ISTI NEWS

Designing tensegrity structures

Automatic planning of struts-and-cable assemblies

structures are known for their aesthetic and structural qualities, which are explored in architecture and art. Their perceived lightness is their distinct visual feature: the heavy elements (the struts) are well disjoint, yet they are held together only by a net of a few cables. The term tensegrity is a combination of "tensional" and "integrity" and refers to the integrity of a stable structure carefully balanced by structural elements carrying pretension (cables) or pre-compression (struts) forces.

Tensegrity structures are nice-looking and statically strong architectural complexes composed of a set of disjoint struts tied together by cables and nothing more. These

Editorial

I was playing a role...

On 21 October 2017, I went to the Historic Museum of the Italian Air Force, in Vigna di Valle (near Rome). I had been invited to make a presentation about the 40th anniversary of the launch of SIRIO, the first Italian geostationary satellite, designed to evaluate the effectiveness of 12 and 18 GHz frequencies in space communications. I was not directly involved in SIRIO's launch, but I was one of the first people to use it for experiments.

OpenAIRE-Connect

Co-funded by Horizon 2020

Open Science is around the corner. Scientists and organizations see it as a way to speed up, improve quality and reward effort, while policy makers see it as a means to optimize cost of science and leverage innovation.

ElasTest

Co-funded by Horizon 2020

Nowadays the demand for larger and more interconnected software systems is constantly increasing. However, the ability of developers to satisfy it is not evolving accordingly. In particular, the motivation behind the ElasTest project is the huge effort needed to build end-to-end tests under real conditions for such systems.

National Research Council of Italy

Contents

I was playing a role in the history of telecommunications, but I did not know!

[Continued]

Those were the years, the 1980s, of STELLA (SAtellite Transmission Experiment Linking Laboratories), the first European network for data transmission via satellite between Telespazio, in Lario and Fucino, and CERN in Geneva. And STELLA became instrumental in the first testing of SIRIO.

At a later stage in our experiments, other European bodies were also involved, thus implementing the first internet connection via satellite. Pioneering times, which seem to belong to the pre-history of telecommunications, even though it was only forty years ago.

At that time, those of us working with STELLA were contributing to building a key lynchpin in the history of telecommunications but, because we were living the event, we did not realize the significance. Indeed, how many of you who are reading this editorial have ever heard of STELLA? And even if you have, how many of you have ever associated the names of Luciano Lenzini, Elia Perotto, Nedo Celandroni, Blasco Bonito and mine with the beginning of telecommunications in Europe? I think very few! Thus, following the Vigna di Valle event, in this my editorial I would like to share some considerations with you.

A first and obvious consideration is the speed with which telecommunications have evolved. Economic globalization has been accompanied by two phenomena: the transport revolution that took place in the 1950s, and the progress of telecommunications systems in the 1980s. The use of satellites began in 1960 when the first satellite of the INTELSAT system, located on the Atlantic Ocean, was launched. After INTELSAT, several other satellite systems were set up, operating at the continental level such as EUTELSAT, and at the national level like SIRIO and ITALSAT, plus satellite constellations such as Galileo. Today, there are about 13.000 satellites in orbit around the earth!! As you well know, today we all use the Internet born in the early '70s, and since the 1980s an amazingly fast communication medium with users all over the world. And, of course, the use of satellites for information transmission was also the basis for the development and spread of mobile telephony, and therefore mobile phones. And now.... let's fix this point: in the 80's I was using the first Italian satellite, SIRIO, for realizing ...for the first time....the internet via satellite! Really pionieristic!

To have a clearer idea of what has been the telecommunication evolution in just over 100 years, I am going to list just the main milestones:

- 1835: Morse telegraph
- 1856-1871: telephone (experiments and patent request by Meucci)
- 1876: Bell patent
- 1895: Marconi radio
- 1939: TV, first regular transmissions
- 1970: optical fiber, teleselection
- 1980s: analog cell phone
- 1992: digital cellular phone
- 1992: Internet (World Wide Web)
- 2000: mobile phone via satellite
- 2002: IMT-2000, UMTS
- 2003: VOIP (skype, etc)
- 2007-2008 British Telecom phony for "all-IP" net only
- 2017: towards 5G. The future!

The second, and more subjective, consideration I took away from the Vigna di Valle event is that the celebrations for these historical events ... SIRIO, Internet, STELLA, etc ... have all been promoted by outside agencies, not by CNR. I do not intend to be polemical, but I must stress my disappointment that an important institution such as CNR, which has played such a relevant role in the realization of many major scientific results, appears to take totally for granted the players involved, giving no indication of pride or recognition of their achievements.

Unfortunately, communication has never been the strength of CNR; it has proved incapable of sufficiently highlighting and valuing its many important results and has rarely acknowledged the worth and merits of the scientists involved. It remains enclosed in an ivory tower of science, forgetting to broadcast its achievements to the outside world. This is despite the fact that, similarly to the developers of STELLA cited above, hundreds of other colleagues have contributed important chunks of the history in their fields. People on the outside often ask: what do you do at CNR. What is the impact of your work? My advice to young researchers is: don't neglect the communication aspects, learn to be synthetic and clear, and to communicate your results not only in technical environments but also to people in the outside world because these are the ultimate recipients!

Well now at least you know how Luciano Lenzini, Nedo Celandroni, Blasco Bonito, Elia Perotto .... and the undersigned... contributed to the evolution of telecommunications!

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Designing tensegrity structures

## Automatic planning of struts-and-cable assemblies

[Continued]

Tensegrities are lightweight, while enjoying surprisingly solid mechanical stability. No welded joints are required, as struts are only connected through cables: the inherent lack of complexity of this kind of connection facilitates the fabrication process.

However, despite these qualities and the interest of the art, architectural and engineering communities, tensegrity structures are rarely used in practice because they are difficult to design. The space of possible configurations of the cable/struts is discrete, highly-constrained, but combinatorially vast and complicated to explore. For this reason, it is not easy to create original tensegrity models with generic shapes that are both visually interesting and structurally valid. Existing computational attempts are limited to conservative variations on stock examples of known connection patterns, or to the combination of known structural templates.

We have recently introduced a new, totally automatic, computational framework to design novel tensegrities start-ing from a user-defined generic 3D shape. This work is the result of a two year collaboration between CNR and the universities of New York, Utrecht and Insubria.
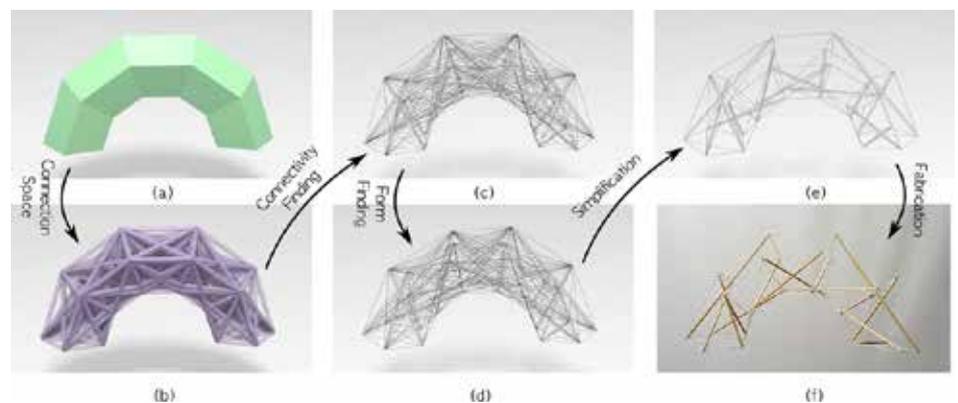
Our framework addresses the problem of creating a tensegrity from a surface in three steps (b—>c, c—>d, and d—>e in the figure above). First we explore the vast combinatorial space of the possible connections between points over the given surface to find a possibly sound tensegrity structure. Once we have chosen the topological connections, we modify the position of the endpoints of the struts to optimize the physical properties of the structure. The resulting structure is stable, but redundantly over-connected. Therefor, we simplify it using a greedy optimization process to remove unnecessary cables and obtain a neat simpler structure that can be successfully fabricated. Our system enables designers and architects to explore the tensegrity structure space with great freedom, without having to rely on predefined patterns but starting from generic free-form 3D shapes. The efficiency of the framework allows multiple different designs to be explored iteratively to evaluate what shapes can be better approximated by a strut and cable structure.

We have demonstrated the practical relevance of our system by designing multiple tensegrity structures starting from many different shapes of varying complexity. We performed physical simulations to evaluate the actual mechanic properties of the generated shapes. For further validation we have also assembled some physical models; two of these tensegrity structures were manu-factured using stainless steel tubes and cables. The larger one is more than two meters high (see the figure) and both of them now permanently embellish the gardens of the Pisa Research Area.

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OpenAIRE-Connect

OpenAIRE - CONNECTing scientific results in support of Open Science
Co-funded by Horizon 2020

Open Science is around the corner. Scientists and organizations see it as a way to speed up, improve quality and reward effort, while policy makers see it as a means to optimize the costs of science and leverage innovation. Open Science is an emerging vision, a way of thinking, whose challenges always gaze beyond its actual achievements. De facto, today's scientific communication ecosystem lacks tools and practices to allow researchers to fully embrace Open Science.

OpenAIRE-Connect aims to provide technological and social bridges, and deliver services enabling uniform exchange of research artifacts (literature, data, and methods), with semantic links between them, across research communities and content providers in scientific communication. It will introduce and implement the concept of Open Science as a Service (OSaaS) on top of the existing OpenAIRE infrastructure, delivering out-of-the-box, on-demand deployable tools.

OpenAIRE-Connect will adopt an end-user driven approach (via the involvement of 5 prominent research communities), and enrich the portfolio of OpenAIRE infrastructure production services with a Research Community Dashboard Service and a Catch-All Notification Broker Service. The Research Community Dashboard Service will offer publishing, interlinking, packaging functionalities to enable scientists to share and re-use their research artifacts (introducing "methods, e.g. data, software, protocols). This work, supported by the harvesting and mining "intelligence" of the OpenAIRE infrastructure, will provide communities with the content and tools they need to effectively evaluate and reproduce science.

OpenAIRE-Connect will combine dissemination and training with OpenAIRE's powerful NOAD network encouraging research communities and content providers to adopt such services. These two combined actions will bring immediate and long-term benefits to scholarly communication stakeholders by affecting the way research results are disseminated, exchanged, evaluated, and re-used.

ISTI-CNR is the Coordinator of the project and is in charge of Administrative, Financial and Technical coordination. Furthermore, ISTI-CNR is in charge of designing the extension of the OpenAIRE data model, upgrading the OpenAIRE back-end software and services accordingly, and of the developments of the Catch-All Notification Broker Service back-end and of the supervision of the Pilots. ISTI-CNR is also involved in all the other activities of the project to support developments of the Dashboard, designing the Open AIRE-Connect interoperability guidelines, supporting dissemination, exploitation, and training, and supporting service realization and operation.

