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ISTI NEWS

PhD Course in Data Science

A new interdisciplinary path on Big Data

A new PhD course is starting right now. An agreement has just been signed by CNR (ISTI and IIT Institutes), the University of Pisa, the Scuola Superiore Sant’Anna, the Scuola Normale Superiore and IMT of Lucca for a PhD course in Data Science, an interdisciplinary course open to graduates of any discipline. This course will respond to the demands of both academia and industry. The digital revolution and the resulting availability of very large volumes of data (the so-called “big data”) make it increasingly necessary to prepare specialized professionals with competence in advanced techniques of statistical analysis, data mining and machine learning. This need is felt by all disciplines, strongly encouraging a hybrid scientific approach.

[continues on page 4]

Megafauna 3D

Megafauna 3D is an online platform that invites you to discover the giant mammals that inhabited South America thousands of years ago. It is a fossil digitization initiative consisting of a collection of 3D models and a series of didactic and interactive activities based in paleontology. Created in Montevideo, Uruguay, this project involves paleontologists, designers and programmers and will grow over time, by adding new 3D models to the collection.

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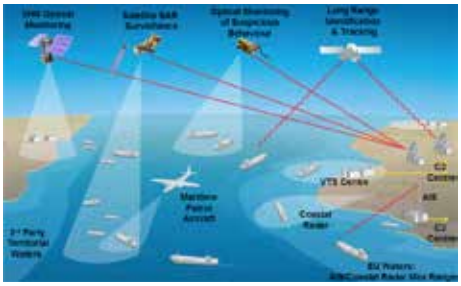


OSIRIS Project

Co-funded by ESA under “General Support Technology Programme” GSTP-6

The European Space Agency (ESA) and a scientific consortium led by MAPSAT, an Italian company providing remote sensing services for continuous monitoring of the Earth’s surface, recently launched the project OSIRIS “Optical/SAR data and system Integration for Rush Identification of Ship models”.

[continues on page 5]

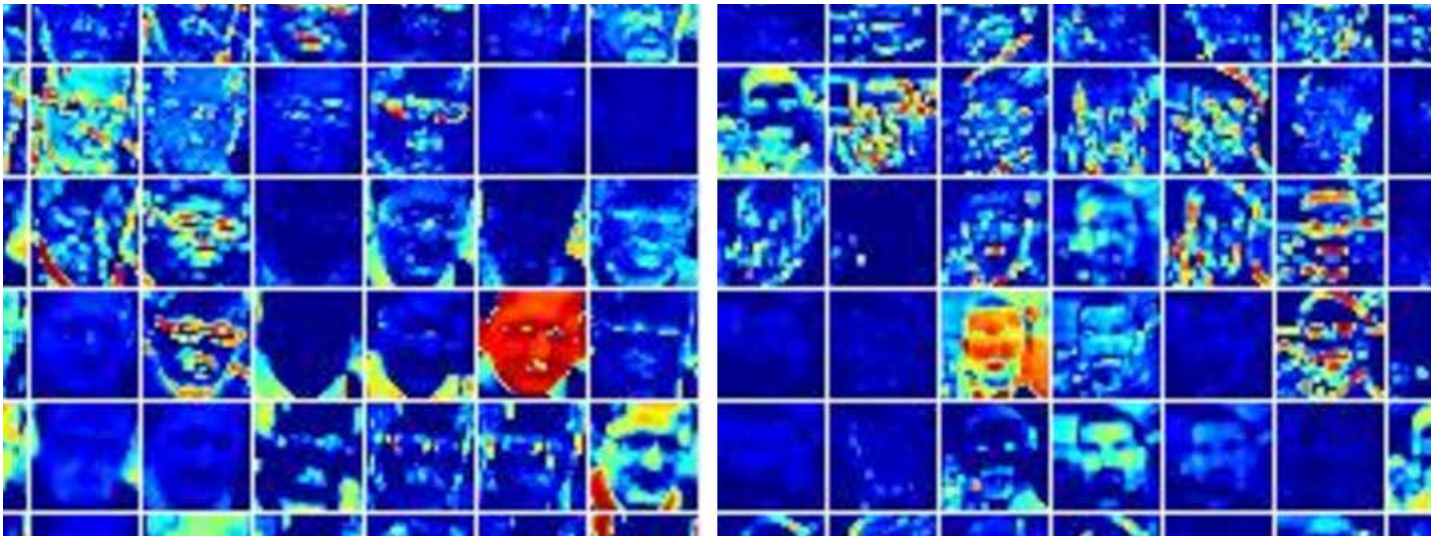
Editorial

Deep Learning

Deep Learning (DL) is a branch of machine learning that focuses on representation-learning methods composed of multiple levels of non-linear modules. Starting from a low level representation of an object (e.g., characters, pixels) each level outputs a representation at a higher, slightly more abstract level, until a complex output is produced (e.g., text classification, scene description).

[continues on page 3]

Contents



Deep learning
[Continued]

The recent success of Deep Learning is mainly due to the availability of big data, which Artificial Neural Networks (ANN) exploit in order to learn very complex models, and the increase of computing power, especially thanks to the technological progress in parallel GPU-based computing. Deep ANN (DNN) have recently proved to be extremely effective in learning complex cognitive processes, such as image understanding, natural language processing and generation, or even beating top-ranked players of Go.

In fact, big news in 2016 was AlphaGo beating the 18-times world champion Lee Se-dol in a five-game Go match. The number of games that can be played on Go are estimated to be about 10^170, an enormous number compared to chess (about 10^47).

AlphaGo, developed by DeepMind (a British company owned by Google DeepMind), achieved this milestone in AI using Deep Learning.

Dual process theory from psychology, can help to understand how AlphaGo uses Deep Learning to play Go. This theory, originally proposed by William James in 1890, has become famous thanks to the work by Daniel Kahneman who won the Nobel prize in economic sciences in 2002. Kahneman in his studies demonstrated that the human brain uses two disparate modes of thinking: intuitive understanding and logical reasoning. Understanding is "fast", parallel, intuitive, subconscious and involuntary. Reasoning is "slow", sequential, logical, conscious and voluntary.

In AlphaGo, Deep Learning is used for the intuitive understanding process needed to reduce the enormous space of possible moves, by "intuitively" forecasting the final result of the match given a single move. Once a reduced set of promising moves is identified by the DNN from all the possible moves, the actual move is selected by a Monte Carlo tree search algorithm that explores the potential evolution of the game. This means that the "slow reasoning" component is mostly a mechanical search that is able to give an intelligent contribution because of the quality of the selection performed by the "fast thinking" DNN component.

The success of AlphaGo shows that deep learning methods are incredibly useful for intuitive understanding. In fact, the most significant advances with respect to previous state-of-the-art techniques achieved by DL tools have been shown in tasks that humans perform using mainly intuitive understanding, such as speech recognition and image classification.

Researchers of our institute are studying deep learning and exploring its application in many different disciplines and scenarios. In June 2016 we had a half day workshop in which some of these activities were presented. Topics ranged from Convolutional ANN-based visual features for image similarity search, to neural language models for information retrieval, efficient parking lot tracking via low resources intelligent cameras, denoising and reconstruction, learning and inference in personal informatics systems, and cross-media retrieval.

One of the winning submissions in the ProgettISTI project proposal writing exercise is based on using deep learning in order to improve the generation of high dynamic range (HDR) images. Some of the other DL-related activities currently ongoing in the institute are focused on anomaly detection in automotive sensors.

DL is not a blanket solution for all artificial intelligence problems, but it is certainly a new approach to machine learning that will have a relevant impact on a wide range of applications. Deep Learning is here to stay.

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PhD course in data science

A new interdisciplinary path on Big Data

The data scientist is currently one of the professions most in demand in the market. In fact, there is general agreement that the demand in this area far exceeds the actual availability. For example, the World Economic Forum's report "The Future of Jobs", released in 2016 and based on a large global survey in different manufacturing sectors, identifies big data and associated technologies as the main disruptive change factor, and the "data scientist/data analyst" as the job that emerges as critical and indispensable in all areas.

Consequently, Italian universities and research centers in Tuscany decided to face this challenge by creating a new generation of researchers who combine specific disciplinary skills with those of the data scientist, and are capable of advancing knowledge by exploiting the wealth of data and models available both in specific disciplines and in the interface between different disciplines .

The interdisciplinary PhD course in Data Science represents only the final part of the interest of Tuscan research centers in this field. For several years now, CNR (ISTI and IIT Institutes), the University of Pisa, the Scuola Superiore Sant'Anna, the Scuola Normale Superiore and IMT of Lucca have been working in the area of big data, employing their researchers in many pioneering European projects and in the first Italian and European experiences aimed at training "data scientists" at the various stages of higher education: bachelor's, master's and PhD courses.

In 2015, SoBigData.eu, the network of European Centers coordinated by the ISTI and IIT institutes of CNR was launched. This network provides data, tools and skills to conduct large-scale experiments in big data analytics by researchers, innovators, startupers, policy-makers and public institutions. SoBigData is an ecosystem of technologies and people making big data accessible as a public resource for open data science, in an ethical framework of transparency of processes and purposes, respect for privacy and responsibility.

> The PhD course will guide students through various fields of data science, from sociology to economics, through biology and health.

In SoBigData, PhD students experiment with new analytical methods and new applications in all disciplines, using the experience acquired over the last 10 years from the preparation of PhD theses in data science in the partner laboratories. In its report on its Big Data working group, MIUR (the Italian Ministry of Education, University and Research) explicitly mentions SoBigData as the only Italian example of a training platform for PhDs in Data Science and recognizes the PhD programme of IMT as an exemplary PhD on topics of big data.

It is intended that the new PhD course will guide students through various fields of data science, from sociology to economics, through biology and health. To enable graduates in all disciplines to tackle the course, an alignment of data science skills is planned in order to create a common ground for PhD students from different disciplinary areas, exploiting the undergraduate and postgraduate courses already active in the different research centers.

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Image by: https://www.flickr.com/photos/tsevis/8596935889/ tsevis/8596935889/

EMOTIVE: towards enhanced AR in museums

EMOTIve Virtual cultural Experiences through personalized storytelling Co-funded by Horizon 2020

EMOTIVE is an EU-funded heritage project that aims to use emotional storytelling to dramatically change how we experience heritage sites.

For heritage professionals, the Emotive application will provide a powerful storytelling engine and a set of rich digital media assets that can be used to create detailed characters and narratives featuring archaeological sites or collections of artifacts.

For visitors, Emotive will offer dramatic, emotionally engaging stories that can be experienced while at a cultural site or remotely. Wherever visitors are, they can follow characters, look for clues and explore environments alone or with family and friends.

The contribution of ISTI-CNR to EMOTIVE will be twofold, in the digital fabrication and in the VR/AR field.

We will exploit recent research developments in the digital fabrication field techniques for the in-house reproduction of physical artifacts that can be cheaper than traditional production processes, and which can easily scale to the production of hundreds of copies, quantities that can be expected to be distributed in museum applications.

We will design and develop an augmented reality system based on consumer hardware that will virtually overlay the correct appearance of the original object over a cheaply fabricated copy, offering a better and more appealing experience. High quality appearance reproduction is a very complicated and costly process, which, for practical and economic reasons, cannot be used in the context of reproductions that have to be distributed to visitors.

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OSIRIS

Co-funded by ESA under “General Support Technology Programme” GSTP-6

The European Space Agency (ESA) and a scientific consortium led by MAPSAT, an Italian company providing remote sensing services for continuous monitoring of the Earth’s surface, recently launched the project OSIRIS “Optical/SAR data and system Integration for Rush Identification of Ship models”. The main goal is the development of a platform dedicated to sea surveillance, capable of detecting and identifying illegal maritime traffic. OSIRIS will thus represent a new tool for combating unauthorized fishing, irregular migration and related smuggling activities. OSIRIS is carried out within the ESA General Support Technology funding Programme (GSTP).

The OSIRIS project consortium includes two CNR research groups, namely the Web Applications for the Future Internet Group of IIT-CNR and the Signals and Images Laboratory of ISTI, providing long-standing expertise in the Machine Learning and Computer Vision fields. Another member of the consortium is Sistemi Territoriali, an Italian company with expertise in the Geographic Information Systems and Business Intelligence Systems fields. The OSIRIS technological platform will be in charge of collecting and integrating data, made available by multi-source multi-sensor satellite missions, for specific maritime areas of interest. High-resolution data will be provided by the Sentinel-1 (SAR) and Sentinel-2 (Optical) satellites, both part of the ESA Copernicus mission. Very high-resolution data will be provided by Optical EROS-B (ISI - IMAGESAT) and SAR COSMOSkyMed (Italian Space Agency). The data will then be processed in order to detect and identify the ships located in the area of interest and to provide estimates of meaningful ships’ features, e.g. kinematics and shape parameters. Crucial information to perform the ship identification task will be collected by means of popular ship monitoring systems such as the Automatic Identification System (AIS) and by integrating additional information gathered from Open-Source Intelligence systems (OSINT). The data will be finally analysed to provide predictive models for the routes of these ships.

