based on the virtual personalization of 3D printing replicas. Its goal is to create a feeling of the object being "theirs" to transfer the sense that these artefacts are creative and malleable pieces of material culture. The proposed system offers users new creative experiences that interact with physical 3D-printed artefacts while seeing the appearance of these artefacts true to their original form.

Photo of the devices made for the three test objects and rendering of their VR counterparts.
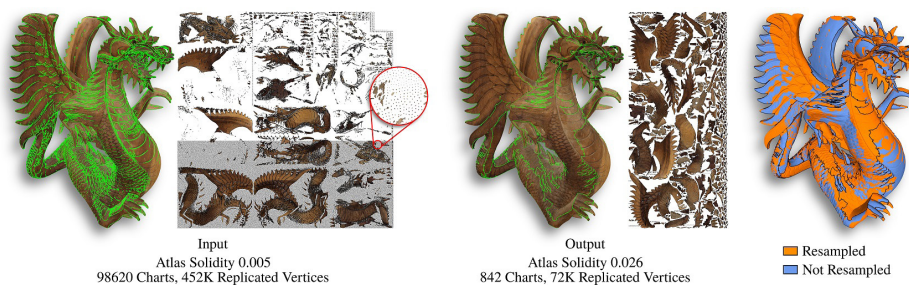
Texture defragmentation for photo-reconstructed 3D models

A. Maggiordomo, P. Cignoni, M. Tarini
Computer Graphics Forum, vol. 40. Wiley, 2021

We propose a method to improve an existing parametrization (UV-map layout) of a textured 3D model, targeted explicitly at alleviating typical defects afflicting models generated with automatic photo-reconstruction tools from real-world objects.

known issues such as rendering artifacts when texture filtering is enabled, poor performance when compressing and storing the texture images, increased GPU memory to render the 3D model due to the large number of replicated vertices required to encode the existing texture seams, among others.

and their high resolution leads to large geometric optimization instances and excessive running times. Moreover, synthesizing the texture images for the newly computed map resamples the signal everywhere, leading to unnecessary degradation as this process is unaware of the original texture samples distribution on the object surface.

Input
Atlas Solidity 0.005
98620 Charts, 452K Replicated Vertices

Output
Atlas Solidity 0.026
842 Charts, 72K Replicated Vertices

■ Resampled
■ Not Resampled

Our algorithm takes as input a textured 3D model (left), and iteratively merges texture charts to reduce the UV-map fragmentation (middle), leveraging the existing parametrization to minimize and possibly avoid resampling artifacts in the output map.
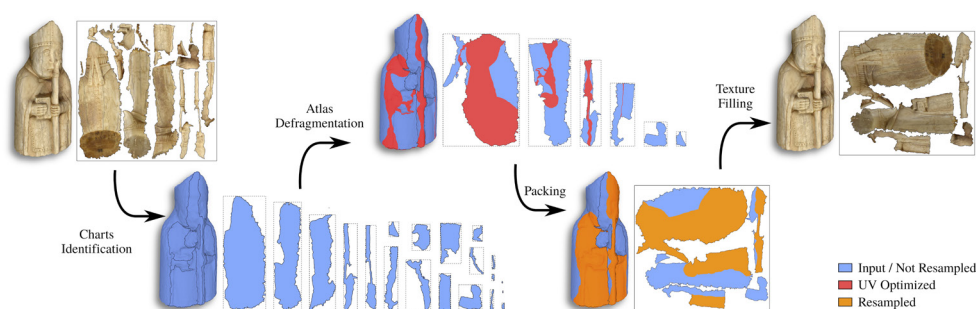
This class of 3D data is becoming increasingly important thanks to the growing popularity of reliable, ready-to-use photogrammetry software packages. The resulting textured models are richly detailed, but their underlying parametrization typically falls short of many practical requirements for further manipulation or fruition in downstream applications. In particular, the photo-reconstructed UV-maps are generally decomposed into a large number of charts, aggravating well-

Producing a completely new and improved UV-map with standard mesh parameterization techniques and then resampling a new texture image is often neither practical nor desirable. In particular, the geometric quality and complexity of these models make them unsuitable for both automatic and manual parametrization. Photogrammetry meshes typically exhibit inconsistencies that break assumptions on the input geometry and topology made by parametrization algorithms,

In contrast, our method improves the existing UV-map instead of replacing it, balancing the reduction of the mapping fragmentation with signal degradation due to resampling, while also avoiding oversampling of the original signal. Our approach avoids recomputing the parametrization whenever possible and leverages this to avoid resampling large portions of the input texture by constraining the rotation and placement of the charts in the new layout.

The proposed approach is fully automatic and extensively tested on a large benchmark of photo-reconstructed models; quantitative evaluation evidences a drastic and consistent improvement of the mappings.