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https://www.openaire.eu/connect
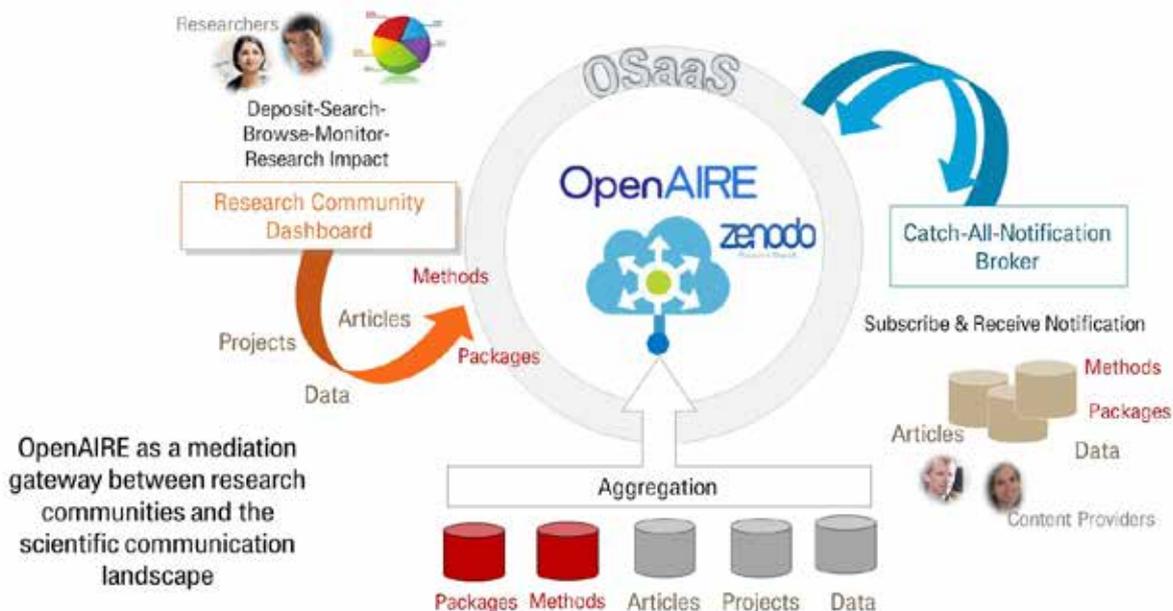
ElasTest

An elastic platform for testing complex distributed large software systems
Co-funded by Horizon 2020

Nowadays the demand for larger and more interconnected software systems is constantly increasing, however the ability of developers to satisfy this demand is not evolving accordingly. In particular, the motivation behind the ElasTest project is the huge effort needed to build end-to-end tests under real conditions for such systems.

The project aims at reducing the time-to-market of software projects, increasing the quality of the resulting software product, decreasing the probability of failures and enhancing the subjective perception of the software by the end users and the developers.

The ElasTest solution towards such objectives is to apply to the testing process the "divide-and-conquer" principle, which is commonly used when architecting complex software: this is done by developing a novel test orchestration theory and toolbox enabling the creation of complex test suites as the composition of simple testing units. This orchestration mechanism is complemented with reusable testing services, cognitive computing capabilities, and advanced instrumentation devices: altogether such capabilities will support rapid and accurate testing of large distributed systems.

ElasTest will release a flexible open source testing platform for both functional and non-functional testing of different
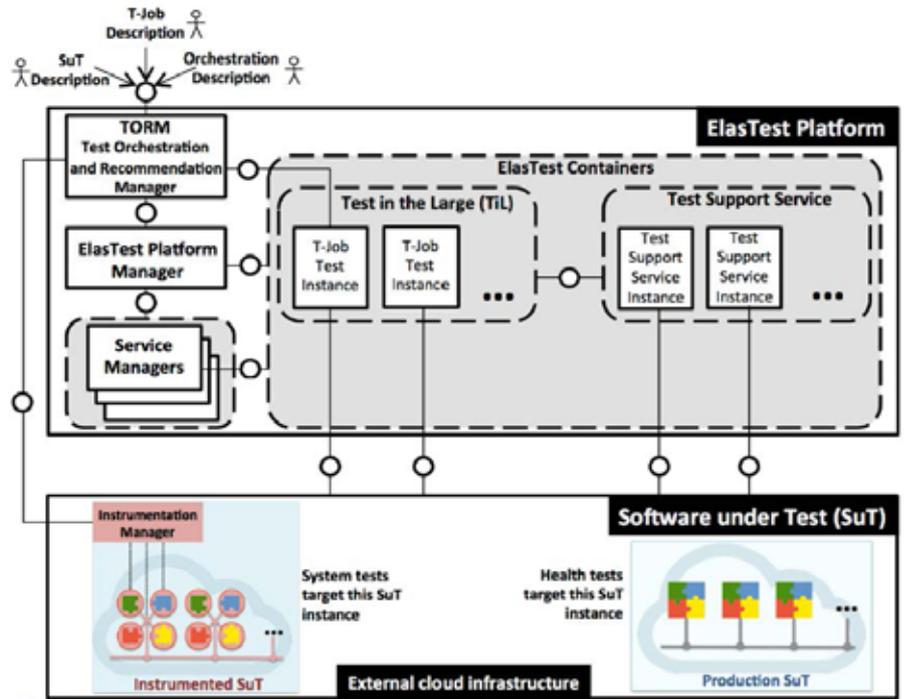
types of applications, including web, mobile, real-time video communications, and Internet-of-Things. The platform will operate in different environments and will be tested on both development and production systems.

Moreover, it is intended that the platform thus created will create a community of users, stakeholders and contributors around it with the objective of turning ElasTest into a worldwide reference in the area of large software system testing and guaranteeing the long-term sustainability of the results obtained in the project.

The CNR group is coordinating the experimental validation of the quantitative project objectives, and is also leading the continuous research scouting in cloud testing.

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AGINFRA PLUS

Accelerating user-driven e-infrastructure innovation in Food Agriculture
Co-funded by Horizon 2020

AGINFRA PLUS addresses the challenge of supporting user-driven design and prototyping of innovative e-infrastructure services and applications. In particular, the project aims to meet the needs of the scientific and technological communities that work on the multidisciplinary and multi-domain problems related to agriculture and food. It will use, adapt and evolve existing open e-infrastructure resources and services (AGINFRA, OpenAIRE, EGI, EUDAT, D4Science), in order to demonstrate how fast prototyping and development of innovative data- and computing-intensive applications can take place.

AGINFRA PLUS will expand and develop further resources and services of the AGINFRA research data e-infrastructure developed in the context of the FP7 AGINFRA project, which is now operated and developed by key stakeholders in agriculture and food (including Agroknow, the Food and Agriculture Organisation of the United Nations, INRA, Wageningen UR, the Chinese Academy of Agricultural Sciences and others).

ISTI-CNR will lead the work package covering the design and implementation of the Data Analytics & Processing Layer of the infrastructure, designing and implementing the required extensions/modification in the gCube open source system developed by ISTI, towards the development of the AGINFRA Data Analytics & Processing components.

Furthermore, it will have a major role in designing and implementing the Presentation Layer of the infrastructure, contributing to the specification and implementation of the AGINFRA Visualisation and Publishing components.

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EOSCpilot

The European Open Science Cloud for Research Pilot Project
Co-funded by Horizon 2020

The EOSCpilot project will support the first phase in the development of the European Open Science Cloud (EOSC) as described in the EC Communication on European Cloud Initiatives [2016].

It will establish the governance framework for the EOSC and contribute to the development of European open science policy and best practice, developing a number of pilots that integrate services and infrastructures to demonstrate interoperability in a number of scientific domains. It will also engage with a broad range of stakeholders, crossing borders and communities, to build the trust and skills required for adoption of an open approach to scientific research. These actions will build on and leverage resources already available and capabilities from research infrastructure and e-infrastructure organizations to maximise their use across the research community.

The EOSCpilot project will address some of the key reasons why European research is not yet fully tapping into the potential of data. In particular, it will: reduce fragmentation between data infrastructures by working across scientific and economic domains, countries and governance models, and improve interoperability between data infrastructures by demonstrating how data and resources can be shared even when they are large and complex and in varied formats. In this way, the EOSCpilot project will improve the ability to reuse data resources and provide an important step towards building a dependable open-data research environment where data from publicly funded research is always open and there are clear incentives and rewards for the sharing of data and resources.

ISTI-CNR will be mainly involved in the definition of an Open Science Policy Framework, the design of the EOSC overall architecture, and the design and implementation of Interoperability Services.

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ACTIVAGE

ACTivating InnoVative IoT smart living environments for AGEing well
Co-funded by Horizon 2020

ACTIVAGE is a European Multi Centric Large Scale Pilot on Smart Living Environments. The main objective is to build the first European IoT ecosystem across several Deployment Sites (DS) in seven European countries. Each DS will be based on one of the existing IoT platforms previously developed acting as an autonomous experimental setting. The main objective is to reuse and scale up open and proprietary IoT platforms, with a combination of technologies and standards, and integrating new interfaces needed to provide interoperability across these heterogeneous platforms. The ACTIVAGE project will enable the deployment and operation at large scale of Active & Healthy Ageing (AHA) IoT based solutions and services, supporting and extending the independent living of older adults in their living environment. One of the expected outputs of the ACTIVAGE project is the design and the implementation of the ACTIVAGE IoT Ecosystem Suite (namely the AIOTES framework), which is a set of Techniques, Tools, and Methodologies for interoperability at different layers among different IoT Platforms. AIOTES will also provide an Open Framework for providing Semantic Interoperability of IoT Platforms for AHA, addressing trustworthiness, privacy, data protection and security.

The ACTIVAGE project will evaluate its impact at different levels: the socio-economic impact, the benefits of IoT-based smart living environments in the quality of life and autonomy, and the sustainability of the health and social care systems. The consortium comprises industries, research centers, SMEs, service providers, public authorities encompassing the whole value chain in every Deployment Site.

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PerformFISH

A Major New Research Project Focused on a New Era of Consumer-Driven Development in Mediterranean Aquaculture
Co-funded by Horizon 2020

Gilthead sea bream and European sea bass are by volume the third and fourth most farmed fish species in the EU, while their collective value surpasses that of salmon, trout or mussel. These two species are farmed and contribute significantly to wealth and job creation in rural and coastal areas in all EU Mediterranean countries. However, production of sea bream/bass in the EU has remained stagnant for the last decade and the industry faces significant sustainability challenges.

The overarching objective of PerformFISH is to increase the competitiveness of Mediterranean aquaculture by overcoming biological, technical and operational issues with innovative, cost-effective, integrated solutions, while addressing social and environmental responsibility and contributing to "Blue Growth". PerformFISH adopts a holistic approach constructed with active industry involvement to ensure that Mediterranean marine fish farming matures into a modern dynamic sector, highly appreciated by consumers and society for providing safe and healthy food with a low ecological footprint, and employment and trade in rural, peripheral regions.

PerformFISH brings together a representative multi-stakeholder, a multi-disciplinary consortium with the aim to generate, validate and apply new knowledge in real farming conditions in order to substantially improve the management and performance of the focal fish species, measured through Key Performance Indicators. At the core of the PerformFISH design are, a) a link between consumer demand and product design, complemented with product certification and marketing strategies to drive consumer confidence, and b) the establishment and use of a numerical benchmarking system to cover all aspects of Mediterranean marine fish farming performance. Created knowledge and innovative solutions will underpin the developed code of conduct and good practices and will foster modernization through capacity building of the Mediterranean aquaculture workforce.

ISTI-CNR will liaise PerformFISH with the BlueBRIDGE e-infrastructure and will be responsible for the development of Virtual Research Environments to host Key Performance Indicators data.

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LIGA

Large-scale Indie Gaming Analytics
Co-funded by Horizon 2020

The market for video games developed by independent teams or small companies, commonly called "Indie Games", has witnessed a significant increase. STEAM, a popular indie gaming platform, provides more than 6 million reviews and about 13 thousand games for a social network of 2.6 million active users. In order to compete against the largest companies, Indie Games SMEs aim at extending users' engagement beyond the gaming experience to the collection and sharing of game-related content, mainly related to 3D printing of game characters. The LIGA experiment proposes a novel platform supporting Indie games SMEs to exploit the huge data available in gaming web portals and social networks to increase their penetration in the gaming-related market, with a focus on 3D printable models. The extensive use of analytics tools in the indie community for theme, visual and core mechanics design is still in its infancy. LIGA will go one step beyond that and analyze the huge volume of data generated by users of gaming web portals and social networks to discover trending topics, user communities, and sentiments about game characters and related aspects to enable new business and market opportunities transcending the boundaries of the digital game into the real physical world. By relying on Big Data analytics running on a dedicated HPC infrastructure LIGA will mine the huge game-related content shared by users to provide accurate recommendations and to promptly detect precise trends and extract relevant insights that can reduce 3D objects time to market. Through its services LIGA will thus support a very innovative manufacturing model, where production of objects is extremely distributed and the entire process relies on HPC Big Data analytics.