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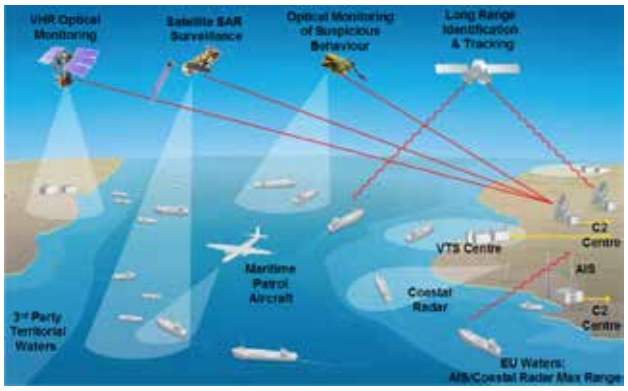

SCIADRO

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

Developed originally for military applications, the use of Unmanned Autonomous Systems (UASs) is increasingly common in the field of civil applications. In fact, civil applications usually require Remotely Piloted Aircraft Systems (RPAS) more than UASs, when a totally autonomous flight is required for the purpose of video recording, context analysis, photogrammetry and precision agriculture, among others.

The SCIADRO (SCIAme di DROni, Drone Swarm) project deals with the safety and protection of the environment by means of reconfigurable sensors able to detect gas, heavy metals, and bacteriological or electromagnetic pollution in areas that are difficult to access by classical instrumentation. SCIADRO is based on six operational objectives with the aim of designing, prototyping and testing innovative enabling technologies and sensors applied to drone swarms.

Several enabling technologies have been identified and will be designed and tested:

- communications between RPASs and one or more ground control stations (GCS), with relative problems of handover between GCS;
- algorithms for on-board pre-processing of optical and infrared sensors, photogrammetry in near real time, looking also at the photogrammetry of dynamic scenes;
- use of cloud computing for the distribution of information;
- innovative GAS sensors;
- sensors of opportunity for the dissemination of real-time data, for security applications in highly dynamic environments;
- compact sensors, installed on drones, for the verification of electromagnetic pollution levels and the verification of the radio traces used by aircraft during landing.

Experimental trials will take place mainly with RPAS provided by IDS “Ingegneria dei Sistemi” S.p.a, specially designed for the testing phase and integrated with the sensor nodes.

The project consortium is composed by a large company, two SMEs and three research organizations.

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Intesa

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

The goal of the INTESA project is the realization of a set of customized services based on innovative and noninvasive ICT technologies, targeted at improving the quality of life in elderly people, with the aim of preventing the worsening in conditions of health in subjects at risk. The Tuscany Region has outlined guidelines for the management of the health of elderly people without disabilities, highlighting the emerging need to find solutions to prevent bone embrittlement through a strengthening of overall conditions, following a “bio-psycho-social” approach acting directly on various functional domains (physical, psychological and social). However, the constant monitoring of patients involves high costs for the national health system unless we can use remote monitoring solutions: Minimally invasive ICT solutions, which are easily acceptable by elderly subjects, would allow for regular monitoring. The Intesa project proposes a range of services and mobile applications targeted at early diagnosis of conditions of fragility and prevention of the aggravation of conditions of health / well-being through the remote monitoring of physical activity and social interaction. The intention is to improve the lifestyle of elderly people. The services will be integrated with respect to data collection and analysis in order to provide customized feedback based on the analysis of the overall condition of subjects, providing an alert message system for the primary care physician and caregivers (family members, social workers, etc.). The Signals & Images and Wireless Network Labs of ISTI are involved in this project together with researchers from IIT-CNR, Pisa.

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SocializeME

A collaboration between ISTI/IIT-CNR and a secondary school Co-funded by Fondazione Cassa di Risparmio di Lucca

The goal of SocializeME is to test and evaluate the use of ICT technologies to study complex social phenomena among teenagers in secondary schools. More specifically, the project focuses on the analysis of the dynamics of social interactions among students during certain activities. For this purpose, the ISTI and IIT institutes have started a collaboration with the "Polo Scientifico Tecnico Professionale E.Fermi – G.Giorgi" located in Lucca in order to recruit students and teachers to conduct a set of experiments.

SocializeME is funded by the "Fondazione Cassa di Risparmio di Lucca" with an expected duration of two years. The main objectives of the projects are:

- To identify relevant sociological markers useful to detect and quantify social ties among students;
- To design and implement a software architecture able to recognize student gatherings with unobtrusive technologies;
- To analyze the data collected in order to understand how students interact during specific activities;
- To actively involve students during the development and testing phases of the project in order to show them concrete examples of the use of ICT technologies.

One of the key-concepts behind SocializeME is to transfer technical expertise to enthusiastic students by involving them as active contributors of the project. CNR researchers will thus organize a tutorial at the school on the technical issues of the project, and will also offer the students the chance to spend some hours at CNR laboratories to support the development and testing of the software architecture that will be used during the experiments. This activity will enable the students to directly experience a research environment and some application scenarios for subjects they study at school.

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https://www.researchgate.net/project/SocializeME

An experiment in the framework of the TITANIO project

Co-funded by Fondazione Cassa di Risparmio di Lucca

TITANIO (Monitoring of historic masonry buildings via innovative sensors) is a research project funded by the Cassa di Risparmio di Lucca Foundation. The project started in August 2016 and is conducted by ISTI (MMS Lab and WN Lab) and INGV (Seismic Observatory of Arezzo). It focuses on the long-term, continuous measurement of the ambient vibrations of old masonry structures. The figure shows the largest bell of the San Frediano bell tower in Lucca, which is being monitored using a low-cost accelerometer developed by WN Lab. The swinging bell has been used to excite the dynamic response of the tower, and the resulting vibrations are measured on the structure via high-sensitive instruments provided by the Seismic Observatory of Arezzo. The NOSA-ITACA code (www.nosaitaca.it/software), developed by MMS Lab, will be used to conduct a numerical simulation: the finite element model of the tower will be subjected to the action of the swinging bell, measured in the experiment. Numerical and experimental results will be compared.

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SmartPark@Lucca

Co-funded by Fondazione Cassa di Risparmio di Lucca

SmartPark@Lucca aims at realizing an information system based on a "smart camera" network capable of monitoring one or more large parking lots. We define a smart camera as a video camera capable of analyzing and processing the acquired image directly on board. Each smart camera will be able to determine, with good accuracy, the occupancy status of the parking spaces monitored, and with limited costs when compared to other parking monitoring solutions.

Looking for a parking space is a common and annoying problem in most large cities. It has been estimated that about 30% of the vehicular traffic in peak hours comes from cars looking for a free parking space. These cars increase traffic congestion and CO2 emissions, and are often the cause of long delays and a high level of stress for drivers.

In order to reduce the time needed to find a free parking space, car drivers should be guided to the available parking spaces.

Automatic parking lot monitoring is one of the most relevant problems for Intelligent Transportation Systems (ITS) in urban scenarios. In general, this problem is approached by using pervasive technologies, like Wireless Sensor Networks (WSN), movement magnetic sensors and electromagnetic sensors installed in the road. These are very reliable tools, but their installation and maintenance costs constitute a heavy constraint, in particular in large areas where many parking spaces need to be monitored.

Thanks to recent computer vision techniques, it is possible to realize a totally automatic visual monitoring approach to solve this problem. The main features of the proposed system are:

Low cost: the smart cameras are realized by using low cost hardware and open source software.

Low bandwidth: image processing is executed directly on board by the smart camera. This means that images are not transmitted, only binary information (occupied/available) about each parking space is sent to the server.

Easy deployment: the smart cameras can be installed cable-free. In many cases it is even possible to reuse already available infrastructures, such as for instance lamp posts, walls, etc.

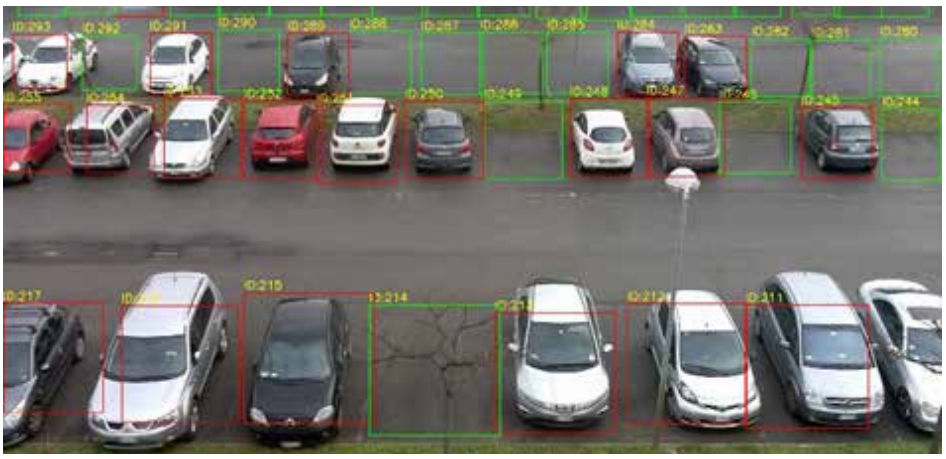
Sustainability: the smart cameras are designed to be energetically autonomous since they can exploit solar panels as the power source.

Scalability: the number of smart cameras to be installed is proportional to the number of parking spaces to be monitored (each smart camera is able to monitor from 30 to 50 parking spaces, depending on the configuration of the parking lot).

Flexibility: if the available bandwidth permits the sending of large volumes of data, the video stream can be optionally transmitted. In addition, each smart camera can store locally a certain amount of images, that can be accessed, if needed.

Multi-service: the visual monitoring infrastructure can be also used for other purposes, such as security, surveillance and navigation.

Accessibility: in addition to the real time visual parking monitoring service, the system also provides aggregated statistical data. This information can be used to develop more efficient parking solutions and to facilitate urban mobility.



The project involves the "NeMIS" and the "SILab" laboratories of ISTI-CNR in Pisa, and Metro Srl in Lucca.

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e-rés@Mont

Mountain Medicine Applications around Mont Blanc
Co-funded by Auvergne-Rhône-Alpes Region under Interreg V-A Italy-France ALCOTRA program

Mont Blanc is an emblematic site famous throughout the world. Even today, this mountain is not seen as a territorial limit but as a geographical feature connecting the Valle d'Aosta, Haute Savoie and Valais areas of Italy and France. These mountainous regions share the same cultural, environmental and sociological features, and work together in transboundary actions.

In particular, medical and rescue activities stand to benefit from synergies and transboundary supplies. Since 2006, the cooperation between helicopter rescue operators and mountain medical operators of Haute Savoie and Val d'Aosta has been supported by the Résamont project network – the mountain medical network of Mont Blanc.

The e-res@Mont project has been developed by the Résamont network to fulfil the requirements of medical operators of the interested regions by developing innovative medical services (intended both for residents and tourists) that combine traditional mountain medicine with promising innovations aimed at increasing the safety of remote mountain areas and at preventing their depopulation. e-rés@Mont is carried out within the Interregional V ALCOTRA programme between Italy and France as part of a project which aims to "Encourage the development of social and health services to tackle the depopulation of rural and mountain areas". 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).

In e-rés@Mont, an ISTI research team from the Signals & Images Lab will use its expertise and experience in biomedical and multimedia data processing for the design and development of decision support and smart assistance systems. The researchers will contribute to the design of a web-based monitoring system which will make it possible to remotely control the health status of people at risk by non-invasive measuring and acquisition of physiological parameters (blood pressure, heart rate , oxygen saturation, ECG monitoring) enriched with images and videos for a more complete clinical evaluation. The decision support system will also propose an anamnestic classification of subjects under examination and will evaluate their individual lifestyle for more personalized assistance. Models will also be designed and implemented for the assessment of risk related to Acute Mountain Sickness (AMS). These services will also be made available through a mobile app that provides access to a self-assessment questionnaire and information about AMS at any time and at any location without the need for an internet connection.