Charts
Identification

Atlas
Defragmentation

Packing

Texture
Filling

■ Input / Not Resampled
■ UV Optimized
■ Resampled

Overview of our method. We begin by extracting the charts from an input textured model, then iteratively merge them by optimizing a small area in neighborhood of the fused boundaries (in red). Then, we detect and repack the texture atlas, striving to limit the necessary resampling in the following texture filling phase (orange areas are resampled, blue areas are grid-preserving [RNLL10] and copied verbatim from the original).

Sounding the atmospheric density at the altitude of LARES and Ajisai during Solar Cycle 24
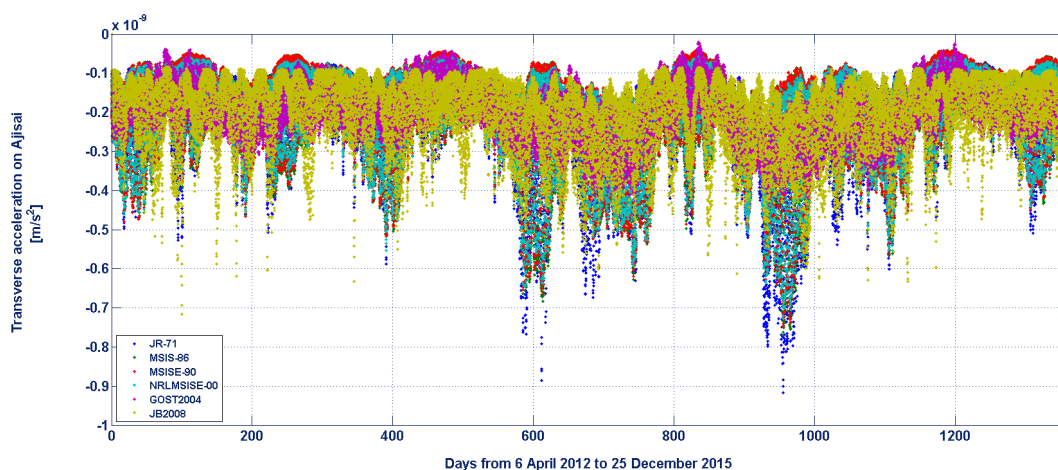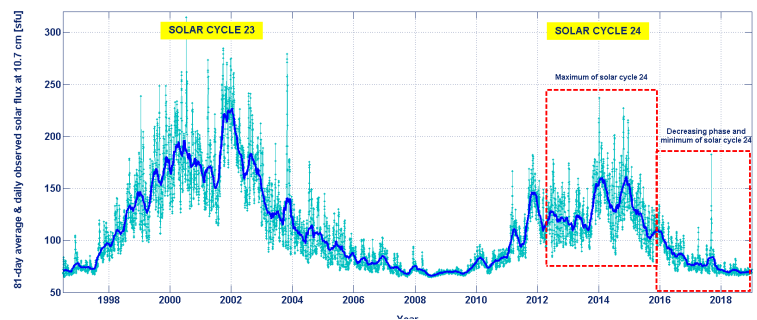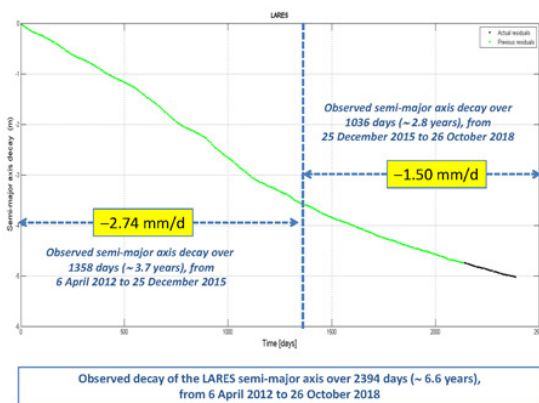
C. Pardini, L. Anselmo, D.M. Lucchesi, R. Peron, M. Bassan, C. Magnafico, G. Pucacco, M. Visco

During Solar Cycle 24, the passive spherical satellites LARES and Ajisai, placed in nearly circular orbits with mean geodetic altitudes between 1450 and 1500 km, were used as powerful tools to probe the neutral atmosphere density and the performances of six thermospheric models in orbital regimes for which the role of dominant atomic species is contended by hydrogen and helium, and accurate satellite measurements are scarce.

The starting point of the analysis was the accurate determination of the secular semi-major axis decay rate and the corresponding neutral drag acceleration in a satellite-centered orbital system. Then, for each satellite, thermospheric model and solar activity level, the drag coefficients capable of reproducing the orbital decay observed were found. These coefficients were finally compared with the physical drag coefficients computed for both satellites in order to assess the biases affecting the thermospheric density models. None of them could be considered unconditionally the best, the specific outcome depending on solar activity and the regions of the atmosphere crossed by the satellites. During solar maximum conditions, an additional density bias linked to the satellite orbit inclination was detected.