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eInfraCentral

European E-Infrastructure Services Gateway
Co-funded by Horizon 2020

eInfraCentral's mission is to ensure that by 2020 a broader/more varied set of users (including industry) benefits from European infrastructures. A common approach to defining and monitoring e-infrastructures services will increase their uptake. It will also enhance understanding of where improvement can be made in delivering services. The challenge is to shift towards an e-Infrastructure ''market place'' to initiate new service offerings and to engage with a broader set of users and needs. This will be achieved through an exchange of know-how between e-infrastructures consultations with a broad range of existing or potential users.

eInfraCentral will pursue 3 specific objectives: 1. Structure an open and guided discussion between e-infrastructures to consensually define a common service catalog 2. Develop a one-stop shop portal for users to browse the service catalog and enhance the monitoring of key performance indicators that focus on availability and quality of services and user satisfaction 3. Draw policy lessons for a future European e-infrastructure market place as an extension of the common service catalog and portal (incorporating a larger number of e-infrastructures).

Key highlights of the project are: 1. A multidisciplinary team combining technical knowledge & insights from the e-infrastructure community with independent expertise in community building consultation, policy and data mapping and monitoring; 2. A co-design process that will involve funders, the e-research infrastructure community and a representative user group (incl. SMEs); 3. On-going user interaction that will guide the design and development of the *eInfraCentral* portal (as the main entry point to European e-infrastructure services) in two phases: a prototype with a first set of services and a full release with a KPI dashboard; 4. The strenghthening of collaboration between e-infrastructures and the optimisation of access to and uptake of e-infrastructures services by end users.

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SIGS

Co-funded by the Tuscany Region under the FAR-FAS 2014 program

The SIGS project aims at developing an innovative methodology, for carrying out a quantitative assessment of very low, low and medium temperature shallow geothermal resources in the Pisa floodplain at the end of the Arno valley. The implementation of this methodology, and the resulting geology and energy-related analysis methods will, therefore, allow us to test and develop procedures and tools not yet used in a systematic and multi-sectoral way. Given that the Pisan plain, despite its peculiarities, is a typical example of alluvial plain similar to many others throughout Europe,

once the methodology has been validated, it could be used in other similar contexts in Italy and in Europe and could be made available to local administrators in order to start integrating hydrogeological and energy-related data into territorial planning tools. Moreover, the project will propose an energy and environmental long-term monitoring system able to measure both the energy consumed by end users and the environmental parameters in office environments. Indeed, the proposed energy and environmental long-term monitoring system will be able to assist users in tun-

ing their habits (i) for reducing power consumption; (ii) for safety and comfort issues. The presence of intelligent systems that support long-term monitoring of selected behaviors and, more generally, human well-being, can prevent the emergence of illnesses or pathological situations related to unhealthy buildings or bad user habits like sedentariness and lack of socialization, or nutritional issues.

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FITS.ME

Flexible Indoor Tracking System for Medical Environments
Co-funded by the Tuscany Region under the POR FESR 2014-2020 program

The FITS.ME project aims to design and implement a new integrated system capable of supporting indoor localization within architecturally complex structures and providing real-time suggestions regarding how to reach the desired target point of interest. The project involves three companies (Lifetronic, Tertium Technology, Virtualis) and the HIIS Laboratory at ISTI-CNR. The goal is to facilitate user orientation, and intuitively and effectively avoid the disorientation in spatial movements within large structures and complexes (eg hospitals, public offices, historic buildings and large

museums), thus overcoming the limitations of systems with similar purposes currently available on the market.

The system will be particularly useful and effective for those users who exhibit reduced orientation skills (eg disabled, elderly, hospital patients). The project will design and develop an innovative wearable device equipped with vibro-tactile interfaces.

The HIIS laboratory will be mainly involved in the design of the multimodal interface including vibrotactile feedback and its us-

ability evaluation. The main requirements of the device are: it should not be obtrusive but a natural extension of the hosting environment; it should be easily used by people who are not accustomed to digital interfaces, such as elderly people; it should have low production cost and reduced energy consumption.

This device for supporting orientation inside buildings and user guidance in complex buildings will be characterized by a new type of low-cost wearable product and will use multimodal interfaces based on vibro-tactile feedback. It should be usable by first-time visitors without requiring particular learning efforts and should provide vibro-tactile orientation cues when necessary avoiding information overloading. Thus, the system proposed will have as essential elements: high usability, accessibility for every category of users including old and disabled, and great efficiency.

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# Sleep behavior assessment via smartwatch and stigmergic receptive fields

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Personal and Ubiquitous Computing. Springer, in press.

Sleep behavior is a key factor in maintaining good physiological and psychological health. A well-known approach to monitor sleep is polysomnography. However, it is costly and intrusive, which may disturb sleep. Consequently, polysomnography is not suitable for sleep behavior analysis. Other approaches are based on actigraphy and sleep diary. Although being a good source of information for sleep quality assessment, sleep diaries can be affected by cognitive bias related to subject's sleep perception, while actigraphy overestimates sleep periods and night-time disturbance compared to sleep diaries. Machine learning techniques can improve the objectivity and reliability of the observations. However, since signal morphology vary widely between people, conventional machine learning is complex to set up. In this regard, we present an adaptive, reliable, and innovative computational approach to provide per-night assessment of sleep behavior to the end-user. We exploit heartbeat rate and wrist acceleration data, gathered via smartwatch, in order to identify subject's sleep behavioral pattern. More specifically, heartbeat rate and wrist motion samples are processed via computational stigmergy, a bio-inspired scalar and temporal aggregation of samples. Stigmergy associates each sample with a digital pheromone deposit (mark) defined in a mono-dimensional space and characterized by evaporation over time. As a consequence, samples close in terms of time and intensity are aggregated into functional structures called trails. The stigmergic trails make it possible to compute the similarity between time series on different temporal scales, to support classification or clustering processes. The overall computing schema includes a parametric optimization for adapting the structural parameters to individual sleep dynamics. The outcome is a similarity between sleep nights of the same subject, to generate clusters of nights with different quality levels. Experimental results are shown for three real-world subjects. The resulting similarity is also compared with the dynamic time warping, a popular similarity measure for time series.
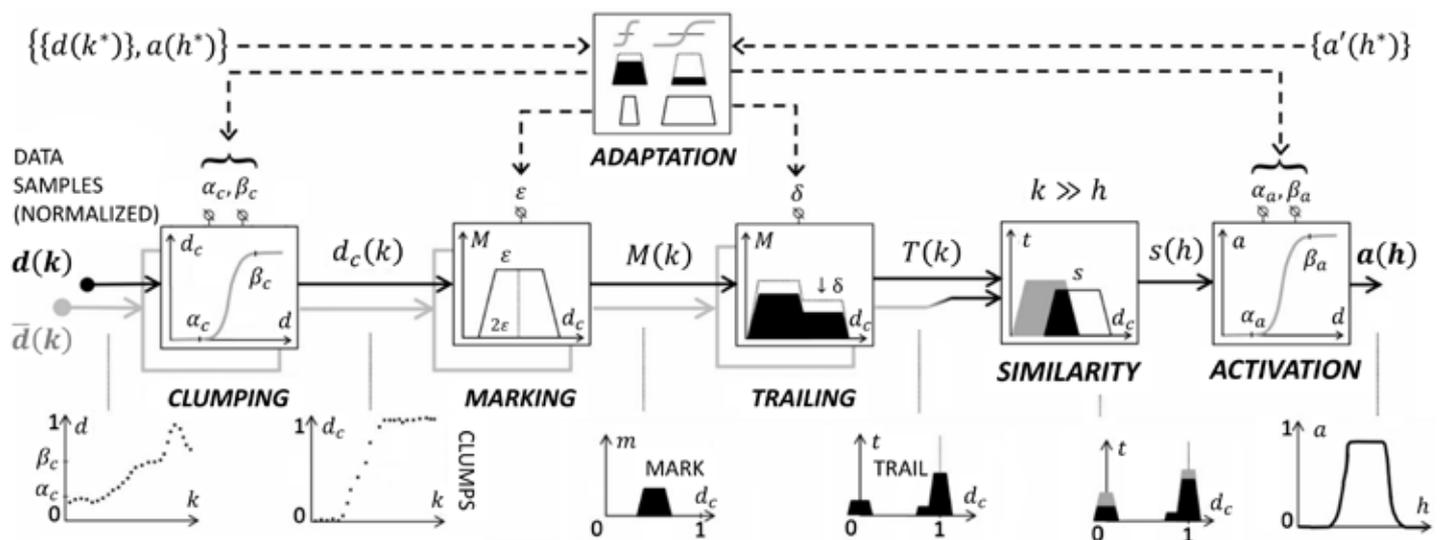
An experience in using machine learning for short-term predictions in smart transportation systems

D. Bacciu, A. Carta, S. Gnesi, L. Semini
Journal of Logical and Algebraic Methods in Programming, vol. 87. Elsevier, 2017.

Bike-sharing systems (BSS) are a means of smart transportation with the benefit of a positive impact on urban mobility. To improve the satisfaction of a user of a BSS, it is useful to inform her/him on the status of the stations at run time, and indeed most of the current systems provide the information in terms of number of bicycles parked in each docking stations by means of services available via web. However, when the departure station is empty, the user could also be happy to know how the situation will evolve and, in particular, if a bike is going to arrive (and vice versa when the arrival station is full).

To fulfill this expectation, we envisage services able to make a prediction and infer if there is in use a bike that could be, with high probability, returned at the station where a user is waiting. The goal of this paper is hence to analyze the feasibility of these services. To this end, we put forward the idea of using Machine Learning methodologies, proposing and comparing different solutions.
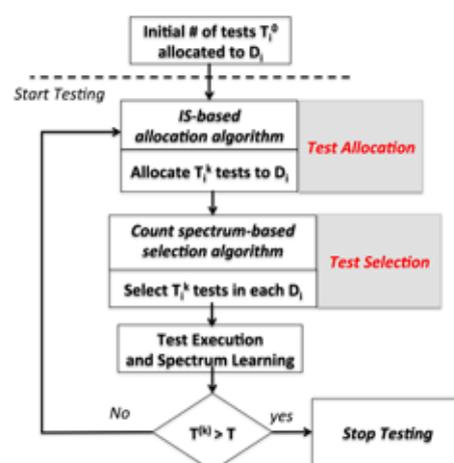
Adaptive coverage and operational profile-based testing for reliability improvement

A. Bertolino, B. Miranda, R. Pietrantuono, S. Russo
ICSE 2017 - 39th ACM/IEEE International Conference on Software Engineering. IEEE, 2017.

We introduce *covrel*, an adaptive software testing approach based on the combined use of operational profile and coverage spectrum, with the ultimate goal of improving the delivered reliability of the program under test. Operational profile-based testing is a black-box technique that selects test cases having the largest impact on failure probability in operation; as such, it is considered well suited when reliability is a major concern. Program spectrum is a characterization of a program's behavior in terms of the code entities (e.g., branches, statements, functions) that are covered as the program executes. The driving idea of covrel is to complement operational profile information

with white-box coverage measures based on count spectra, so as to dynamically select

the most effective test cases for reliability improvement. In particular, we bias operational profile-based test selection towards those entities covered less frequently. We assess the approach by experiments with 18 versions from 4 subjects commonly used in software testing research, comparing results with traditional operational and coverage testing. Results show that exploiting operational and coverage data in a combined adaptive way actually pays in terms of reliability improvement, with covrel overcoming conventional operational testing in more than 80% of the cases.