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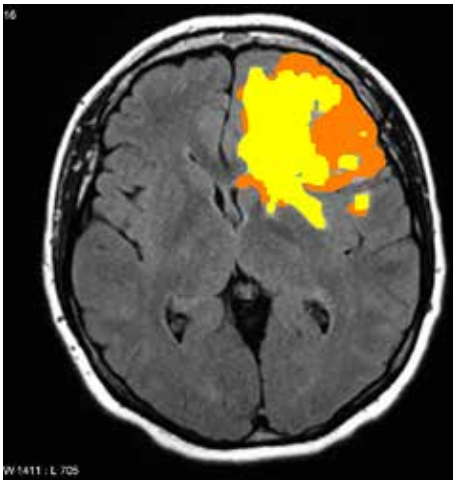
Model checking spatial logics for closure spaces

V. Ciancia, D. Latella, M. Loreti, M. Massink

Logical Methods in Computer Science, vol. 12 (4). Logical Methods in Computer Science, 2016.

Spatial aspects of computation are becoming increasingly relevant in Computer Science, especially in the field of Collective Adaptive Systems---CAS, a class of systems encompassing many smart-cities applications like advanced urban transportation management systems and smart-grid energy production and distribution systems, etc.---and, more generally, when dealing with systems distributed in physical space. It is essential to be able to specify system requirements in a rigorous way, and have automatic tools available that support reasoning on the design and its requirements.

Traditional formal verification techniques are well suited for analyzing the temporal evolution of systems, but typically do not take into account spatial aspects of computation. We define a logic in the tradition of topological interpretations of modal logics, dating back to earlier logicians such as Tarski, where modalities describe neighborhood. The logic is interpreted in spatial models ranging from continuous 2-,3- dimensional Euclidean spaces, to abstract n-dimensional spaces, to discrete, graph-based structures, including graphical images interpreted as (finite) 2-dimensional grids. The logic can describe features of entities in space such as "near", "surrounded", "reachable". We define also efficient model checking algorithms, and provide the first-of-its-kind, open-source proof-of-concept tool topochecker. In [Ci+14] we used topochecker for quality analysis of GPS data concerning the bus system of the city of Edinburgh. Interestingly, the model-checker is applicable also in areas that were not foreseen; for instance, in [Be+16] we combined spatial model checking with texture analysis to segment tumor and edema in medical images, which is of immediate relevance for automatic contouring applications used in radiotherapy for brain glioblastoma.



The proposed approach can be integrated in a more general framework of spatio-temporal logics and related model-checking algorithms [Ci+15a]. For instance, in [Ci+15b,Ci+16] our spatio-temporal model-checker has been used for discovering anomalies in a bike-sharing system of the same size as that of London.

DOI: 10.2168/LMCS-12(4:2)2016

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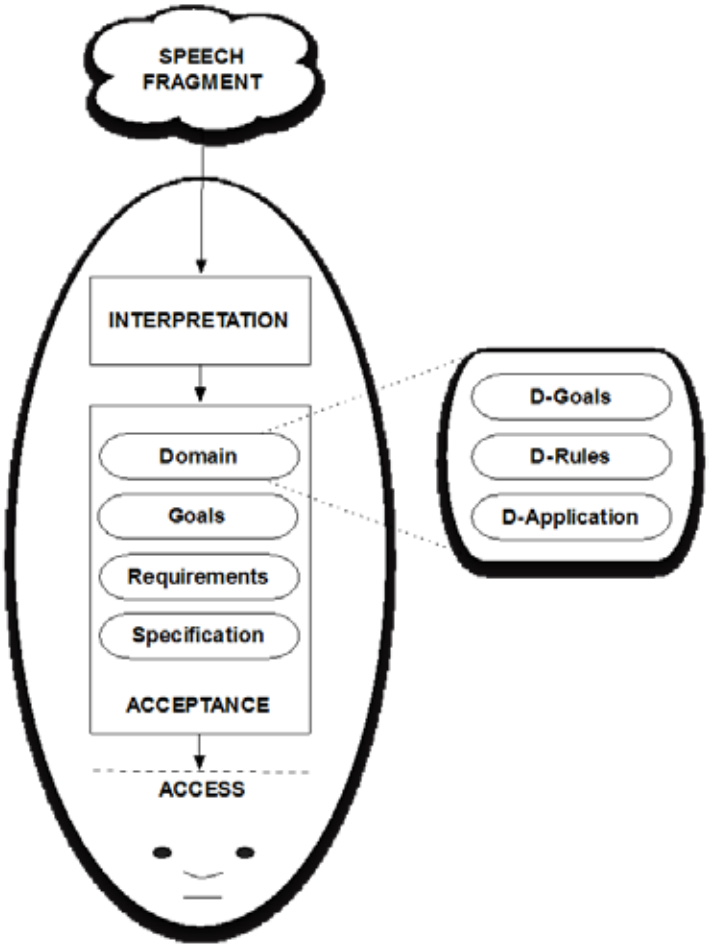
Ambiguity and tacit knowledge in requirements elicitation interviews

A. Ferrari, P. Spoletini, S. Gnesi
Requirements Engineering Journal, vol. 21 (3). Springer, 2016.

Interviews are the most common and effective means to perform requirements elicitation and support knowledge transfer between a customer and a requirements analyst. Ambiguity in communication is often perceived as a major obstacle for knowledge transfer, which could lead to unclear and incomplete requirements documents. In this paper, we analyze the role of ambiguity in requirements elicitation interviews, when requirements are still tacit ideas to be surfaced. To study the phenomenon, we performed a set of 34 customer–analyst interviews. This experience was used as a baseline to define a framework to categorize ambiguity. The framework presents the notion of ambiguity as a class of four main sub-phenomena, namely unclarity, multiple understanding, incorrect disambiguation and correct disambiguation. We present examples of ambiguities from our interviews to illustrate the different categories, and we highlight the pragmatic components that determine the occurrence of ambiguity. Along the study, we discovered a peculiar relation between ambiguity and tacit knowledge in interviews. Tacit knowledge is the knowledge that a customer has but does not pass to the analyst for any reason. From our experience, we have discovered that, rather than an obstacle, the occurrence of an ambiguity is often a resource for discovering tacit knowledge. Again, examples are presented from our interviews to support this vision.



The figure gives a model of the understanding of a speech fragment (i.e., sentence) of the customer by a requirements analyst during an interview. The model is composed of a set of blocks that we call pragmatic components, which jointly contribute to access the information that a customer wishes to express. The access to the information (Access line in figure) implies that the analyst first gives an interpretation (Interpretation block) and then considers if this interpretation is acceptable in light of his/her current mental framework (Acceptance block). Indeed, during the elicitation the analyst builds a mental framework of the problem domain, which is incrementally updated while new information comes from the customer. This mental framework includes the other requirements currently expressed by the customer (Requirements), the motivations of the requirements (Goals), the domain knowledge currently available (Domain), and some form of mental specification of the system (Specification), which the analyst defines to assess the feasibility of the system in advance. The domain knowledge component is further characterised by sub-components, as shown in the figure. Overall, any conflictual phenomenon between the speech fragment expressed by the customer and the different pragmatic components might give raise to an ambiguity. Hence, in our paper, ambiguities are categorised based on the different types of conflicts that might occur with the different pragmatic components.

DOI: 10.1007/s00766-016-0249-3

Empowering mobile crowdsensing through social and ad-hoc networking

A. Corradi, S. Chessa, L. Foschini, M. Girolami
IEEE Communications Magazine, vol. 54 (7). IEEE, 2016.

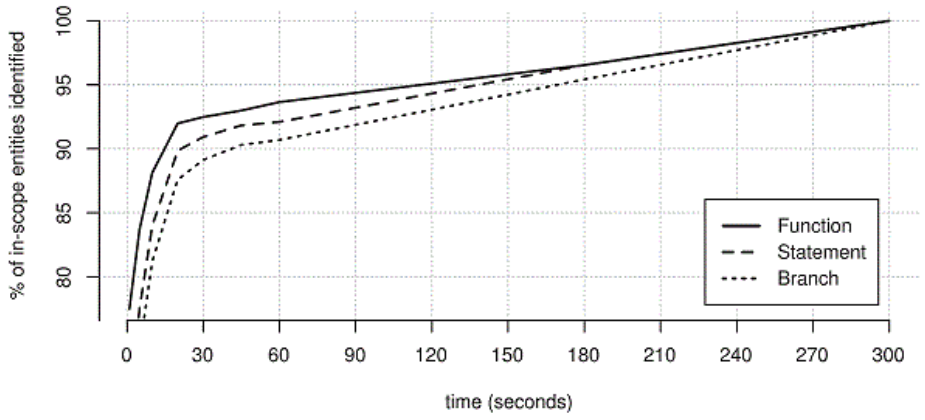
Mobile Crowd-Sensing (MCS) enables collective data harvesting actions by coordinating citizens willing to contribute data collected via their sensor-rich smartphones that so represent sources of valuable sensing information in urban environments nowadays. One of the biggest challenges in a real long-running MCS system lies in the capacity not only to attract new volunteers, but also and most importantly, to leverage existing social ties between volunteers to keep them involved so as to build long-lasting MCS communities. In addition, the advent of

highly-performing devices and ad-hoc communication technologies can help to further amplify the effect of sensing actions in proximity to the volunteer devices. The paper describes how to exploit these socio- technical networking aspects to increase the performance of MCS campaigns in the ParticipAct living lab, an ongoing MCS real-world experiment that involved about 170 students of the University of Bologna for more than two years. The paper also reports some significant experimental results to quantify the effectiveness of the proposed techniques.

DOI: 10.1109/MCOM.2016.7509387

Scope-aided test prioritization, selection and minimization for software reuse

B. Miranda, A. Bertolino
The Journal of Systems and Software. Elsevier, (in press).



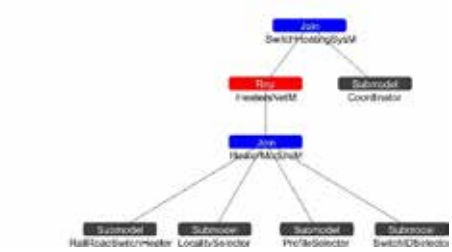
Software reuse can improve productivity, but does not exempt developers from the need to test the reused code into the new context. For this purpose, we propose here specific approaches to white-box test prioritization, selection and minimization that take into account the reuse context when reordering or selecting test cases, by leveraging possible constraints delimiting the new input domain scope. Our scope-aided testing approach aims at detecting those faults that under such constraints would be more likely triggered in the new reuse context, and is proposed as a boost to existing approaches. Our empirical evaluation shows that in test suite prioritization we can improve the average rate of faults detected when considering faults that are in scope, while remaining competitive considering all faults; in test case selection and minimization we can considerably reduce the test suite size, with small to no extra impact on fault detection effectiveness considering both in-scope and all faults. Indeed, in minimization, we improve the in-scope fault detection effectiveness in all cases.

DOI: 10.1016/j.jss.2016.06.058

A stochastic model-based approach to analyze reliable energy-saving rail road switch heating systems

D. Basile, S. Chiaradonna, F. Di Giandomenico, S. Gnesi
Journal of Railway Transport Planning and Management, Vol 6(2). Elsevier, 2016.

Nowadays, there is a great attention towards cautious usage of energy sources to be employed in disparate application domains, in order to save both in economic terms and in environmental impact. When the application domain is a dependability-critical one, such as the transportation sector, energy saving needs to be considered in conjunction with other properties requested from the system, including reliability, safety and availability. Therefore, the interplay of energy consumption and dependability-related measures needs to be analysed. This is a rather new research activity. Dependability analysis has been pursued for a long time, while energy consumption evaluation has become popular only in recent years. Analyses through formal models and tools help developers of energy supply strategies in properly trading between energy consumption and reliability. Generally, probabilistic phenomena are involved in those systems that are modelled through stochastic formalisms. The selected case study is a rail road switch heating system. Rail road switch heaters are essential components for the correct functioning of railway stations, in absence of which possible disasters can be verified (i.e. derailments, collisions). In particularly cold regions, ice and snow can prevent the switches from working properly, and heaters are used to guarantee the correct functioning of the rail road switch system. We address reliability and energy consumption of this system through Stochastic Activity Networks and the Moebius tool.

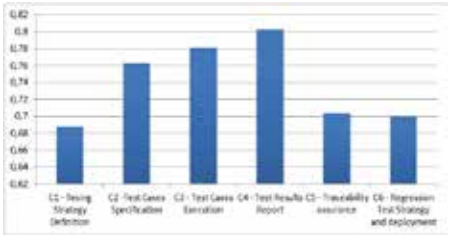


DOI: 10.1016/j.jrtpm.2016.03.003

An empirical study on software testing practices in automotive

G. Lami, I. Biscoglio, F. Falcini
SPICE 2016 - Software Process Improvement and Capability Determination. (Communications in Computer and Information Science, vol. 609). Springer, 2016.