Solar flux at 10.7 cm measured during solar cycles 23 and 24.

Transverse drag acceleration on the Ajisai satellite fitted with six atmospheric density models.

The prestigious Eurographics 2021 Technical Contribution Award goes to Paolo Cignoni

The award was conferred for Cignoni's "extraordinary technical contribution" to 3D graphics and for his graphic models applicable to the protection and conservation of Italy's artistic heritage

Paolo Cignoni, Director of the Visual Computing Lab, ISTI-CNR, won the prestigious "Eurographics Outstanding Technical Contributions Award" for the fundamental contribution, over the last twenty years, of a senior researcher to the 3D graphics sector. The award was presented in Vienna on May 3 during the annual Eurographics conference.

Cignoni received this important international recognition for his research in geometric processing - the study of algorithms that exploit the mathematical properties of three-dimensional shapes in order to optimize and improve 3D digital modelling, thus making it a best fit for many applications, including digital manufacturing and cultural heritage.

Many of Cignoni's contributions revolve around the idea of moving, through new algorithms, from real physical objects to complex digital representations and then, by means of digital fabrication, back again to the creation of a real object.

The entire computer graphics process, from the acquisition of the 3D shape and its appearance to its reproduction, through three-dimensional printing, owes much to Cignoni's research activity. His latest contributions to 3D printing processes involve the development of new solutions for the reproduction of objects or low-cost moulds that allow the creation of multiple copies, starting from digital models.

Cignoni's important contributions to the computer graphics community also include several popular open source tools. Of particular note is MeshLab, a software system for the management and analysis of complex 3D models. MeshLab has been used by hundreds of thousands of users and is considered an international reference point in the sector of 3D digitization and applications to cultural heritage.

"I am happy that, beyond the importance of scientific results, this award also recognizes the intense activity over these years dedicated to the production and maintenance of free open-source software tools. The development and release of programs that, like MeshLab, that have been used widely, even outside the research environment, has denoted the significance of the impact of the activities of recent years", commented Cignoni.

The Eurographics Outstanding Technical Contributions Award.

Recently, Cignoni has also explored the connections between geometric processing and computational design for architecture. He has proposed new approaches for constructing advanced structures like Tensegrites, and active bending constructions based on the optimization of the design of metamaterials. This work led to the design of an architectural installation, the FlexMaps Pavilion, which was chosen by Alessandro Melis, the curator of the Italian pavilion at the Venice Architecture Biennale, to be exhibited in the section dedicated to Vittorio Giorgini, as an example of the Italian ability to radically innovate in architecture and design.

Paolo Cignoni is the second Italian to win the award after Roberto Scopigno, Director of ISTI-CNR, 13 years ago.

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From the real to the digital and back to the physical through 3D scanning, geometric processing and 3D printing, three sectors where Cignoni has made a significant scientific contribution.

The tensegrity structure that decorates the gardens of the CNR Research Area, an example of the architectural constructions with challenging properties that can be computationally designed by using innovative geometric algorithms.

Carmen Pardini appointed as expert in the IAF Space Traffic Management Committee

Carmen Pardini has been appointed as an expert in the International Astronautical Federation (IAF) Technical Committee 26 on Space Traffic Management (IAF TC 26 STM). This is a platform through which experts from different organizations, and with different backgrounds, compare and exchange information. The activities of the Committee essentially cover all the technical aspects related to space traffic management, such as: space operations assurance; space environment management, which includes activities on the study of space debris, mitigation, remediation, active debris removal, just-in-time collision avoidance, and large debris traffic management; space situational awareness; space surveillance and tracking; space weather; operational coordination services; and collision avoidance (both in orbit and at launch). Collaboration between the various aspects is fundamental; space traffic management will be difficult to achieve unless appropriate steps are taken in the space environment management field, such as the mitigation of space debris and the application of some form of remediation. An activity investigating the risks associated with the reentry of objects into the earth's atmosphere has recently been added to the previous technical initiatives. The importance of this new topic in the context of space traffic management is recognized in consideration of future scenarios for space traffic, which foresee the placing of large constellations of satellites in low earth orbit, with a consequent significant increase of reentries into the atmosphere. Pardini will mainly focus on this area and will contribute to a "white paper" on the hazards associated with such reentries. The appointment, by the Executive Director of the International Astronautical Federation, is effective from December 2020.

Best Poster Award at the 36th ACM Symposium on Applied Computing (SAC 2021)

The paper "Heterogeneous Document Embeddings for Cross-Lingual Text Classification" by Alejandro Moreo, Andrea Pedrotti, and Fabrizio Sebastiani, has received the Best Poster Award at the SAC 2021. Funnelling (Fun) is a method for cross-lingual text classification (CLC) based on a two-tier ensemble for heterogeneous transfer learning. In Fun, 1st-tier classifiers, each working on a different, language-dependent feature space, return a vector of calibrated posterior probabilities (with one dimension for each class) for each document, and the final classification decision is taken by a metaclassifier that uses this vector as its input.