Statistical model checking of an energy-saving cyber-physical system in the railway domain

D. Basile, F. Di Giandomenico, S. Gnesi
SAC 2017 - 32th ACM SIGAPP Symposium on Applied Computing. ACM, 2017.

Studies aimed at reducing energy consumption while guaranteeing acceptable reliability levels are nowadays gaining importance in a variety of application sectors. Analyses through formal models and tools help developers of energy supply strategies to correctly trade between energy consumption and reliability. Generally, probabilistic phenomena are involved in those systems, and they can be modelled through stochastic formalisms. Validating these models is paramount, in order to guarantee reliance on the analysis results they provide. In this paper, we uniformly address both evaluation and validation of energy consumption policies on a case study from the railway domain using formal techniques. In particular, we analyse a system of rail road switch heaters, which are used to keep the temperature of rail road switches above certain levels to ensure their correct functioning. Strategies based on thresholds to control the energy supply are modelled through hybrid automata, a formalism which allows to analyse both the discrete and the continuous nature of cyber-physical systems. We verify the correctness of the proposed model, and we evaluate energy consumption and reliability indicators through Statistical Model Checking using the Uppaal SMC toolbox.
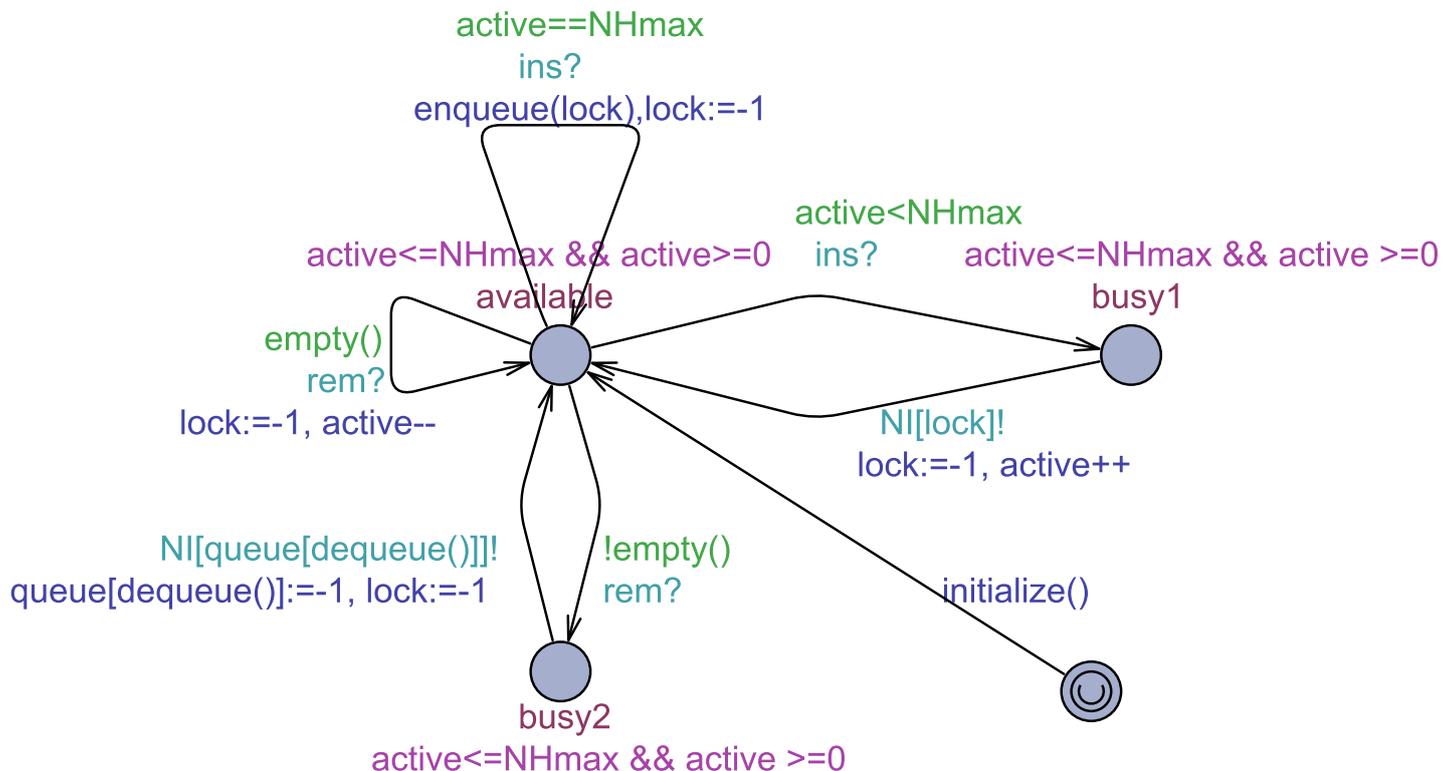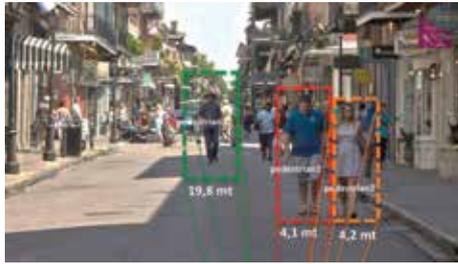
Deep learning in automotive software

F. Falcini, G. Lami, A.C. Mitidieri
IEEE Software, vol. 34 (3). IEEE, 2017.

Deep-learning-based systems are becoming pervasive in automotive software. So, in the automotive software engineering community, the awareness of the need to integrate deep-learning-based development with traditional development approaches is growing, at the technical, methodological, and cultural levels. In particular, data-intensive deep neural network (DNN) training, using ad hoc training data, is pivotal in the development of software for vehicle functions

that rely on deep learning. Researchers have devised a development lifecycle for deep-learning-based development and are participating in an initiative, based on Automotive SPICE (Software Process Improvement and Capability Determination), that's promoting the effective adoption of DNN in automotive software. This article is part of a theme issue on Automotive Software.

Personalization of context-dependent applications through trigger-action rules

G. Ghiani, M. Manca, F. Paternò, C. Santoro
ACM Transactions on Computer-Human Interaction, vol. 24 (2). ACM, 2017.

Our life is characterized by the presence of a multitude of interactive devices and smart objects exploited for disparate goals in different contexts of use. Thus, it is impossible for application developers to predict at design time the devices and objects users will exploit, how they will be arranged, and in which situations and for which objectives they will be used. For such reasons, it is important to make end users able to easily and autonomously personalize the behaviour of their Internet of Things applications, so that they can better comply with their specific expectations. In this paper, we present a method and a set of tools that allow end users without programming experience to customize the context-dependent behaviour of their Web applications through the specification of trigger-action rules. The environment is able to support end-user specification of more flexible behaviour than what can be done with existing commercial tools, and it also includes an underlying infrastructure able to detect the possible contextual changes in order to achieve the desired behaviour. The resulting set of tools is able to support the dynamic creation and execution of personalized application versions more suitable for users' needs in specific contexts of use. Thus, it represents a contribution to obtaining low threshold/high ceiling environments. We also report on an example application in the home automation domain, and a user study that has provided useful positive feedback.
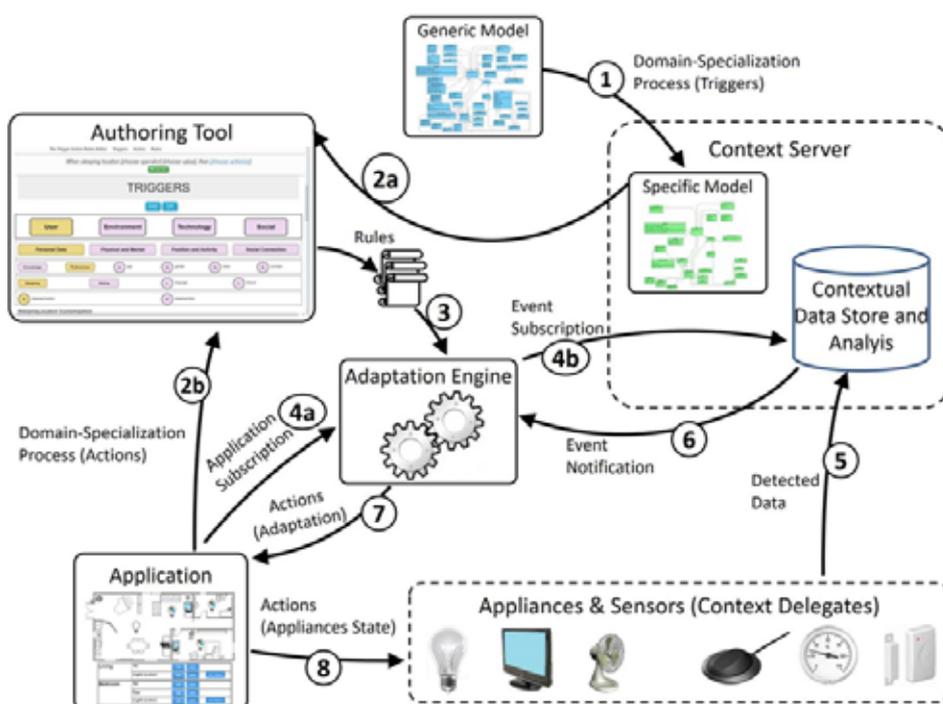
Personalizing a student home behaviour

L. Corcella, M. Manca, F. Paternò
IS-EUD 2017 - 6th International Symposium on End User Development. Springer, 2017.

Trigger-Action programming is emerging as an expressive and effective approach when customizing services and applications that have to react to several dynamic events. Recent research efforts aim to overcome some limitations of existing commercial tools in supporting editing of personalization rules. However, they have often been applied and assessed in laboratories. In this work we report on how a personalization platform has been applied to an application controlling the home of a group of students. The home has been equipped with various appliances and sensors accessible through an Arduino board. The personalization platform has been customized to integrate with the home application through a context manager middleware. The resulting personalization tool and the home application have been used and assessed by the students living in the home and various colleagues and friends without programming experience.
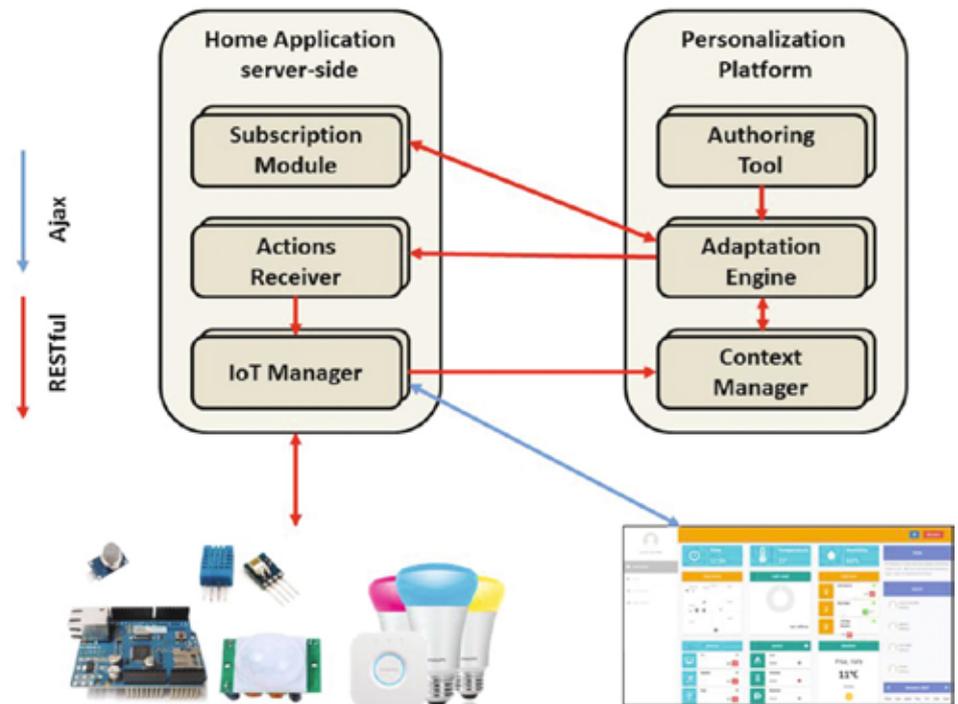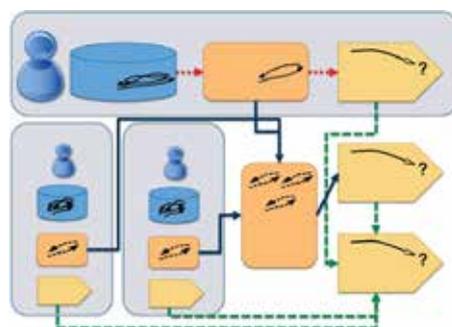
MyWay: location prediction via mobility profiling