This paper presents the results of an empirical study aimed at characterizing and analyzing recurrent software development weaknesses in the automotive industry. In the automotive domain software development is mainly demanded to specialized software suppliers that are required by car makers to improve and measure the process quality of their projects by applying process models such as Automotive SPICETM. The authors, as Automotive SPICE assessors, have directly recorded and identified specific software process improvement opportunities on the basis of the evidence gathered from real software development projects during a significant number of assessments performed at several organizations world-wide. This paper, that focuses specifically on the software testing-related processes, is a step in a wider study that the authors are carrying out. Such a study aims at identifying, using data from real automotive software development projects, common software development weaknesses having negative impact according Automotive SPICETM, in order to derive a picture of the state of the practice of software development in automotive industry and to provide researchers and practitioners with a reference for improvement initiatives aimed at solving those weaknesses.

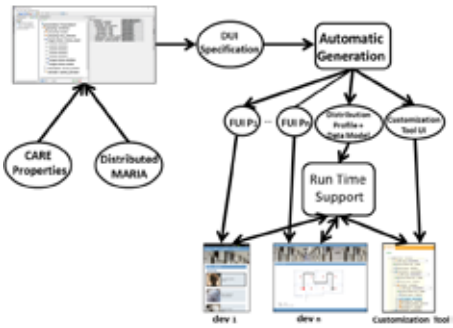


DOI: 10.1007/978-3-319-38980-6_22

Customizable dynamic user interface distribution

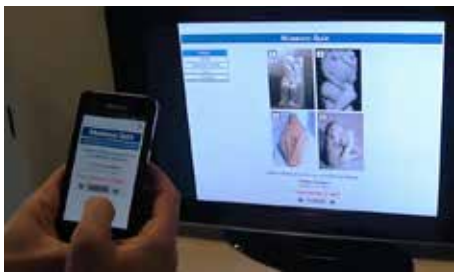
M. Manca, F. Paternò

EICS '16 - The 8th ACM SIGCHI Symposium on Engineering Interactive Computing Systems. ACM, 2016.



This paper describes a solution for flexibly obtaining distributed user interfaces across multiple devices. To this end, we propose a model-based approach, with associated authoring environment, which allows designers and developers to specify how to distribute interfaces at various granularity levels, ranging from entire user interfaces to parts of single interactive elements, and obtain the corresponding implementations. This solution includes run-time support for keeping the resulting user interfaces synchronized and customization tools that allow end users to dynamically change how the user interface elements are distributed across multiple interactive devices in order to address unforeseen situations. We also report on a first user test and how the environment has evolved according to the user feedback.

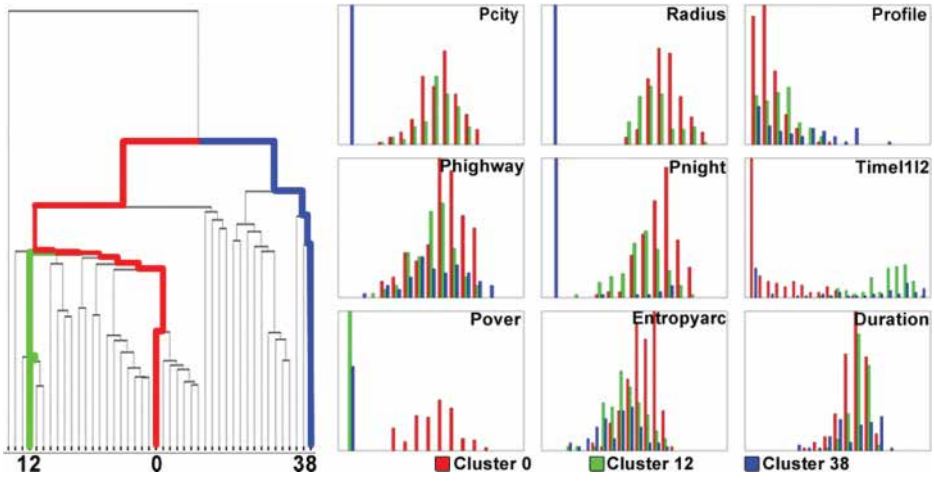
DOI: 10.1145/2933242.2933259



Driving profiles computation and monitoring for car insurance CRM

M. Nanni, R. Trasarti, A. Monreale, V. Grossi, D. Pedreschi

ACM Transactions on Intelligent Systems and Technology, vol. 8 (1). ACM, 2016

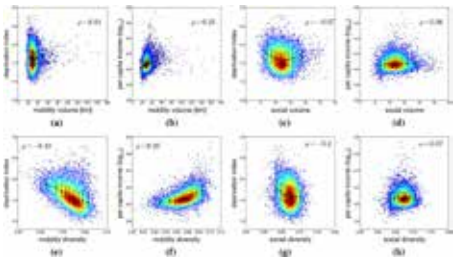


Customer segmentation is one of the most traditional and valued tasks in customer relationship management (CRM). In this article, we explore the problem in the context of the car insurance industry, where the mobility behavior of customers plays a key role: Different mobility needs, driving habits, and skills imply also different requirements (level of coverage provided by the insurance) and risks (of accidents). We describe a methodology to extract several indicators describing the driving profile of customers, and we provide a clustering-oriented instantiation of the segmentation problem based on such indicators. Then, we consider the availability of a continuous flow of fresh mobility data sent by the circulating vehicles, aiming at keeping our segments constantly up to date. We tackle a major scalability issue that emerges in this context when the number of customers is large-namely, the communication bottleneck - by proposing and implementing a sophisticated distributed monitoring solution that reduces communications between vehicles and company servers to the essential. We validate the framework on a large database of real mobility data coming from GPS devices on private cars. Finally, we analyze the privacy risks that the proposed approach might involve for the users, providing and evaluating a countermeasure based on data perturbation.

DOI: 10.1145/2912148

An analytical framework to nowcast well-being using mobile phone data

L. Pappalardo, M. Vanhoof, L. Gabrielli, Z. Smoreda, D. Pedreschi, F. Giannotti
Journal of Data Science and Analytics, vol. 2 (1). Springer, 2016.

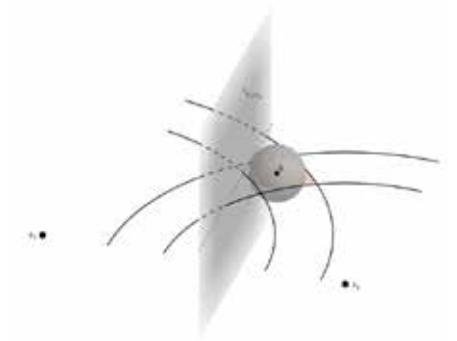


An intriguing open question is whether measurements derived from Big Data recording human activities can yield high-fidelity proxies of socio-economic development and well-being. Can we monitor and predict the socio-economic development of a territory just by observing the behavior of its inhabitants through the lens of Big Data? In this paper, we design a data-driven analytical framework that uses mobility measures and social measures extracted from mobile phone data to estimate indicators for socio-economic development and well-being. We discover that the diversity of mobility, defined in terms of entropy of the individual users' trajectories, exhibits (i) significant correlation with two different socio-economic indicators and (ii) the highest importance in predictive models built to predict the socio-economic indicators. Our analytical framework opens an interesting perspective to study human behavior through the lens of Big Data by means of new statistical indicators that quantify and possibly "nowcast" the well-being and the socio-economic development of a territory.

DOI: 10.1007/s41060-016-0013-2

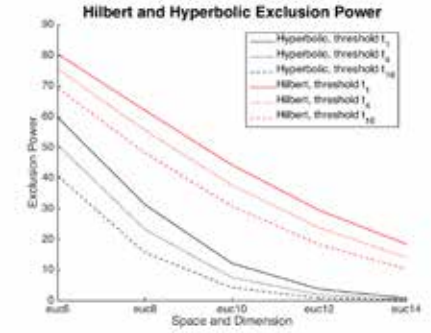
Hilbert exclusion: improved metric search through finite isometric embeddings

R. Connor, F.A. Cardillo, L. Vadicamo, F. Rabitti
ACM Transactions on Information Systems, vol. 35 (3). ACM, 2016.



Most research into similarity search in metric spaces relies on the triangle inequality property. This property allows the space to be arranged according to relative distances to avoid searching some subspaces. We show that many common metric spaces, notably including those using Euclidean and Jensen-Shannon distances, also have a stronger property, sometimes called the four-point property: In essence, these spaces allow an isometric embedding of any four points in three-dimensional Euclidean space, as well as any three points in two-dimensional Euclidean space. In fact, we show that any space that is isometrically embeddable in Hilbert space has the stronger property. This property gives stronger geometric guarantees, and one in particular, which we name the Hilbert Exclusion property, allows any indexing mechanism which uses hyperplane partitioning to perform better. One outcome of this observation is that a number of state-of-the-art indexing mechanisms over high-dimensional spaces can be easily refined to give a significant increase in performance; furthermore, the improvement given is greater in higher dimensions. This therefore leads to a significant improvement in the cost of metric search in these spaces.

DOI: 10.1145/3001583

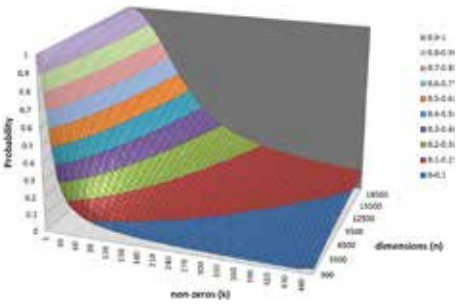


Lightweight random indexing for polylingual text classification

A. Moreo Fernandez, A. Esuli, F. Sebastiani
Journal of Artificial Intelligence Research, vol. 57. AI Access Foundation, 2016.

Multilingual Text Classification (MLTC) is a text classification task in which documents are written each in one of a set L of natural languages, and in which all documents must be classified under the same classification scheme, irrespective of language. There are two main variants of MLTC, namely Cross-Lingual Text Classification (CLTC) and Polylingual Text Classification (PLTC). In PLTC, which is the focus of this paper, we assume (differently from CLTC) that for each language in L there is a representative set of training documents; PLTC consists in improving the accuracy of each of the |L| monolingual classifiers by also leveraging the training documents written in the other (|L| - 1) languages. The obvious solution, consisting of generating a single polylingual classifier from the juxtaposed monolingual vector spaces, is usually infeasible, since the dimensionality of the resulting vector space is roughly |L| times that of a monolingual one, and is thus often unmanageable. As a response, the use of machine translation tools or multilingual dictionaries has been proposed. However, these resources are not always available, or are not always free to use. One machine-translation-free and dictionary-free method that, to the best of our knowledge, has never been applied to PLTC before, is Random Indexing (RI). We analyse RI in terms of space and time efficiency, and propose a particular configuration of it (that we dub Lightweight Random Indexing - LRI). By running experiments on two well known public benchmarks, Reuters RCV1/RCV2 (a comparable corpus) and JRC-Acquis (a parallel one), we show L previously proposed machine-translation-free and dictionary-free PLTC methods that we use as baselines.

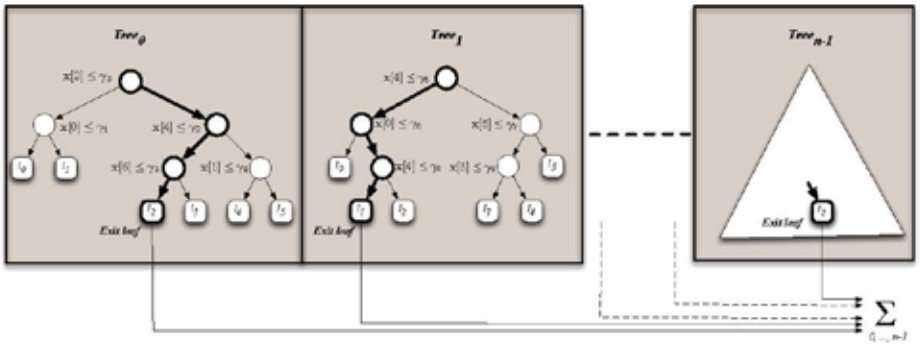
DOI: 10.1613/jair.5194



Fast ranking with additive ensembles of oblivious and non-oblivious regression trees

D. Dato, C. Lucchese, F.M. Nardini, S. Orlando, R. Perego, N. Tonellotto, R. Venturini
ACM Transactions on Information Systems, vol. 35 (2). ACM, 2016.