The metaclassifier can thus exploit class-class correlations, and this (among other things) gives Fun an edge over CLC systems where these correlations cannot be leveraged.

We here describe Generalized Funnelling (gFun), a learning ensemble where the metaclassifier receives as input the above vector of calibrated posterior probabilities, concatenated with document embeddings (aligned across languages) that embody other types of correlations, such as word-class correlations (as encoded by Word-Class Embeddings) and word-word correlations (as encoded by Multilingual Unsupervised or Supervised Embeddings). We show that gFun improves over Fun by describing experiments on two large, standard multilingual datasets for multi-label text classification.

2021 SIGCHI Awards

Fabio Paternò, research director and head of the laboratory on Human Interfaces in Information Systems, has been appointed to the ACM SIGCHI Academy for his numerous contributions in the field of methods and tools that can improve the interaction between people and digital technologies in terms of usability, accessibility, and user experience. It is the first time that an Italian researcher has received this recognition, which is considered the most prestigious internationally in the human-computer interaction scientific field. (https://sigchi.org/awards/sigchi-award-recipients/2021-sigchi-awards/).

Interdisciplinary Group on Science, Technology and Society

Working Group on "Computers and Society"

In January 1947 Albert Einstein wrote an open letter ("Dear friend, I write you ..") which ended with the following words:

"We scientists recognize our inescapable responsibility to carry to our fellow citizens an understanding of the simple facts of atomic energy and its implications for society. In this lies our only security and our only hope -- we believe that an informed citizenry will act for life and not death".

When he was President of the Accademia dei Lincei, Edoardo Amaldi founded the SICA Working Group on International Security and Arms Control (SICA) and started a series of conferences on the impact of science and technology on society (now called Amaldi Conferences, that still today are held every two years).

The Russell-Einstein Manifesto of 1955 ended with an invitation to the international scientific community to come together and work to make the world less dangerous and more just. Thus, in 1957, the Pugwash Conferences on Science and World Affairs (Nobel Peace Prize in 1995) were begun, and are still held all over the world today. On April 9, 2021, the "Gruppo Interdisciplinare su Scienza, Tecnologia e Società" (GI-STS) was founded at the CNR Research Campus, Pisa. GI-STS aims at facilitating informed and rigorous discussion on the impact on Society of Scientific Research and Technology and the consequent responsibility of scientists and technologists.

Of course, today, serious implications for society also come from disciplines other than physics, including computer science and technology. The GI-STS Working Group on Computers and Society addresses issues of Ethical and Social Responsibility concerning computer scientists and professionals. The WG is coordinated by Diego Latella

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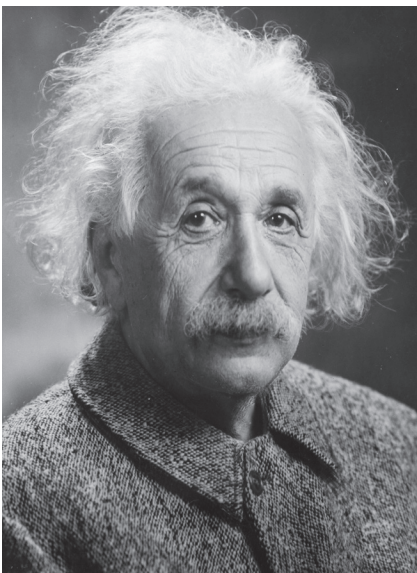
Albert Heinstein

Joseph Rotblat

Photo from the Nobel Foundation archive.

Edoardo Amaldi

Conferences - Co-organized by ISTI

26th International Conference on Formal
Methods for Industrial Critical
Systems (FMICS 2021)
Paris, France, 23-27 August 2021

25th ACM International Systems and Software
Product Line Conference (SPLC 2021)
Leicester, UK, 6-11 September 2021
https://splc2021.net/

https://web3d.siggraph.org/

11th International Conference on Indoor
Positioning and Indoor Navigation
29 Nov.-2 Dec. Lloret de Mar, Spain
http://ipin-conference.org/2021/about.html

https://clef2022.clef-initiative.eu/

9th International Workshop on Computational
Intelligence for Multimedia Understanding
Sept. 29 - Oct. 1, 2021 - Rodhes, Greece
https://iwcim.itu.edu.tr/

16th International Workshop on Advanced
Infrared Technology & Applications
26-28 Oct. 2021
https://sciforum.net/event/AITA2021

24th international Symposium on
Formal Methods (FM 2021)
20-26 November 2021, Beijing, China

DataMod 2021, 10th International Symposium
"From Data Models and Back"
6-7 December 2021