R. Trasarti, R. Guidotti, A. Monreale, F. Giannotti
Information Systems, vol. 64. Elsevier, 2017.

Forecasting the future positions of mobile users is a valuable task allowing us to operate efficiently a myriad of different applications which need this type of information. We propose MyWay, a prediction system which exploits the individual systematic behaviors modeled by mobility profiles to predict human movements. MyWay provides three strategies: the individual strategy uses only the user individual mobility profile, the collective strategy takes advantage of all users individual systematic behavior, and the hybrid strategy that is a combination of the previous two. A key point is that MyWay only requires the sharing of individual mobility profiles, a concise representation of the user's movements, instead of raw trajectory data revealing the detailed movement of the users. We evaluate the prediction performances of our proposal by a deep experimentation on large real-world data. The results highlight that the synergy between the individual and collective knowledge is the key for a better prediction and allow the system to outperform the state-of-art methods.
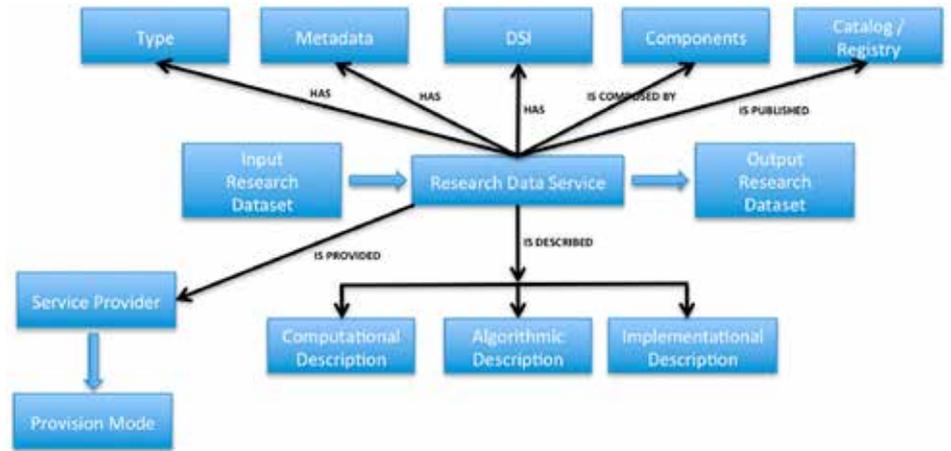
White paper on research data service discoverability

C. Thanos, F. Klan, K. Kriticos, L. Candela
Publications, vol. 5 (1). Multidisciplinary Digital Publishing Institute, 2017.

This White Paper reports the outcome of a Workshop on "Research Data Service Discoverability" held in the island of Santorini (GR) on 21-22 April 2016 and organized in the context of the EU funded Project "RDA-E3". The Workshop addressed the main technical problems that hamper an efficient and effective discovery of Research Data Services (RDSs) based on appropriate semantic descriptions of their functional and non-functional aspects. In the context of this White Paper, by RDSs we denote those data services that manipulate/transform research datasets for the purpose of gaining insight into complicated issues. In this White Paper, the main concepts involved in the discovery process of RDSs are defined; the RDS discovery process is illustrated; the main technologies that enable the discovery of RDSs are described; and a number of recommendations are formulated for indicating future research directions and making an automatic RDS discovery feasible.

Generalizing type-2 fuzzy ontologies and type-2 fuzzy description logics

F. Bobillo, U. Straccia
International Journal of Approximate Reasoning, vol. 87. Elsevier, 2017.
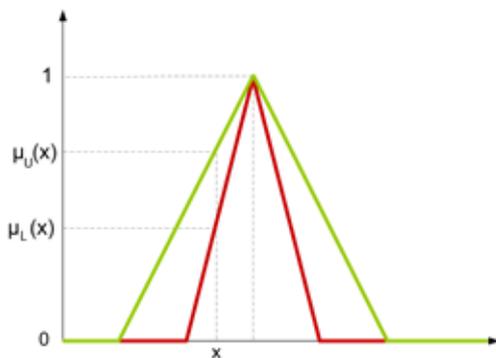
In the last years, we are witnessing an increase of real-world applications of fuzzy ontologies. Most fuzzy ontologies are based on type-1 fuzzy logic, and type-2 fuzzy ontologies have not yet received such attention so far. Furthermore, there exists an important gap between type-2 knowledge representation formalisms (type-2 Description Logics) and type-2 fuzzy ontology applications. In this paper, we propose a formal framework for type-2 fuzzy ontologies taking into account the needs of existing applications. Essentially, our approach makes it possible to manage some uncertainty in the fuzzy membership functions used in the fuzzy datatypes and in the degrees of truth of the axioms. We define a type-2 Description Logic, a reasoning algorithm, and give a Fuzzy OWL 2 specification of it.
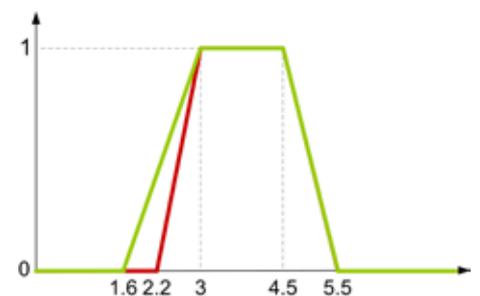
Fast connected components computation in large graphs by vertex pruning

A.Lulli, E. Carlini, P. Dazzi, C. Lucchese, L. Ricci
IEEE Transactions on Parallel and Distributed Systems, vol. 28 (3). IEEE, 2017.

Finding connected components is a fundamental task in applications dealing with graph analytics, such as social network analysis, web graph mining and image processing. The exponentially growing size of today's graphs has required the definition of new computational models and algorithms for their efficient processing on highly distributed architectures. In this paper we present CRACKER, an efficient iterative MapReduce-like algorithm to detect connected components in large graphs. The strategy of CRACKER is to transform the input graph into a set of trees, one for each connected component in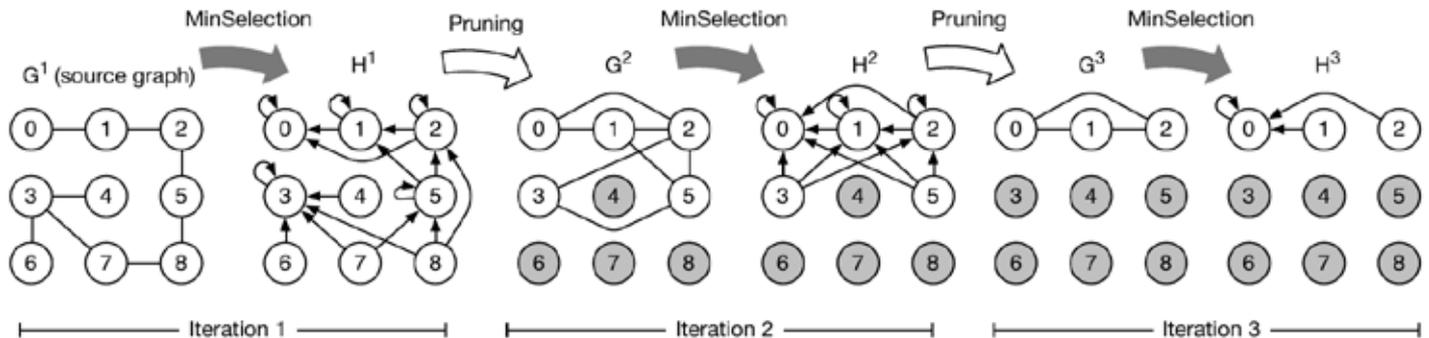 the graph. Nodes are iteratively removed from the graph and added to the trees, reducing the amount of computation at each iteration. We prove the correctness of the algorithm, evaluate its computational cost and provide an extensive experimental evaluation considering a wide variety of synthetic and real-world graphs. The experimental results show that CRACKER consistently outperforms state-of-the-art approaches both in terms of total computation time and volume of messages exchanged.

Perception of social phenomena through the multidimensional analysis of online social networks

M. Coletto, A. Esuli, C. Lucchese, C.I. Muntean, F.M. Nardini, R. Perego, C. Renso
Online Social Networks and Media, vol. 1. Elsevier, 2017.

We propose an analytical framework aimed at investigating different views of the discussions regarding polarized topics which occur in Online Social Networks (OSNs).

The framework supports the analysis along multiple dimensions, i.e., time, space and sentiment of the opposite views about a controversial topic emerging in an OSN.

To assess the usefulness of the framework in mining insights about social phenomena, we apply it to two different Twitter case studies: the discussions about the refugee crisis and the United Kingdom European Union membership referendum. These complex and contended topics are very important issues for EU citizens and stimulated a multitude of Twitter users to take side and actively participate in the discussions. Our framework make it possible to monitor in a scalable way the raw stream of relevant tweets and to automatically enrich them with location information (user and mentioned locations), and sentiment polarity (positive vs. negative). The analyses we conducted show how the framework captures the differences in positive and negative user sentiment over time and space. The resulting knowledge can support the understanding of complex dynamics by identifying variations in the perception of specific events and locations.

Lip segmentation based on Lambertian shadings and morphological operators for hyper-spectral images

A. Danielis, D. Giorgi, M. Larsson, T. Stromberg, S. Colantonio, O. Salvetti
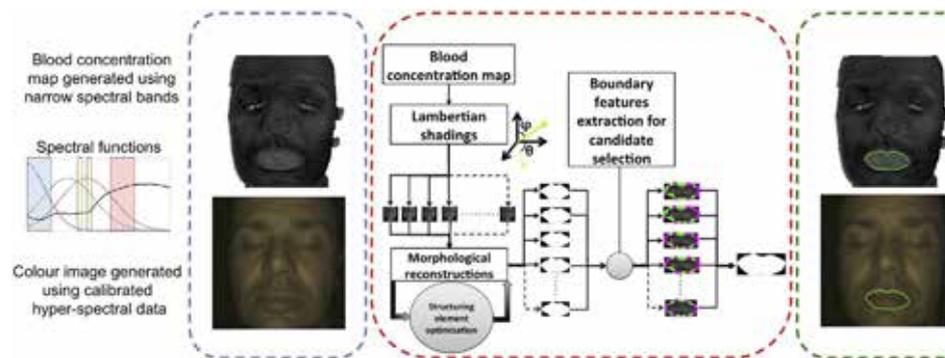
Lip segmentation is a non-trivial task because the colour difference between the lip and the skin regions may not always be very noticeable. We propose an automatic lip segmentation technique for hyper-spectral images from an imaging prototype with medical applications. Contrarily to many other existing lip segmentation methods, we do not use colour space transformations to localise the lip area. As input image, we use for the first time a parametric blood concentration map computed by using narrow spectral bands. Our method mainly consists of three phases: (i) for each subject generate a subset of face images enhanced by different simulated Lambertian illuminations, then (ii) perform lip segmentation on each enhanced image by using constrained morphological operations, and finally (iii) extract features from Fourier-based modeled lip boundaries to select the lip candidate. Experiments for testing our approach are performed under controlled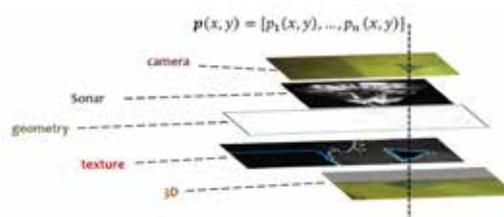 conditions on volunteers and on a public hyper-spectral dataset. Results show the effectiveness of the algorithm against low spectral range, moustache, and noise.