Learning-to-Rank models based on additive ensembles of regression trees have been proven to be very effective for scoring query results returned by large-scale Web search engines. Unfortunately, the computational cost of scoring thousands of candidate documents by traversing large ensembles of trees is high. Thus, several studies have investigated solutions aimed at improving the efficiency of document scoring by exploiting advanced features of modern CPUs and memory hierarchies. In this paper, we present QS, a new algorithm that adopts a novel cache-efficient representation of a given tree ensemble. The algorithm performs an interleaved traversal by means of fast bitwise operations, and also supports ensembles of oblivious trees. An extensive and detailed test assessment is conducted on two standard Learning-to-Rank datasets and on a novel very-large dataset we made publicly available for conducting significant efficiency tests. The experiments show unprecedented speedups over the best state-of-the-art baselines ranging from 1.9x to 6.6x. The analysis of low-level profiling traces shows that QS efficiency is due to its cache-aware approach both in terms of data layout and access patterns, and to a control flow that entails very low branch mis-prediction rates.



DOI: 10.1145/2987380

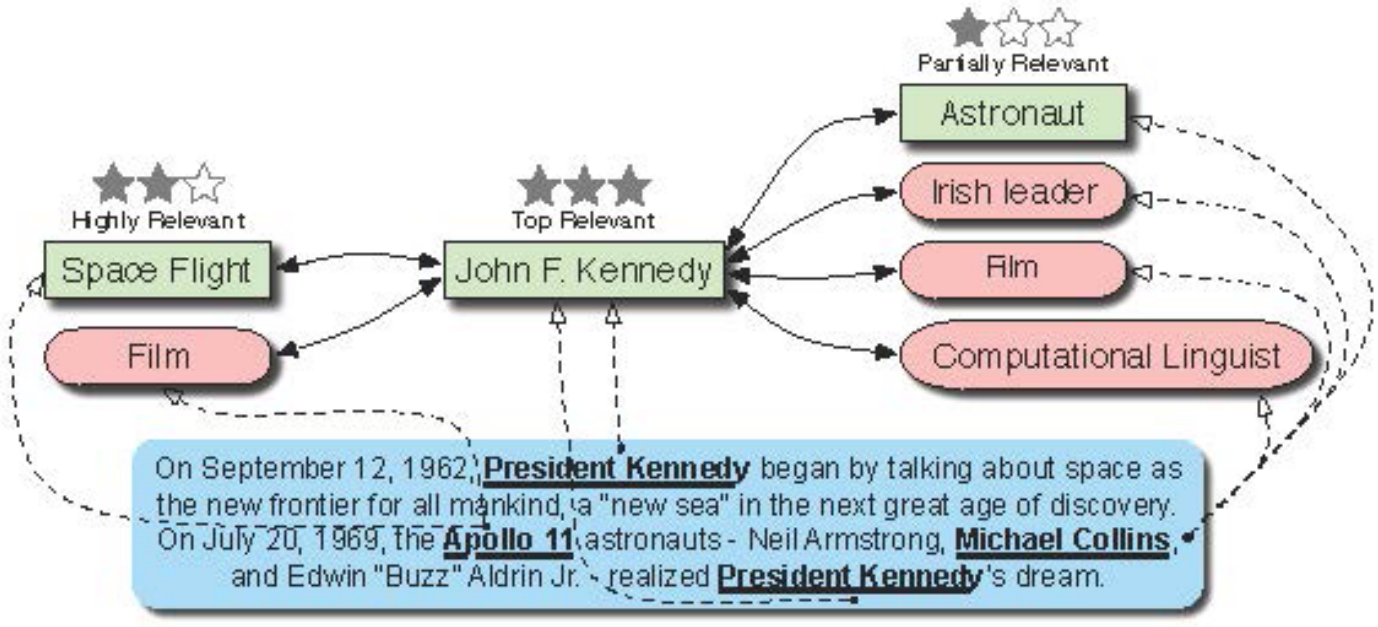
SEL: a unified algorithm for entity linking and saliency detection

S. Trani, D. Ceccarelli, C. Lucchese, S. Orlando, R. Perego

DocEng '16 - ACM Symposium on Document Engineering. ACM, 2016.

The Entity Linking task consists in automatically identifying and linking the entities mentioned in a text to their URIs in a given Knowledge Base, e.g., Wikipedia. Entity Linking has a large impact in several text analysis and information retrieval related tasks. This task is very challenging due to natural language ambiguity. However, not all the entities mentioned in a document have the same relevance and utility in understanding the topics being discussed. Thus, the related problem of identifying the most relevant entities present in a document, also known as Salient Entities, is attracting increasing interest. In this paper we propose SEL, a novel supervised two-step algorithm comprehensively addressing both entity linking and saliency detection. The first step is based on a classifier aimed at identifying a set of candidate entities that are likely to be mentioned in the document, thus maximizing the precision of the method without hindering its recall. The second step is still based on machine learning, and aims at choosing from the previous set the entities that actually occur in the document. Indeed, we tested two different versions of the second step, one aimed at solving only the entity linking task, and the other that, besides detecting linked entities, also scores them according to their saliency. Experiments conducted on two different datasets show that the proposed algorithm outperforms state-of-the-art competitors, and is able to detect salient entities with high accuracy.

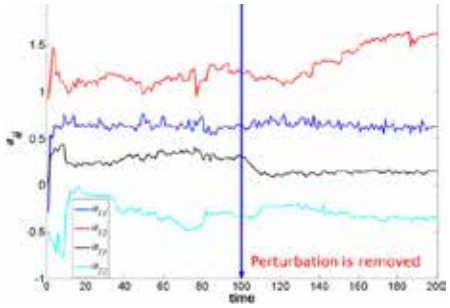
DOI: 10.1145/2960811.2960819



Time-dependent gene network modelling by sequential Monte Carlo

S. Ancherbak , E.E. Kuruoglu, M. Vingron

IEEE/ACM Transactions on Computational Biology and Bioinformatics, vol. 13 (6). IEEE, 2016.



Most existing methods used for gene regulatory network modeling are dedicated to inference of steady state networks, which are prevalent over all time instants. However, gene interactions evolve over time. Information about the gene interactions in different stages of the life cycle of a cell or an organism is of high importance for biology. In the statistical graphical models literature, one can find a number of methods for studying steady-state network structures while the study of time varying networks is rather recent. A sequential Monte Carlo method, namely particle filtering (PF), provides a powerful tool for dynamic time series analysis. In this work, the PF technique is proposed for dynamic network inference and its potentials in time varying gene expression data tracking are demonstrated. The data used for validation are synthetic time series data available from the DREAM4 challenge, generated from known network topologies and obtained from transcriptional regulatory networks of S. cerevisiae. We model the gene interactions over the course of time with multivariate linear regressions where the parameters of the regressive process are changing over time.

DOI: 10.1109/TCBB.2015.2496301

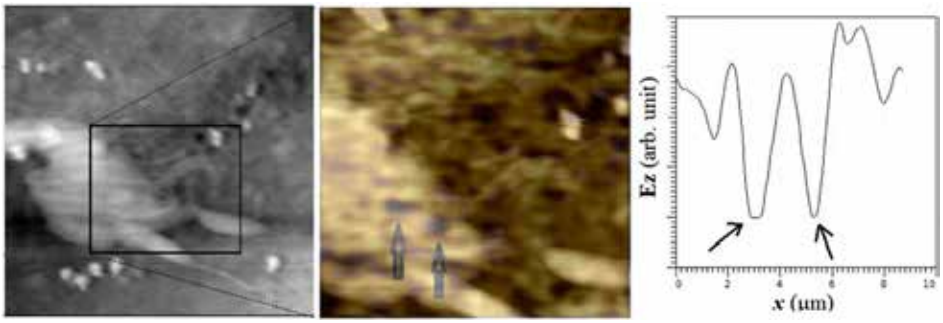
Detection and localization of gold nanoshells inside cells: near-field approximation

M. D'Acunto, A. Cricenti, S. Danti, S. Dinarelli, M. Luce, D. Moroni, O. Salvetti

Applied Optics, vol. 55 (34). Optical Society of America, 2016.

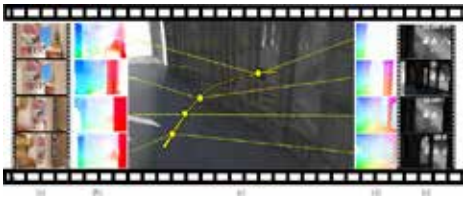
The optical properties of metal nanoparticles play a fundamental role for their use in a wide range of applications. In hyperthermia treatment, for example, gold nanoshells (NSs, dielectric core+gold shell) pre-embedded in a cancer cell absorb energy when exposed to appropriate wavelengths of a laser beam and heat up, thereby destroying the cancer cell. In this process, nevertheless, healthy tissues (not targeted by the NSs) along the laser path are not affected; this is because most biological soft tissues have a relatively low light absorption coefficient in the near-infrared (NIR) regions - a characteristic known as the tissue optical window. Over such a window, NIR light transmits through the tissues with scattering-limited attenuation and minimal heating, thereby avoiding damage to healthy tissues. As a consequence, the identification of NSs assumed a fundamental role for the further development of such cancer treatment. Recently, we have demonstrated the possibility of identifying 100-150 nm diameter gold NSs inside mouse cells using a scanning near-optical microscope (SNOM). In this paper, we provide a numerical demonstration that the SNOM is able to locate NSs inside the cell with a particle-aperture distance of about 100 nm. This result was obtained by developing an analytical approach based on the calculation of the dyadic Green function in the near-field approximation. The implications of our findings will remarkably affect further investigations on the interaction between NSs and biological systems.

DOI: 10.1364/AO.55.000D11



Presentation of 3D scenes through video example

A. Baldacci, F. Ganovelli, M. Corsini, R. Scopigno
IEEE Transactions on Visualization and Computer Graphics. IEEE (in press).



Using synthetic videos to present a 3D scene is a common requirement for architects, designers, engineers or Cultural Heritage professionals. However, it is usually time consuming and, in order to obtain high quality results, the support of a film maker/computer animation expert is necessary. We introduce an alternative approach that takes the 3D scene of interest and an example video as input, and automatically produces a video of the input scene that resembles the given video example. In other words, our algorithm allows the user to "replicate" an existing video, on a different 3D scene. We build on the intuition that a video sequence of a static environment is strongly characterized by its optical flow, or, in other words, that two videos are similar if their optical flows are similar. We therefore recast the problem as producing a video of the input scene whose optical flow is similar to the optical flow of the input video. Our intuition is supported by a user-study specifically designed to verify this statement. We have successfully tested our approach on several scenes and input videos, some of which are reported in the accompanying material of this paper.

DOI: 10.1109/TVCG.2016.2608828

FlexMolds: automatic design of flexible shells for molding

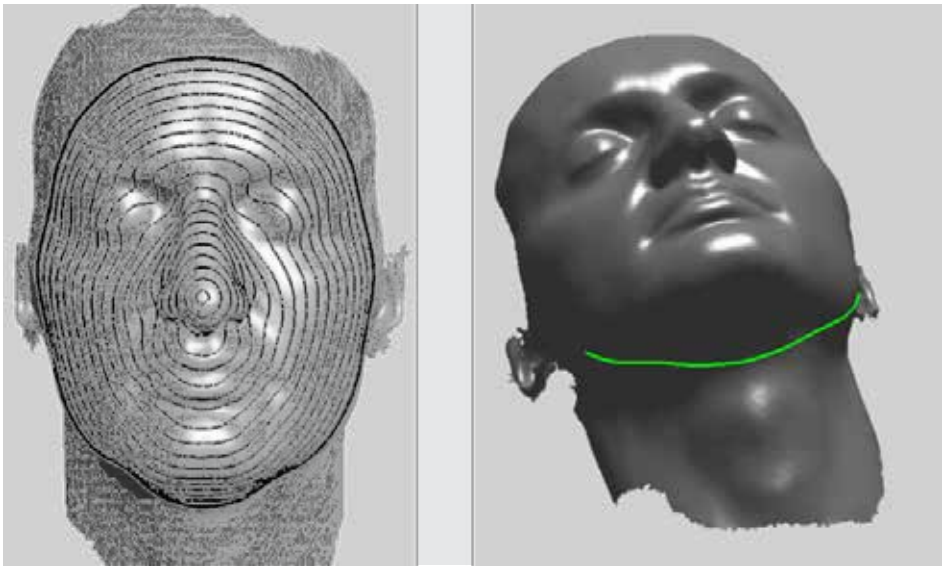
L. Malomo, N. Pietroni, B. Bickel, P. Cignoni
ACM Transactions on Graphics, Volume (6). ACM, 2016.