Seafloor analysis and understanding for underwater archeology

M. Reggiannini, O. Salvetti

Surveying the oceans' floors represents both a demanding and a relevant task for operators concerned with marine biology, engineering or sunken cultural heritage preservation. Scientific researchers and others interested in the question combine their efforts to identify optimized solutions aiming at the mapping of underwater areas, the detection of interesting objects and, in the case of archaeological surveys, the safeguard of the detected sites. Among the typical tools exploited to perform these operations the Autonomous Underwater Vehicles (AUVs) represent a validated and reliable technology. These vehicles are typically equipped with properly selected sensors that collect data from the surveyed environment. This data can be employed to detect and recognize targets of interest, such as man-made artifacts located on the seabed, both in an online or offline modality. The adopted approach consists in laying emphasis on the amount of regularity contained in the data, referring to the content of geometrical shapes or textural surface patterns. These features can be used to label the environment in terms of more or less interesting areas, where more interesting refers to higher chances of detecting the sought objects (such as man-made objects) in the surveyed area. This paper describes the methods developed to fulfill the purposes of mapping and object detection in the underwater scenario and presents some of the experimental results obtained by the implementation of the discussed techniques in the underwater archaeology field.

Digital fabrication techniques for cultural heritage: a survey

R. Scopigno, P. Cignoni, N. Pietroni, M. Callieri, M. Dellepiane
Computer Graphics Forum, Volume 36 (1). Wiley, 2017.

Digital fabrication devices exploit basic technologies in order to create tangible reproductions of 3D digital models. Although current 3D printing pipelines still suffer from several restrictions, accuracy in reproduction has reached an excellent level. The manufacturing industry has been the main domain of 3D printing applications over the last decade. Digital fabrication techniques have also been demonstrated to be effective in many other contexts, including the consumer domain. Cultural Heritage is one of the new application contexts and is an ideal domain to test the flexibility and quality of this new technology. This survey overviews the various fabrication technologies, discussing their strengths, limitations, and costs. Various successful uses of 3D printing in the Cultural Heritage are analysed. We review works that have attempted to extend fabrication technologies in order to deal with the specific issues in the use of digital fabrication in the Cultural Heritage. Finally, we also propose areas for future research.

Enhanced visualization of detected 3D geometric differences

G. Palma, M. Sabbadin, M. Corsini, P. Cignoni
Computer Graphics Forum. Wiley, in press.
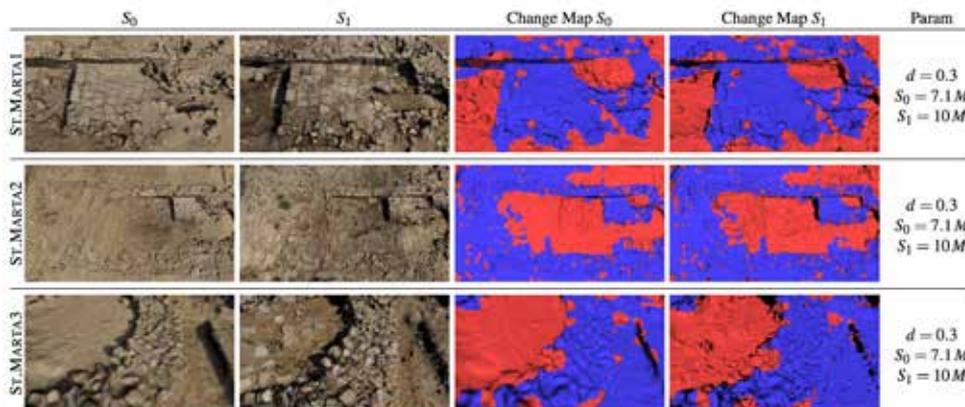
The effective visualization of changes and variations that happen in time on 3D models is becoming an important problem. In fact, the wide availability of 3D acquisition devices makes them viable for monitoring shape changes in time. The current techniques for the analysis of time-varying data can efficiently detect significant geometric changes and rule out differences due to irrelevant variations (like sampling, lighting, coverage). On the other hand, the effective visualization of such detected changes is challenging when we want to show at the same time the original appearance of the 3D model.

In this paper, we propose a dynamic technique for the effective visualization of detected differences between two 3D scenes. The presented approach, while retaining the original appearance, allows the user to switch between the two models in a way that enhances the geometric differences that have been detected as significant. Additionally, the same technique is able to visually hide the other negligible, yet visible, variations. The main idea is to use two distinct screen space time-based interpolation functions for the significant 3D differences and for the small variations to hide. We have validated the proposed approach in a user study on a different class of datasets, proving the objective and subjective effectiveness of the method.

An interactive online web application that demonstrates the technique on a number of datasets is also available at: http://vcg.isti.cnr.it/~palma/visChange/.

Ambient vibration recording on the Maddalena Bridge in Borgo a Mozzano (Italy): data analysis

R.M. Azzara, A. De Falco, M. Girardi, D. Pellegrini
Annals of Geophysics, vol. 60 (4). Istituto Nazionale di Geofisica e Vulcanologia, 2017.

The paper reports on a vibration measurements campaign performed on the medieval Maddalena Bridge, also known as the "Devil's Bridge", in Borgo a Mozzano (Italy), one of the most fascinating in Italy. This 11th century masonry bridge, supported by four circular arcades, crosses the Serchio River for about one hundred meters (see photo). Information on both the dynamic response of the structure and the effects produced by the passage of trains on the adjacent railway tracks has been obtained through a wholly nondestructive technique, by measuring the environmental vibrations affecting the structures.

A monitoring system has been fitted on the external surface of the bridge in order to evaluate its dynamic response to vibrations originating in the adjacent railway and the two nearby roads. The natural frequencies and mode shapes of the structure and the corresponding damping ratios have been obtained by analyzing the recorded data via Operational Modal Analysis. Lastly, a finite-element model of the bridge has been calibrated via the NOSA-ITACA code to fit the experimental data.

Comparison of chemical propulsion solutions for large space debris active removal

P. Tadini, U. Tancredi, M. Grassi, C. Pardini, L. Anselmo, T. Shimada, L.T. Deluca
Chemical Rocket Propulsion - A Comprehensive Survey of Energetic Materials. Springer, 2017.
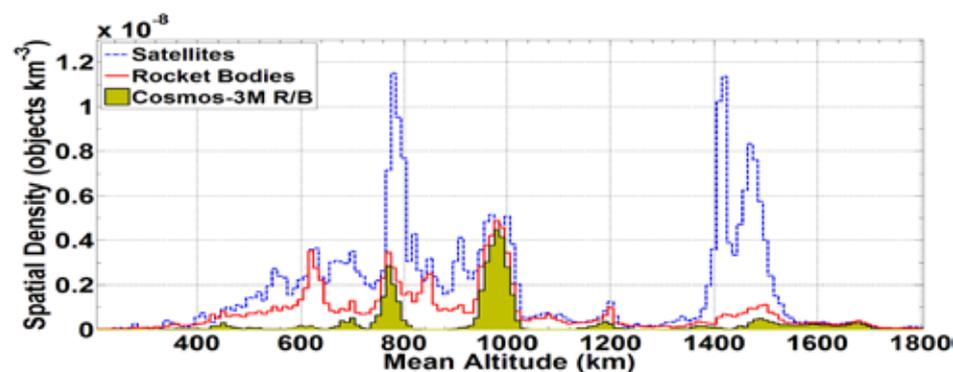
In recent years, the development of active removal missions, to face the growing risk of catastrophic collisions and new debris generation due to the high density of orbital debris in LEO, is widely discussed in the international space community. Besides legal and political issues, active removal solutions are strongly hampered by the high costs involved. Chemical propulsion might represent the preferred way to carry out the controlled reentry of large abandoned objects, and, in the perspective of cost reduction, hybrid rocket technology is considered a valuable option, due to the potential lower fabrication and operational costs, if compared with bipropellant liquid systems. The possibility to use nontoxic propellants, besides their lower prices, reduces the complexity of handling, storability, and loading operations, decreasing the connected costs and avoiding the need of a special staff. Solid rocket technology allows for very small and compact motor units, although without throttleability and reignition capability and characterized by lower safety level than liquid and hybrid systems. This study deals with the preliminary design and mass budget of solid, liquid, and hybrid propulsion modules, as well as their comparison, to be used for active removal of large abandoned rockets in LEO.

WorldFoodMap

Social Media Image Recognition for Food Trend Analysis

An increasing number of people share thoughts and images reflecting their lives on social media platforms. And people frequently share on-line what they are eating by taking photos of their dishes. The hashtag #foodporn is constantly among the most popular hashtags in Twitter, and food photos are the second most popular subject in Instagram after selfies. The system we propose, WorldFoodMap, captures a stream of photos related to food from social media and, thanks to a Convolutional Neural Network (CNN) trained on images of food, identifies the categories of food that people are sharing. By collecting from the Twitter stream, food images and associating a food category and location with them, WorldFoodMap depicts and interactively visualizes shared food popularity and trends throughout the world. Four types of analyses are provided: Relative and Absolute Frequency, Trend and Divergence.

The WorldFoodMap image recognition engine leverages Deep Learning techniques based on deep Convolutional Neural Networks (CNNs). We use a pre-trained GoogLeNet CNN, fine-tuned using training images from the ETHZ Food-101 dataset, containing a total of 101.000 images belonging to 101 food categories. Food recognition is achieved using a k-NN classifier on the deep features extracted from image queries and the images of a training set composed of ETHZ Food-101 and UPMC Food-101 datasets. When the tweets are without images, we resort to text analysis in order to identify the food categories mentioned.

Geolocation information is derived from the GPS and Place fields of tweets. When missing, we infer this information from the free-text location field in the user profile by exploiting Geonames.

The potential users of WorldFoodMap may vary from researchers in social media mining to domain-specific stakeholders such as, for example, health and nutrition-based experts.

WorldFoodMap was presented as a demo paper at ACM SIGIR 2017 and was created by Giuseppe Amato, Paolo Bolettieri, Vinicius Monteiro de Lira, Cristina Ioana Muntean, Raffaele Perego and Chiara Renso, as a joint work between two ISTI laboratories, HPC and NEMIS.

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http://foodmap.isti.cnr.it/
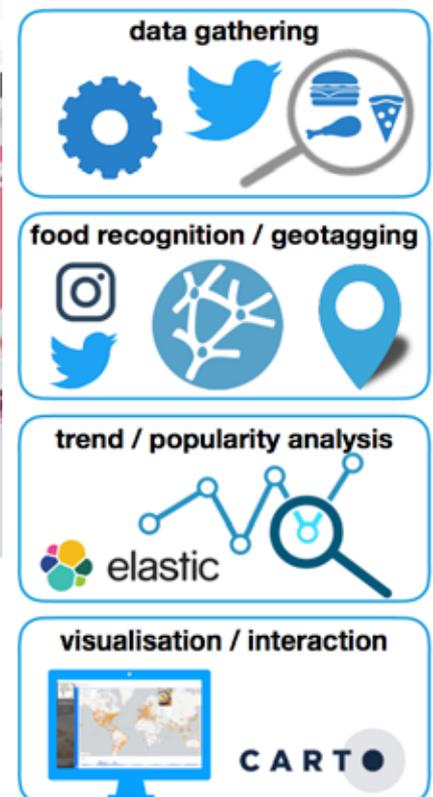
NOSA-ITACA 1.1

An improved version of our finite element code for ancient masonry structures

NOSA-ITACA is a software package for the static and dynamic analysis of masonry constructions. It is distributed freely in order to facilitate the use of mathematical models and numerical tools in the field of Cultural Heritage. It has been implemented by integrating the finite element code NOSA into the open-source graphical platform SA-LOME.

NOSA-ITACA has been substantially modified in the last three years, leading to a new release (NOSA-ITACA 1.1). To support recent research activities of the MMS Lab, focused on the dynamic identification of ancient masonry buildings, special attention has been given to modal analysis. These changes have contributed to making the performance of NOSA-ITACA comparable to state-of-the-art commercial software.