Mold casting is a widely used manufacturing process for rapidly fabricating shapes. It allows to replicate a single object using a wide range of materials and it is scalable with the number of required copies. However, reusable molds require to be detachable from the actual cast part without physically destructing the mold or the molded part. Inspired by silicone mold casting techniques, we propose a novel reproduction approach for highly detailed shapes, based on flexible mold shells (FlexMolds). FlexMolds are made of a thin but still sufficiently shape-preserving shell of deformable material, which can be printed by using a commercial 3D printing device. Once 3D-printed, our flexible molds allow to physically fabricate, by means of liquid casting, multiple copies of complex shapes with rich surface details and complex topology. Contrarily to industrial mold casting techniques, which rely on rigid molds, FlexMolds, thanks to their flexibility, provide more freedom during the removal process. This allows the reproduction of complex shapes even with molds composed by a single piece. By creating shell-only molds, we allow the reproduction of very complex objects that normally require, even using silicone casting, an initial decomposition and subsequent reassembly of the cast pieces. Given a digital 3D model, we first generate a shell around it. Then, taking advantage of dynamic simulation, we automatically produce a set of cuts on the shell to allow the extraction of the cast rigid object and, at the same time, guarantee that the flexible mold is not damaged during this process. To ensure a correct casting, we also provide the optimized orientation of the mold. The final mold will be equipped with holes to avoid trapped air bubbles, and small pegs along the cuts to ease the mold-sealing process. The resulting FlexMolds are generated automatically allowing even unexperienced users to produce limited series of objects in a cheaper and easier way with respect to standard manufacturing techniques

DOI: 10.1145/2980179.2982397

Face reconstruction and characterization

A tool for the assessment of overweight and obesity from facial data

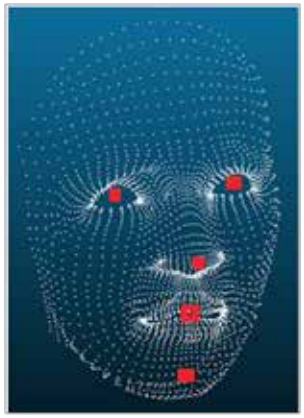


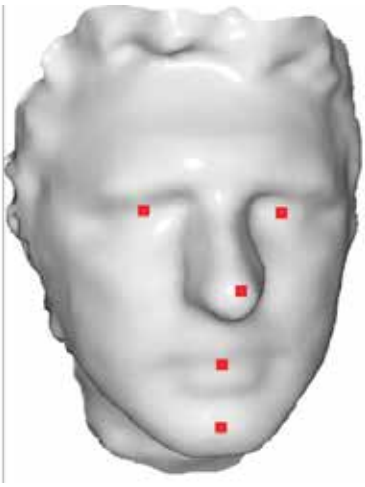
In the framework of the EU FP7 project SEMEOTICONS (2013-2016) coordinated by ISTI-CNR, a novel hardware and software platform to reconstruct and characterize human faces was developed. The aim was to study the face morphology to look for potential facial correlates of overweight and obesity. Methods for data acquisition, 3D face reconstruction and labelling, and shape characterization have been jointly developed by the Signals and Images Lab (ISTI-CNR) and the Robotics and Computer Vision Research Laboratory (University of Central Lancashire). The methods implemented can run almost in real time, and are integrated into the Wize Mirror, a smart mirror to promote health and wellbeing with respect to cardio-metabolic risk.

The platform is based on inexpensive off-the-shelf components for 3D facial reconstruction. The face segmentation is based on random forest detection and 3D model registration, frame reordering and rejection; Poisson surface estimation is used for meshing; and the localization of landmarks on the 3D face uses statistical shape models. The facial characterization is based on the automatic extraction of four 3D features, which are normalised Euclidean and geodesic lengths and areas .

The 3D features were found correlated to well-established body fat parameters and indices (including BMI, body weight, waist, and neck circumference) in a validation study of 72 volunteers. Hence, such 3D descriptors can be used to automatically assess overweight and obesity in the adult population.

Contact: Maria Antonietta Pascali, SI Lab
maria.antonietta.pascali@isti.cnr.it
http://www.semeoticons.eu





A multimedia interactive system for treating autism spectrum disorders

ISTI-CNR has begun a collaboration with the Fondazione Maria Assunta in Cielo (fMAiC) of Pistoia, a foundation which provides social services for disabled people.

The Body Sensing Unit of SI-Lab, following the guidelines of a team of fMAiC specialists, has developed a system for treating children with autism spectrum disorder and motor dyspraxia. The intent is to improve imitative interactions and motor coordination. The system is conceived as a set of exer-games based on low cost gestural interfaces (Microsoft Kinect and Leap Motion), displayed on a big screen, each structured in levels of increasing difficulty. Some of these games consist in motion-based exercises, by controlling a stylized avatar shown on the screen, through the full body movement. The system can automatically assess the quality of the execution by instantly providing audiovisual feedback. Another game, though still controllable by gesture interfaces, is based on audio-visual stimuli and requires some cognitive capabilities. Other games focus instead on the motion of the hands, in order to stimulate the fine movement coordination. SEMI was installed on the premises of the fMAiC foundation and has been successfully tested on a sample of children (age: 8-11). The data that were collected anonymously during the experimentation have been used for further analysis. The results of the experiment have shown a clear benefit on interaction capacities and, especially, on movement coordination capabilities. SEMI is conceived to support and complement traditional treatments, and not as an alternative to them.

Contact: Massimo Magrini, SI Lab
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ISTI and Cryptex (US) collaborate on personalized monitoring devices

ISTI has signed an agreement for collaboration between its Signals and Images Lab and the American company Cryptex LLC, New York

The goal of this collaboration is the design and development of low cost personal monitoring devices for evaluating the physical response to exercises aimed at improving the efficiency of the musculoskeletal system (e.g. leg strength), in order to be able to self-program a custom-designed workout.

We intend to develop comfortable wearable sensors easily connectable to mobile phones and desktop computers, and to study intelligent algorithms for personalized coaching that provide suggestions for correcting and improving physical performance.

These devices are intended not only for athletes or similar wanting to improve their performance, but also for anyone wishing to maintain or improve their physical condition.

Contact: Massimo Magrini,SI Lab, Giovanni Bonocore
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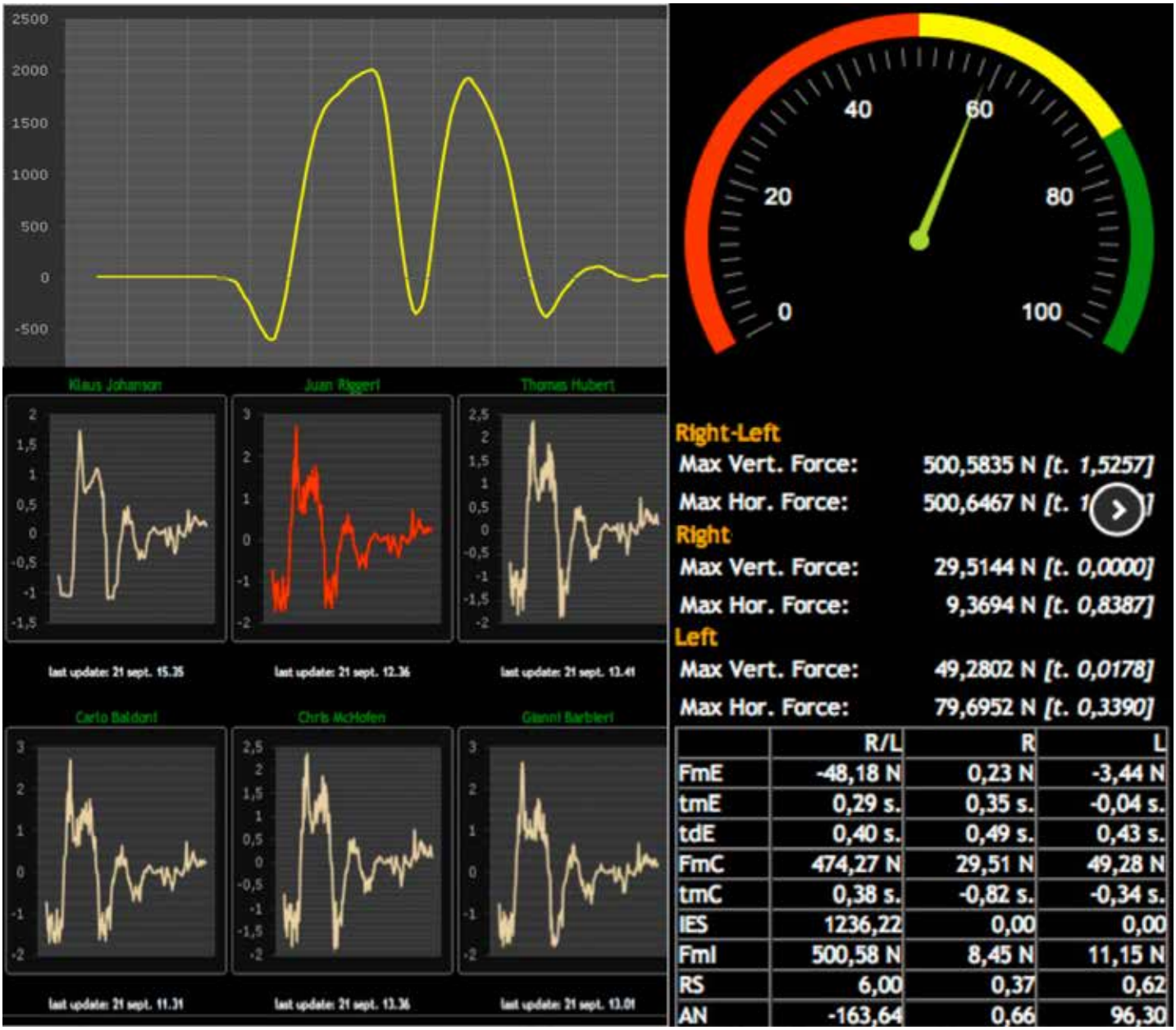
info@icryptextraining.com



	R/L	R	L
FmE	-48,18 N	0,23 N	-3,44 N
tmE	0,29 s.	0,35 s.	-0,04 s.
tdE	0,40 s.	0,49 s.	0,43 s.
FmC	474,27 N	29,51 N	49,28 N
tmC	0,38 s.	-0,82 s.	-0,34 s.
IES	1236,22	0,00	0,00
FmI	500,58 N	8,45 N	11,15 N
RS	6,00	0,37	0,62
AN	-163,64	0,66	96,30

A sensorized doll for improving dementia care

Dementia steals people's memories and identity, making them incapable to do every day things as the disease progresses. This causes confusion, frustration, agitation, distress. The role of caregivers thus becomes very important; as important as it is burdensome, both from a social and economic point of view.

There are pharmacological and non-pharmacological treatments for symptoms of dementia and its related cognitive decline. One of the most recent non-pharmacological approaches for dementia-related behavioral disorders involves Empathy Dolls, the so-called *Doll Therapy*. The aim is to ensure that patients look after the Doll, as if it were a real baby. The patients, involved in simple activities, such as taking care of the doll, become less aggressive; they also become less agitated and are more likely to be engaged in conversation.

However, such positive outcomes tend to be based on subjective narrative accounts of success, and are not supported by objective data.

The idea behind the SI and WN labs' project proposal **EMPATHY- A Sensorized Doll for Improving the Assessment and Validation of Non-pharmacological Dementia Care**, which gained second place in the Progetto ISTI 2016 contest, is to integrate sensors within the Empathy Doll (see figure above) in order to collect objective data about i) interaction of the patient with the Doll; ii) patient's stress and agitation levels; iii) patient's psycho-physical status and lifestyle in general.

Sensory data are elaborated by means of machine learning techniques that provide information on the use of the Doll during therapy and on its effect on the patient, in terms of stress levels. As reported in the diagram in the figure below, the ground truth for stress levels is collected by means of a wristband equipped with galvanic skin response (GSR) and photoplethysmogram (PPG) sensors. These measurements will be collected during a short-time training phase in order to train the proposed neural network (based on the Reservoir Computing paradigm) to recognize the stress levels only using data coming from the inertial, force, and audio sensor embedded in the Doll. After the training phase, the Doll will be able to detect the stress levels independently from the wristband, providing an unobtrusive tool for the long-term monitoring and evaluation of the therapy.