Mode 1
bending mode along X
$f_1^{\text{exp}} = 1.05\,\text{Hz}$
$f_1 = 1.08\,\text{Hz}$

Mode 2
bending mode along Y
$f_2^{\text{exp}} = 1.30\,\text{Hz}$
$f_2 = 1.28\,\text{Hz}$

Mode 3
torsional
$f_3^{\text{exp}} = 4.20\,\text{Hz}$
$f_3 = 4.24\,\text{Hz}$

Mode 4
bending and torsional
$f_4^{\text{exp}} = 4.50\,\text{Hz}$
$f_4 = 4.52\,\text{Hz}$

The package relies on a finite element formulation of the differential equations governing the statics and dynamics of masonry buildings. NOSA-ITACA contains an extensive element library, including beam, plane, shell, three-dimensional and axisymmetric elements.

This code can be used to perform static and dynamic analyses under different loads and boundary conditions, in addition to modal analysis. The modal analysis is performed considering master-slave constraints (tying or multipoint). This gives rise to a large scale eigenvalue problem (typical sizes range from 100K up to 1 million of unknowns), which needs to be solved via a Lanczos-type method. Since the frequencies of interest are the smaller ones, inverse iterations are needed; in the most recent version of the NOSA-ITACA package we employed the ARPACK code (performing Lanczos iteration with implicit restarts) together with the multifrontal
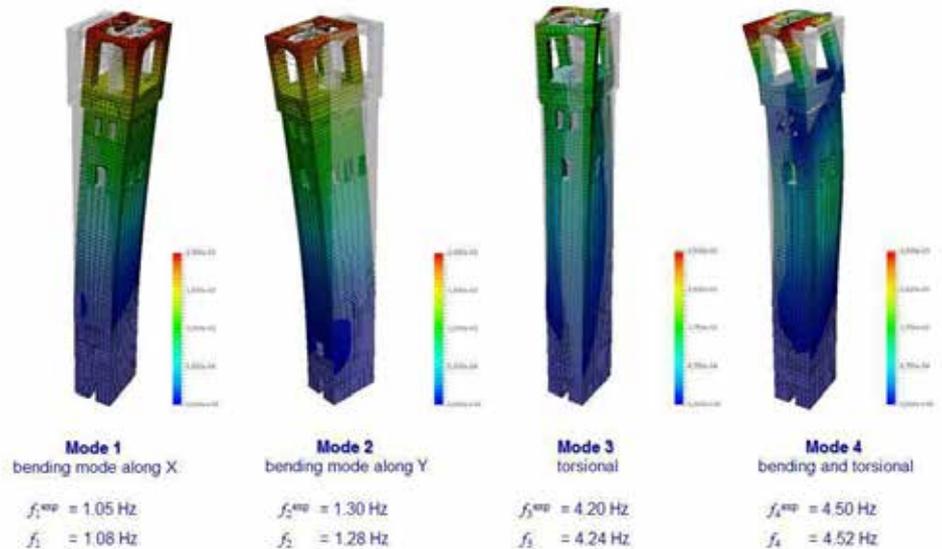
sparse linear system solver MUMPS, which exploits the (multi)-band structure available in the discretization of local operators. Imposing constraints does not degrade the sparse structure of the eigenvalue problem, thanks to the fact that each constraint involves a small number of nodes.

In the linear elastic framework, where several state-of-the-art commercial software packages are available, we attain comparable computation times (sometimes even faster). The solution of the problem modeled using the constitutive equation of masonry-like materials is slightly more expensive, due to the nonlinearity, but only by a small multiple; in fact, the Newton method often converges in just a few steps, and thus the analysis requires the solution of a small number of linear elastic problems.

The package is available at http://www.nosaitaca.it/software/, and works on any mod-

ern GNU/Linux system. The distribution system has been improved with respect to past releases, and it is now possible to run NOSA-ITACA 1.1 simply by downloading a compressed file and launching the executable.

Future developments of the software will include the integration of a model updating step, matching the experimentally measured frequencies and identifying the unknown properties of the materials constituting the structure under study.

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Inspecting vessel kinematics by satellite imagery processing

Wake components frequency analysis

Azimuth shift effect estimation

Optical/SAR data and system Integration for Rush Identification of Ship models (OSIRIS) is a European Space Agency project launched in March 2016, with the primary purpose of developing a software platform dedicated to maritime surveillance. The platform will be in charge of: (i) collecting optical/radar data provided by satellite missions such as Sentinel-1/Sentinel-2, Cosmo-SkyMed and EROS-B, and (ii) processing the acquired data in order to detect and classify seagoing vessels.

Previous research has provided a robust description of the physics underlying the wake pattern generated by the ship's passage through water. Starting from these results, a main goal in OSIRIS is the development of computational imaging procedures to process Synthetic Aperture Radar (SAR) data in order to provide insights about ship kinematics.

The wake formation results from the combination of multiple oscillatory components whose summation exhibits a V-shaped pattern centered on the ship's route axis. The angular aperture of this V usually features

a constant value, which approximates 39°. Exploiting these observable phenomena, the route direction can be estimated by first detecting the V pattern through a Radon-transform-based linear detector, and later by identifying the wake center axis. The upper figure illustrates this by showing a SAR map with a large wake pattern and the wake components recognized by means of Radon-transform-based line detection.
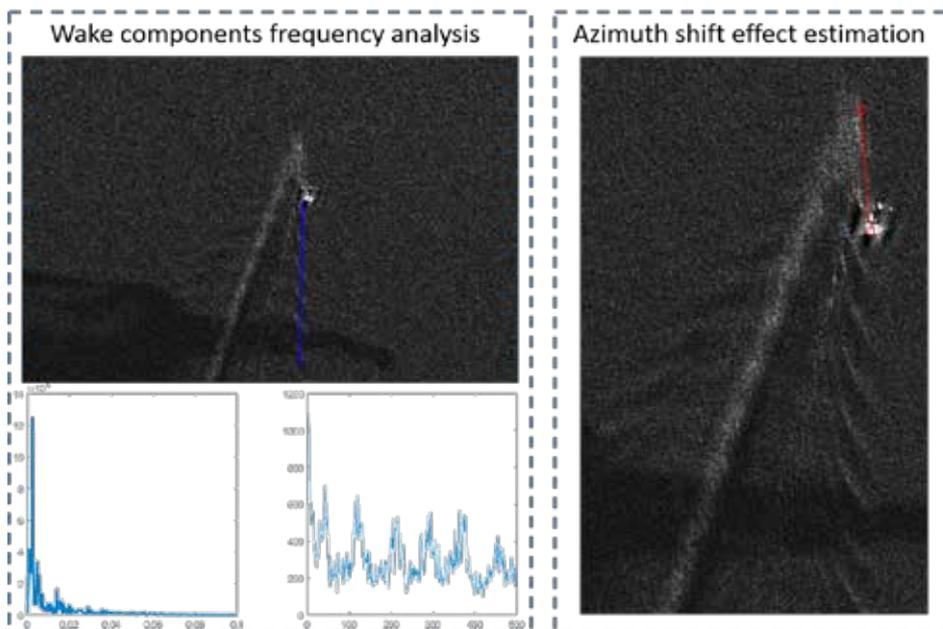
The wake pattern also carries information about the vessel's speed. For example, the oscillatory components observed in the external boundaries of the wake, feature wavelength values that depend on the velocity of the ship. Hence, provided the image resolution is large enough to observe these specific wake details, the ship's velocity can be estimated by performing a frequency analysis of the external wake components, followed by the computation of the dominant wavelength. A second method to estimate the speed of the vessel regards the azimuth shift effect, a distortion that affects SAR remote sensing, causing an artificial separation in the map captured between the ship in motion and its corresponding wake. The separation length is proportional to the vessel's speed. The speed can thus be obtained by measuring the separation length directly on the SAR map. In the lower figure, these two image processing methods implemented in our software are applied to data captured in the OSIRIS framework.

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http://wiki.services.eoportal.org/tiki-index.php?page=OSIRIS

High-altitude telemedicine

A telemedicine system has been developed in the framework of the e-Rés@Mont project: Mountain Medicine Applications around Mont Blanc

A system for telemedicine to support people at high altitudes has been designed and developed by the Signals & Images Lab at ISTI. This system has been implemented as part of the e-Rés@Mont project, carried out within the Interregional V ALCOTRA European programme.

The system is intended for use in mountain shelters above 2100 m.a.s.l, and enables a remote connection to hospital clinicians, mainly but not exclusively to assess risks related to Acute Mountain Sickness (AMS). The project is coordinated by the Local Health Authority of Valle d'Aosta (AUSL). In the Espace Mont Blanc context of cross-border cooperation, the partners are Montagna Sicura Foundation (IT), Ifremmont (FR), GRIMM (CH), Hes.So (CH), Espace Mont Blanc (FR, IT, CH) and IFC and ISTI of the National Research Council of Italy (IT).

The telemedicine system supports nurses while they are visiting patients, providing a smart interface for the acquisition of information regarding anamnesis and vital parameters: this multimedia data comprises text, audio, ECG, images and videos.

A videochat conference system has been implemented using real-time communication functionalities innate in new browsers and integrated in the smart interface in order to connect nurses and patients with remote clinicians. In this way, the clinician on duty can use a tablet or a personal computer to check the information collected in real time and can provide a diagnosis. In the absence of connectivity, a Smart Assistance System based on a Decision Support System provides risk scores and guidelines on the basis of the information acquired.

For the winter campaign, a survey on a mobile app and a Web site (http://e-resamont.isti.cnr.it/) have been also developed at ISTI with the aim of collecting information related to lifestyle and Acute Mountain Sickness (AMS) in order to evaluate new indices of risk at high altitudes. Anyone visiting the mountain can fill in this survey either in written form, via web or using an ad-hoc mobile app with local storage functionalities. In the latter case, data is stored first in the mobile phone in case of absence of connectivity, then, when connection is available is automatically sent to the server implemented at ISTI. For further checkups, an anonymous identifier relates data acquired via this survey with data collected using the telemedicine system.

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RankEval

An Evaluation and Analysis Framework for Learning-to-Rank Solutions

RankEval is an open-source tool for the analysis and evaluation of Learning-to-Rank (LtR) models based on ensembles of regression trees, presented as a demo at ACM SIGIR 2017. Gradient Boosted Regression Trees (GBRT) is a flexible statistical state of the art classification and regression learning technique for training effective LtR solutions. The success of GBRT led to the development of several open-source LtR libraries targeting efficiency in the learning phase and the effectiveness of the resulting models. However, these libraries offer limited help for the tuning and evaluation of trained models. In addition, the implementations for evaluation metrics differ from library to library, thus making objective evaluation and comparison between trained models a difficult task. RankEval addresses these issues by providing a common ground for LtR libraries with respect to evaluation and model comparison.

The most important features provided by RankEval are: effectiveness analysis (model performance, tree-wise performance, query-wise performance, query-class performance, document graded relevance performance, rank confusion matrix), feature analysis (feature importance, feature use statistics), structural analysis (statistical significance, bias vs. variance decomposition), topological analysis, interoperability among GBRT libraries (LightGBM, XG-Boost, QuickRank, and scikit-learn). These functionalities can be applied to several models at the same time, so to have a direct comparison of the analysis performed.

There are two ways in which RankEval can be used: i) as a Python module and ii) as a Python Jupyter notebook. The results of each test are presented as report tables and plots, which can be either saved into files or observed inline in a Python Jupyter notebook. Several Jupyter notebooks, available on the GitHub repository, show the main functionalities and can be used as tutorials.

RankEval can be used by researchers in the LtR field, but also by software engineers and product managers looking for the best practical solution for analyzing and solving their machine-learned ranking problems.

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Narrative building and visualising tool

Building and visualising narratives in digital libraries

The Narrative Building and Visualising Tool (NBVT) is a semi-automatic tool designed to construct and visualise narratives, intended as semantic networks of events related to each other through semantic relations.