The sensorized Empathy Doll is a very helpful tool from several points of view: i) from the patient's point of view, the Doll remains a baby to be looked after; ii) for relatives and occupational therapists it becomes a watchful eye on the patient, and a source of information when verbal communication is compromised; iii) from the specialists (physicians) point of view, it provides objective measured data to monitor the psycho-physical status of the patient (both in situ and remotely).

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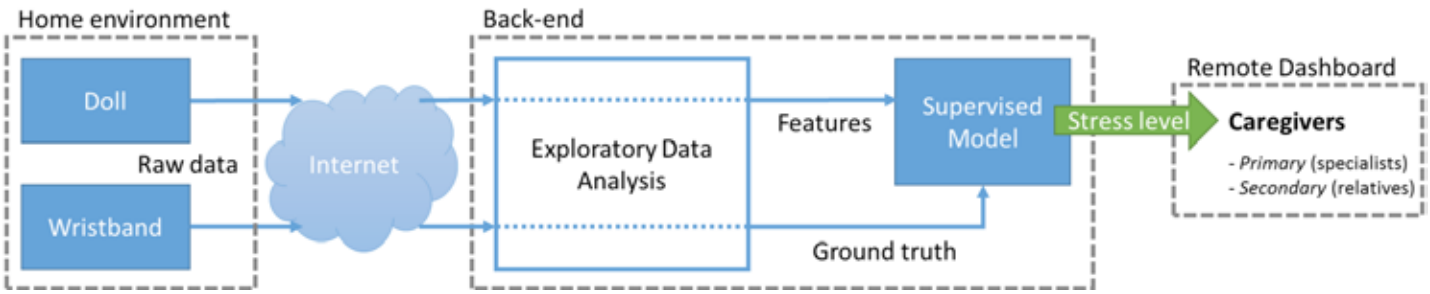


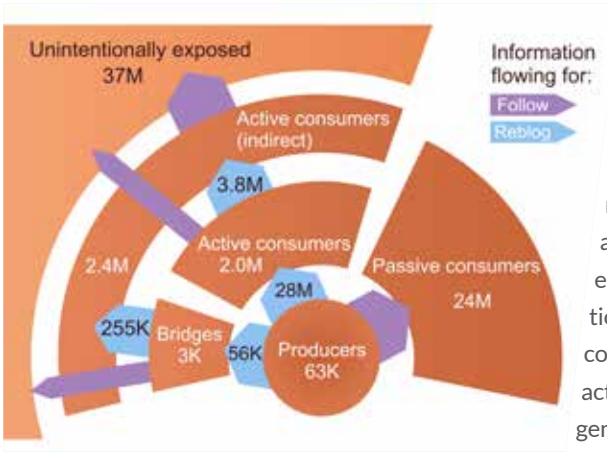
Deviant communities in social media

The structure of a social network is fundamentally related to the interests of its members. People associate spontaneously based on the topics that are relevant to them, forming social groups that revolve around different subjects. Online social media are also favorable ecosystems for the formation of topical communities centered on matters that are not commonly taken up by the general public because of the embarrassment, discomfort, or shock they may cause.

These are communities that depict or discuss what are usually referred to as deviant behaviors, conduct that is commonly considered inappropriate because it somehow violates the social norms or moral standards that are shared among the majority of the population. Adult content consumption, drug use, excessive drinking, illegal hunting, eating disorders, or any self-harming or addictive practice are all examples of deviant behaviors. Many of these topics are represented, to different extents, on social media. However, since they touch upon different societal taboos, the common-sense assumption is that they are embodied either in niche, isolated social groups or in communities that might be quite numerous but whose activity runs separately from mainstream social media. In line with this belief, research has also mostly considered these groups in isolation, focusing predominantly on the patterns of communication among community members or, from a sociological perspective, on the motivations of their members and on the impact of the group activities on their lives and perceptions.

> Content is produced by a small core of nodes clustered in dense sub-communities, but it is spread via bridge communities to the remainder of the network potentially reaching half of the users.

In reality, people who are involved in deviant practices are not segregated outcasts, but are part of the fabric of the global society. As such, they can be members of multiple communities and interact with very diverse sets of people, possibly exposing their deviant behavior to the public. We aimed to go beyond previous studies that looked at deviant groups in isolation by observing them in context.



We focused on the deviant behavior of adult content consumption. We studied this phenomenon on a large anonymized dataset sampled from the Tumblr social network. The Tumblr dataset contains more than 130 million users and almost 7 billion directed dyadic interactions. We modeled the social network as a graph whose nodes are the users and whose edges are the observed interactions between them: users can follow (i.e., subscribe to the content produced by) other users or reblog (i.e., share) content generated by other users.

> Content diffusion includes young and underage users, both male and female.

The network of users that exclusively produce explicit adult content is a tiny portion of the whole graph, representing less than 0.05% of Tumblr users in our sample. This tightly connected community of content producers is linked with the rest of the network with a very high number of (mostly incoming) ties. The figure above shows the content spreading mechanism in the Tumblr network. We studied two interesting communities that post less explicit adult content sporadically. They either focus on celebrities or function as aggregator blogs with high content variety. In both cases, they act as bridges allowing content generated within the producer communities to spread across the rest of the social network. If we consider as unintentionally exposed those users who follow other users who reblog deviant content, the fraction of users potentially exposed to adult content is as large as 50% of the Tumblr sample.

Consumption and production of adult content in general purpose online social networks has never been studied at this scale before. It is known that male users consume more adult content than female, but if we analyze the consumption according to age we observe surprisingly interesting patterns. The consumption of adult content is substantially equal between the two genders under 25 years old. Above that age the percentage of male users increases progressively compared to female users. We thus confirm that male users consume more adult content, but surprisingly we found that consumption in young people is comparable between the two genders. Finally, we found that, in order to limit the potential exposition of underage users, it would be sufficient to restrict the content production of just 200 of the network users.

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Referece: Coletto, M., Aiello, L. M., Lucchese, C., Silvestri, F. (2016) On the Behaviour of Deviant Communities in Online Social Networks. In 10th International AAAI Conference on Web and Social Media. ICWSM 2016, May 17-20, Cologne, Germany.

ProgettISTI 2016: the final decision

The final selection stage of ProgettISTI was completed in September 2016. The ProgettISTI initiative calls for the presentation of short project proposals by young researchers from different laboratories. The aim is to improve the mutual knowledge of the research activities in the Institute, to encourage young researchers to experiment the creation and writing of a project proposal, and hopefully to help in starting new collaborations.

Ten proposals were received and were subjected to a two-stage selection. After the first stage, five proposals were presented to the Advisory Committee, which then decided on the three winners. The proponents of each proposal selected will receive a sum of 5000 Euros to support their research activities.

The proposals selected for 2016 were:

- **Machine-Training**, a data driven personal trainer for cyclists (Proponents: Paolo Cintia, KDD Lab and Michele Girolami, WN Lab)
- **EMPATHY**: A sensorized doll for improving the assessment and validation of non-pharmacological dementia care (Proponents: Danila Germanese, SI Lab and Filippo Palumbo, WN Lab)
- **Learning from Sequential Visual Data**, a Deep Learning Hybrid Approach (Proponents: Francesco Banterle, VC Lab and Alejandro Moreo Fernandez, NeMIS Lab).

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Grants for young mobility

Second Call 2016

The ISTI Grants for Young Mobility (GYM) program enables young researchers (below 34) to carry out research in cooperation with foreign Universities and Research Institutions of clear international standing. It complements similar CNR programs.

The winners for the second call 2016 are:

Alejandro Moreo Fernandez

Alessio Ferrari

The 2016 RERS challenge

Franco Mazzanti (FM&&T Lab) participated the 6th International Challenge on the Rigorous Examination of Reactive Systems, competing against other major international institutions in the "Reachability, data structures" class of problems. The ISTI approach to Reactive Systems Examination, which exploits the locally developed KandISTI formal verification framework, ranked first with 229 points in the ranking for this class.

This result was obtained also with the support of the HPC Laboratory, which ran the KandISTI framework on their multicore systems for the identification of serious problems.

http://rers-challenge.org/2016
http://fmt.isti.cnr.it/kandisti

Best paper award - SISAP 2016

The paper "Supermetric Search with the Four-Point Property" by Richard Connor, Franco Alberto Cardillo, Lucia Vadicamo and Fausto Rabitti has been elected as the Best Paper at the 9th International Conference on Similarity Search and Applications (SISAP 2016), October 24-26,Tokyo,Japan.

http://link.springer.com/chapter/10.1007/978-3-319-46759-7_4

FQXi, Foundational Questions Institute

Tommaso Bolognesi, member of the FM&T ISTI group, has become member of FQXi, Foundational Questions Institute. FQXi catalyzes, supports, and disseminates research on questions at the foundations of physics and cosmology, particularly new frontiers and innovative ideas integral to a deep understanding of reality.

Best student paper award - ACM DocEng 2016

The paper "SEL: A Unified Algorithm for Entity Linking and Saliency Detection" by Salvatore Trani, Diego Ceccarelli, Salvatore Orlando, and Raffaele Perego won the Best Student Paper award at the 16th ACM Symposium on Document Engineering (ACM DocEng 2016), Vienna, Austria, September 13 - 16, 2016.

http://dl.acm.org/citation.cfm?id=2960819

Featured ACM member: Fabrizio Sebastiani

Fabrizio Sebastiani was, from July 2014 to December 2016, a Principal Scientist at Qatar Computing Research Institute, Qatar Foundation, and is a Senior Research Scientist at the Institute for the Science and Technologies of Information (ISTI), an institute of the Italian National Research Council (CNR). His research interests lie at the crossroads of information retrieval, machine learning, and human language technology, with particular emphasis on text classification, opinion mining, and their applications.

He has published 64 peer-reviewed articles on topics including information retrieval, text analytics, and opinion mining. Sebastiani is an active member of the ACM Special Interest Group on Information Retrieval (SIGIR) and served as General Co-Chair of the 2016 ACM SIGIR Conference, which took place in Pisa, Italy, 17-21 July.

http://www.acm.org/articles/people-of-acm/2016/fabrizio-sebastiani

Digital humanities awards 2016

The EU funded EAGLE Project (www.eagle-network.eu) - whose data aggregation and image processing infrastructure was implemented by the NeMIS Lab of ISTI-CNR - won the Digital Humanities Awards 2016 (dhawards.org/dhawards2016/results/) for the "Best DH Tool or Suite of Tools" category.

Digital Humanities Awards are a set of annual awards where the public is able to nominate resources for the recognition of talent and expertise in the digital humanities community. The resources are nominated and voted for entirely by the public. These awards are intended as an awareness raising activity, to help put interesting DH resources in the spotlight and engage DH users (and general public) in the work of the community. Awards are not specific to geography, language, conference, organization or field of humanities that they benefit. Any suitable resource in any language or writing system may be nominated in any category.

EAGLE (Europeana network of Ancient Greek and Latin Epigraphy, a Best Practice Network partially funded by the European Commission) aggregates epigraphic material provided by some 15 different epigraphic archives (about 80% of the classified epigraphic material from the European and Mediterranean area) for ingestion to Europeana (www.europeana.eu/). The aggregated material is made available to the scholarly community and the general public for research and cultural dissemination. EAGLE has defined a common data model for epigraphic information, into which data models from different archives can be optimally mapped. The data infrastructure is based on the D-NET software toolkit (www.d-net.research-infrastructures.eu) developed by the InfraScience Research Group of the NeMIS Lab, which handles data collection, mapping, cleaning, indexing, and access provisioning through web portals or standard access protocols. A novel search feature offered by EAGLE and developed by the Multimedia Information Retrieval Research Group of the NeMIS Lab is the possibility of visually searching for epigraphic information. A picture of an inscription can be used as a query to search for similar inscriptions or to obtain information on it. Visual queries can also be issued from a smartphone, by pointing its embedded camera toward the inscription of interest. Visual inscription search leverages jointly on deep learning techniques and index structures for large scale similarity searching. Currently, more than one million epigraphs are visually searchable with EAGLE.

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Highly cited research award 2017 of Journal of Cultural Heritage, Elsevier

Members of the Visual Computing Lab (M. Dellepiane, M. Callieri and R. Scopigno) received the "Highly Cited Research Award 2017" given by the Journal of Cultural Heritage, Elsevier, for the paper published in the 2013 issue:

"Archeological excavation monitoring using dense stereo matching techniques", Matteo Dellepiane, Nicolo Dell'Unto, Marco Callieri, Stefan Lindgren, Roberto Scopigno, Journal of Cultural Heritage, Elsevier, Volume 14:3, pp. 201-210, 2013.