This tool references an ontology for narratives we developed as an extension of the CIDOC CRM standard vocabulary. NBVT uses Wikidata as an external knowledge base of entities and imports images from Wikimedia Commons. The users of NBVT can populate the ontology either by choosing entities automatically imported from Wikidata, or by defining new entities. NBVT assigns URIs to the selected entities, makes it possible to link entities to related events, and events to each other through semantic relations. The tool also allows events to be connected to related digital objects stored in external digital libraries. In addition, users can also provide primary and secondary sources for the events of the narrative.

The knowledge acquired by the tool is exported as Linked Data and it is automatically saved, behind the scenes, as an OWL (Web Ontology Language) graph in a Blazegraph triple store. Using this representation, the tool allows the knowledge in the graph to be visualized in simple formats using SPARQL queries. In particular, the tool aggregates and visualizes the knowledge in different ways: (i) a timeline of the narrative; (ii) a graphical representation of the events and related entities; (iii) a graphical representation of the entities and related events; (iv) a table showing the events occurring in a certain range of time; (v) a table showing the primary sources of the events.

Currently, four different narratives have been built with the NBVT tool on: (i) the life of Dante Alighieri, (ii) the life of Gustav Klimt, (iii) the history of the giant squid, (iv) climate change. These narratives can be explored on the Web site of the project.

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ISTI Young Researcher Award

Edition 2017

The "Young Researcher Award" is an initiative by ISTI that aims at rewarding and making visible the work by young researchers at the Institute.

The award (2017 is the fifth edition) selects the three best students in two categories (Young, for Ph.D. students and researchers less than 32 years old, and Young++, Ph.D. students and researchers less than 35 years old). The selection is made on the base of the number and quality of the publications produced in the previous year. The winners receive a small sum to support their research activity and have the possibility to present their research to their colleagues in the context of a cycle of seminars.

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For the 2017 edition, the winners of the two categories were:

Young

 Riccardo Guidotti

 Lucia Vadicamo

Young++

 Davide Basile

 Alessio Ferrari

Best Paper Award - SIGNAL 2017

The paper "A Low Cost Technology-based Device for Breath Analysis and Self-monitoring" by Danila Germanese, Mario D'Acunto, Massimo Magrini, Marco Righi, Ovidio Salvetti has received the Best Paper award at the The Second International Conference on Advances in Signal, Image and Video Processing - from Sensing to Applications (SIGNAL 2017) May 21 - 25, 2017 - Barcelona, Spain.

https://www.iaria.org/conferences2017/AwardsSIGNAL17.html

Eurographics Software Award - Symposium on Geometry Processing 2017

MeshLab, the open source mesh processing system developed by the Visual Computing Lab of the ISTI - CNR has been endowed with the prestigious Eurographics Software Award. MeshLab, which has a wide user base both in the research and in the industrial community, is currently utilized by hundreds of thousands of users for cleaning, converting, visualizing and remeshing 3D models.

MeshLab has been downloaded more than 3 million times and it has been recognised at the most important conference on geometry processing "for having contributed to the scientific progress in Geometry Processing by making the software available to the public such that others can reproduce the results and further build on them in their own research work".

http://www.meshlab.net/

Ph.D. dissertations

An ontology for narratives

Author: Valentina Bartalesi Lenzi, Dipartimento di Ingegneria dell'Informazione, Università degli Studi di Pisa

Supervisors: Francesco Marcelloni, Carlo Meghini

Digital Libraries (DLs) are mostly built around collections of scarcely related objects and offer simple search functionalities that return a ranked list of their resources. Generally, no semantic relation between the objects, which could help users to obtain a more complete knowledge on the subject of the search, are reported. The long term aim of this thesis is to enrich the information space of DLs by introducing narratives as first-class objects that can support a better search functionality. This functionality should not only return a list of objects but should also present narratives, composed of events that are linked to the DLs objects and are endowed with semantic relations connecting these events into a meaningful semantic network. As a necessary step in this direction, the thesis presents an ontology for representing narratives. A conceptualisation inspired to narratology literature was developed and expressed using the CIDOC CRM as reference ontology. This expression was implemented and used to validate the conceptualisation through the creation of a narrative of Dante Alighieri's life. For this experiment, a semi-automated tool was developed that collects basic knowledge about objects and events from Wikidata. This ontology can be used beyond biographies to represent general types of narratives. [Web site: dlnarratives.org]

Analysis of polarized communities in online social network

Author: Mauro Coletto, Scuola IMT Alti Studi Lucca

Supervisors: Claudio Lucchese, Rocco De Nicola

Increasingly, people around the globe use Social Media (SM) - e.g. Facebook, Twitter, Tumblr, Flickr, Youtube - to publish multimedia content (posting), to share it (retweeting, reblogging or sharing), to reinforce it or not (liking, disliking) and to discuss (through messages and comments) in order to be in contact with other users and to get informed about topics of interest. Online Social Networks (OSNs), then, provide a space for user aggregation in groups, expressing opinions, accessing information, contributing to public debates, and participating in the formation of belief systems. Our work is an initial study of opinion polarization on Online Social Networks with some in-depth analyses of specific topical user communities. It brings novel contributions in: i) characterizing communities through the perspective of user polarization; ii) proposing a novel method to classify polarized users and topic evolution over time; iii) understanding user behavior from a social media perspective; iv) integrating polarization with other variables (time, space) with the purpose of analyzing a social phenomenon; v) defining controversy and how to detect it regardless of the content; vi) describing how people aggregate and share information in various contexts. Different topical communities and several OSNs are described in the dissertation, providing a general overview of the investigation field and proposing contributions to the discussion and solutions.

Personal data analytics: capturing human behavior to improve self-awareness and personal services through individual and collective knowledge

Author: Riccardo Guidotti, Dipartimento di Informatica, Università degli Studi di Pisa

Supervisors: Dino Pedreschi, Fosca Giannotti

In the era of Big Data, every user leaves behind a myriad of digital breadcrumbs while performing her daily activities. This enormous amount of personal data could be exploited to improve the lifestyle of each individual by extracting, analyzing and exploiting user's behavioral patterns like the items frequently purchased, the routinary movements, etc. However, even though some user-centric models named Personal Data Store are emerging, currently there is still a significant lack in terms of algorithms and models specifically designed to extract and capture knowledge from personal data.

This thesis proposes an extension to the idea of Personal Data Store through Personal Data Analytics. With Personal Data Analytics we describe parameter-free algorithms which are able to automatically extract the patterns from the user's data, and we define personal data models which are able to capture the users' behavioral patterns. In addition, we exploit Personal Data Analytics to propose individual and collective services for users organized in a Personal Data Ecosystem and available to share part of their own patterns as a return of the providing service. We show how sharing with the collectivity improves the level of service for individuals and simultaneously leads to forms of collective gain. To prove the feasibility of Personal Data Analytics we report extensive experimentation on real world data.

Distributed graph processing: algorithms and applications

Author: Alessandro Lulli, Dipartimento di Informatica, Università degli Studi di Pisa

Supervisors: Laura Emilia Maria Ricci, Patrizio Dazzi

Thinking Like A Vertex (TLAV) is a popular computational paradigm suitable to express many distributed and iterative graph algorithms. It has been adopted as base computational paradigm for many distributed frameworks and endorsed by numerous industries and academias. Recently, TLAV has been exploited to define algorithms to extract useful information from graphs. The thesis presents several problems for which a solution is not always available or state-of-art algorithms are unsatisfactory, under many points of view. This thesis aims at providing guidelines for defining distributed graph algorithms structured according to TLAV and showing their applicability to real applications. The thesis shows how approximation, simplification and versatility can be combined to define novel distributed algorithms to improve currently available solutions with the goal of enhancing the functionalities of the algorithms. In particular, novel algorithms for computing betweenness centrality, connected components and clustering are presented. Such algorithms are exploited for Spam campaign detection, population estimation and hashtag centrality. For this purpose, large datasets provided by our colleagues has been exploited: Symantec for Spam emails, a large Italian Mobile Phone provider, for mobile calls, and ISTI-CNR for a two years collection of real tweets from the Twitter social network.

Enhancing digital fabrication with advanced modeling techniques

Author: Luigi Malomo, Dipartimento di Informatica, Università di Pisa
Supervisors: Paolo Cignoni, Nico Pietroni

Given the digital nature of machine-controlled manufacturing processes, a clear need exists for computational tools that support a new way of productional thinking. For this reason, the ultimate target of this research is to improve the ease of use of such technologies, providing novel supporting tools and methods to ultimately sustain the concept of democratized design ("fabrication for the masses"). The thesis presents a novel set of methods to enable, with the available manufacturing devices, new cost-effective and powerful ways of producing objects. The contributions of the thesis are three. The first one is a technique to automatically create a tangible illustrative representation of a 3D model by interlocking together a set of planar pieces, which can be fabricated using a 2D laser cutter. The second method makes it possible to automatically design flexible reusable molds to produce many copies of an input digital object. The designs produced by this method can be directly sent to a 3D printer and used to liquid-cast multiple replicas using a wide variety of materials. The last technique is a method that uses a single-material 3D printer to fabricate objects with custom elasticity, and an optimization strategy to design printable objects with a prescribed mechanical behavior.

Data flow quality monitoring in data infrastructures

Author: Andrea Mannocci, Dipartimento di ingegneria dell'informazione, Università degli Studi di Pisa
Supervisors: Marco Avvenuti, Paolo Manghi

A Data Infrastructures (DI) can be intended as an ICT (eco) system offering data and processing components which can be combined into data flows so as to enable arbitrarily complex data manipulations serving the consumption needs of DI customers, be they humans or machines. Data resulting from the execution of data flows represent an important asset both for the DI users and for the organization (or community) operating the DI, whose existence and cost sustainability depend on its adoption and usefulness. At the same time, when operating many data flows over time, several issues may arise and compromise the behavior of the DI, and therefore undermine its reliability and generate stakeholders' dissatisfaction. Monitoring the quality of data flows is therefore a key activity of paramount importance to ensure the uptake and long term existence of a DI. In this thesis, we introduce MoniQ, a general-purpose Data Flow Quality Monitoring system enabling the monitoring of critical data flow components, which are routinely checked during and after every run of the data flow against a set of user-defined quality control rules to make sure the data flow meets the expected behavior and quality criteria over time, as defined by the quality manager.
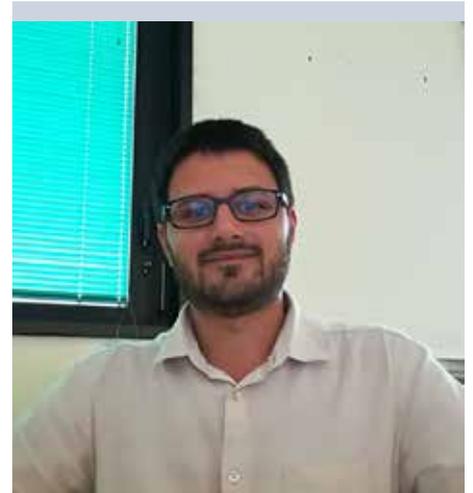
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CCS 2018: Collective and Cooperative Systems - Special Track of the 33rd ACM Symposium on Applied Computing (SAC2018), Pau, France, 9-13 April 2018

http://sac-cas2018.apice.unibo.it/

QAPL 2018 - 16th International Workshop on Quantitative Aspects of Programming Languages and Systems, Oxford, U.K., 14 July, 2018.

http://www1.isti.cnr.it/~Massink/EVENTS/QAPL2018/

FM 2018 - 22nd International Symposium on Formal Methods, Oxford, UK, 15-17 July 2018

http://www.fm2018.org/

FormaliSE - 6th International Conference on Formal Methods in Software Engineering, Gothenburg, Sweden, 2 June 2018 (a co-hosted ICSE 2018 Conference)

http://www.formalise.org

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