50 years ago the first self-synchronized pacemaker in Italy

In 1966 researchers at CSCE/CNR in Pisa developed the first prototype of Self-Synchronized Pacemaker

Investigation of biomedical signals at the ISTI Signals & Images Lab dates back to the 1960s, soon after the creation of the CEP (Calcolatrice Elettronica Pisana) by the Centro Studi Calcolatrici Elettroniche (CSCE/CNR, then IEI and now ISTI). Over the years, the hardware team designed many original transistor devices for acquiring and processing signals acquired by EEG, EMG and ECG (the complete bibliography of research and projects can be found at the website http://csce.isti.cnr.it).

Here we focus on one of the first self-synchronizing pacemakers in the world, a very important transistor device, built in collaboration with the Clinical Physiology Group (a CNR Lab hosted at the University of Pisa), 50 years ago in February-July 1966.

The device remedies critical cases of cardiac electrical intermittent blocks, otherwise not resolvable with usual fixed rate pacemaker of the time.

We take this opportunity to express a heartfelt tribute to the late Franco Denoth, the main driving force behind the project, and many thanks to the dedication of the CSCE technicians who contributed to the development of the device and to Luigi Donato, head of the medical team who followed the patients. Based on the positive experimental results, the inventors decided to apply for a patent (named ESCORT) and then to wrap the device inside a bio-compatible material, suitable for installation under the skin. The above picture shows a box (made in 1967) with several prototypes, exhibited recently at the CNR headquarters in Rome. The other pacemakers shown are the types marketed by the company Sorin Biomedica (Saluggia, Italy) to which the patent for device commercialization was given.

It is important to note that this project had no dedicated budget, but grew out of a spontaneous collaboration between university researchers and CNR-Pisa, with the aim of saving the lives of patients with severe cardiac arrhythmias. The design of the final version of the pacemaker can be found in [DD67], while some developmental steps and details are described in [Bert16]. The success of the self-synchronizing pacemakers undoubtedly strengthened development activity in the bioengineering field within CSCE and in other research institutions in Pisa, which began immediately after the implementation of the CEP for scientific computing.

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[Bert16] Bertini G. Il contributo del CSCE e dell'IEI/CNR di Pisa nell'ambito della cardio-stimolazione (a 50 anni dalla realizzazione del primo pacemaker auto-sincronizzato in Italia). Internal note CNR-ISTI 2016-B4-002, 2016. Available at http://puma.isti.cnr.it/linkdoc.php?icode=2016-B4-002&authority=cnr.isti&collection=cnr.isti

ISYL – Italian Super Yacht Life

ISTI is a founding partner of ISYL, a foundation for permanent education fostering the creation of new professionals in the nautical sector

For the Tuscan coastal area, production in the nautical sector is an industrial reality involving an important chain of manufacturing activities and services, which includes over 70 specialities and links with other production sectors. The specific areas that belong to the marine industry are shipbuilding, refitting, ship supply and port services, and services in general. There is a growing demand for new professionals with high technical and technological skills to work in these area. The "ISYL: Italian Super Yacht Life" foundation has been created to meet these needs and has been granted the status of "Istituto Tecnico Superiore" (ITS). ITSs are highly specialized technological schools intended to ensure a permanent educational offer in technological fields, in accordance with EU and national and regional economic programs. The main goals of ISYL are:

- to ensure close coordination, dialogue and continuous exchanges between the world of education, scientific research and the labor market;

- to promote activities in accordance with EU, national and regional legislation in the field of higher technical education;

- to ensure training activities all over Tuscany;

- to provide analytical tools and information on energy sources and energy efficiency issues;

- to exploit intellectual resources through the training of young people specialized in this field.

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Megafauna 3D (Montevideo, Uruguay) has adopted CNR's 3DHOP in order to publish results on the web

Megafauna 3D is an online platform that invites you to discover the giant mammals that inhabited South America thousands of years ago. It is a fossil digitization initiative consisting of a collection of 3D models and a series of didactic and interactive activities based in paleontology. Created in Montevideo, Uruguay, this project involves paleontologists, designers and programmers and will grow over time, by adding new 3D models to the collection. The scans and 3D reconstructions were done by paleontologists from the Facultad de Ciencias, UdelaR. The tridimensional models have been scanned from specimens found in Uruguay.

On the technical side, the project has used both active 3D scanning and photogrammetric technologies to produce 3D models of the specimens. The project has selected and used two open-source software resources developed by ISTI-CNR:

- MeshLab (http://meshlab.sourceforge.net/) was used for the postproduction of the 3D models;

- 3DHOP (http://www.3dhop.net/) was adopted to enable web-based publication and visualization of the 3D models.

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IPIN 2016 Indoor Localization Competition 2016

The third international IPIN competition (Indoor Positioning and Indoor Navigation), sixth in the EvAAL series, was hosted by the international IPIN conference in Alcalà de Henares, Madrid, Spain, from 4 to 7 October 2016.

Francesco Potortì, Paolo Barsocchi, Michele Girolami and Antonino Crivello, researchers at the WNLab group of CNR-ISTI at Pisa, were among the main organisers.

The aim of the competition is to measure the performance of indoor localisation systems that are usable in offices, hospitals or big public buildings. The 2016 edition attracted 25 teams and allowed the participants to test their localisation solutions with rigorous procedures exploiting the complex and multi-floor structure of the University of Alcalà de Henares.

The competition ended with the awarding of four 1500$ prizes:

- smartphone-based (Frank Ebner, University of Applied Sciences Würzburg-Schweinfurt, Germany)
- pedestrial dead reckoning (Hojin Ju, Università of Seul, Korea)
- offline smartphone-based (Stefan Knauth, Hochschule für Technik Stuttgart, Germany)
- mobile robot (Janis Tiemann, TU Dortmund, Germania)

Prizes were awarded by the official sponsors of the competition KICS , ETRI, TECNALIA, and ASTI, respectively.

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CNR and CNRS are setting up a joint international research Lab on 3D digitization

The CNR Department of Engineering, ICT and Technologies for Energy and Transport (DIITET) has approved a new project starting in 2017 which is setting up a joint international research lab in a collaboration between the Visual Computing Lab of ISTI-CNR (led by Roberto Scopigno) and the Modèles et simulations pour l'Architecture et le Patrimoine (MAP) of CNRS (led by Livio de Luca). The goal of the joint Lab is to integrate and foster the skills and technical resources in the areas of 3D digitization and interactive graphics of the two groups, international leaders in these areas.

A number of issues are standing in the way of the widespread deployment of 3D digitization technologies, especially in the Cultural Heritage (CH) domain. The aim of the project is to design new solutions to make large-scale digitization really possible in the near future. The main goal in the first stage will be to design new practical approaches for high-fidelity digitization and color/reflectance sampling, and to implement tools for web-based collaborative use and semantic enrichment of the 3D models. A collateral but not secondary result will the design of a digitization platform to be shared with the Ministries of Culture of the two countries.

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Ph.D. dissertations

GDup: an integrated and scalable graph deduplication system

Author: Claudio Atzori, Scuola di Dottorato in Ingegneria "Leonardo da Vinci", Università di Pisa
Supervisors: Cinzia Bernardeschi, Paolo Manghi

In this thesis we start from the experiences and solutions for duplicate identification in Big Data collections and address the broader and more complex problem of 'Entity Deduplication over Big Graphs'. We propose a reference architecture and implementation for 'Big Graph Entity Deduplication Systems' (BGEDSs). BGEDSs are integrated, scalable, general purpose systems for entity deduplication over Big Graphs and are intended to support data curators with the out-of-the-box functionalities for duplicates identification and graph disambiguation.

The architecture formally defines the challenge, providing graph type language and graph object language, defining the specifics of the deduplication phases, and explaining how such phases manipulate the initial graph to eventually produce the disambiguated graph. Most importantly, it defines the level of configuration that data curators can exploit when relying on BGEDSs to implement entity deduplication.

GDup, an implementation of a BGEDS is part of the OpenAIRE production environment, the European e-infrastructure for Open Science and Access. It supports scalability and performance over Big Graphs by exploiting an HBase - Hadoop MapReduce stack.

Efficient M2M communications via random access satellite channels

Author: Felice Manlio Bacco, Dipartimento di Ingegneria dell'Informazione e Scienze Matematiche, Università di Siena
Supervisors: Giovanni Giambene, Alberto Gotta

According to data traffic forecast reports, the volume of data transported by Internet in 2020 will exceed the threshold of 2.0 zettabytes per year, generated by more than a trillion of devices. Only a minor portion of the traffic will be generated by PCs; on the contrary, a large quota of Internet traffic is expected to be generated by TVs, tablets, smartphones, and Machine-to-Machine (M2M) devices. In particular, it has been highlighted that M2M traffic will experience a growth rate in the order of 60%. This large amount of traffic will have an important impact on the design of future network architecture and on dimensioning the capacity of the telecommunication infrastructures. From this standpoint, special consideration must be given to the case of M2M services distributed via satellite, whose related industry is continuously increasing in size. This work focuses on the analysis of the behavior of the most common M2M protocol stacks on Random Access satellite links, in order to suggest guidelines to improve the achievable performance level.

Enhanced publication management systems: a systemic approach towards modern scientific communication

Author: Alessia Bardi, Scuola di Dottorato in Ingegneria "Leonardo da Vinci", Università di Pisa
Supervisors: Paolo Manghi, Cinzia Bernardeschi

Traditionally, scientific literature is considered the omni-comprehensive unit of scientific communication. Literature alone, however, cannot support the realisation of the principles of Open Science: to achieve this goal all products related to a research activity should be shared and disseminated.

Enhanced Publications (EPs) are digital objects that aggregate a literature product and the other research products that have been used and produced during the research investigation and are useful to: (i) better interpret the article; (ii) enable more effective peer review, and (iii) support reproducibility of science. Theory and practice of EPs is still not advanced and most Enhanced Publication Information Systems (EPISs) are custom implementations serving community specific needs.

The aim of this thesis is to propose a systemic approach to the realisation of EPISs based on the novel notion of Enhanced Publication Management System (EPMS) and to contribute to building structured foundations with: (a) a terminology and a classification of EPISs; (b) a general-purpose data model for EPs, and (c) a reference architecture for EPMSs.

Redefining and Evaluating Coverage Criteria Based on the Testing Scope

Author: Ferreira de Miranda Breno Alexandro, Dipartimento di Informatica, Università degli Studi di Pisa
Supervisors: Antonia Bertolino

Test coverage information can help to decide when to stop testing and how to augment a test suite when coverage is low. The leading principle is that a program is adequately tested only if all entities (e.g., statements or branches) have been exercised at least once. However, not all entities are of interest in every context and thus traditional coverage metrics might not always provide meaningful information. The thesis proposes to redefine coverage criteria so to focus on the entities that are relevant to the testing scope and instantiates scope-based coverage in three contexts. When applied to software reuse, scope-based coverage proved to be useful in improving test case prioritization, selection and minimization. When source code is not available, coverage can be measured on invocations at interface and customized based on invocations by similar users. Finally, in operational testing, coverage scope exploits program spectra obtained from usage traces. The definition of scope-based coverage paves the way for a new research thread aimed at improving the cost- effectiveness of testing.

Ambient intelligence in assisted living environments

Author: Filippo Palumbo, Dipartimento di Informatica, Università degli Studi di Pisa
Supervisors: Stefano Chessa

Ambient Intelligence (AmI) aims at supporting humans in achieving their everyday objectives by enriching physical environments with distributed devices and computational resources. One of the most important AmI research areas is represented by Ambient Assisted Living (AAL), in which AmI technologies are used to enable people with specific needs to live longer in their home. In the AAL scenarios, the recognition of human activities and position is the basis of the so-called "context-awareness".

This thesis deals with two major problems that still prevent the spreading of AAL solutions in real homes: (i) the need for a common medium to transmit sensory data and information produced by algorithms and (ii) the unobtrusiveness of context-aware applications in terms of both placement of devices and period of observations. We address these issues by means of a middleware infrastructure and a suite of unobtrusive applications allowing the detection of the user's context and behavioral profile. The proposed solution has been thoroughly evaluated in real testbeds offered by European FP7 projects.

Recommending places based on the wisdom-of-the-crowd

Author: Igo Ramalho Brilhante, Departamento de Computação, Universidade Federal do Ceará & Dipartimento di Informatica, Università degli Studi di Pisa
Supervisors: Jose de Macedo, Dino Pedreschi, Chiara Renso

The collective opinion of a great number of users, wisdom of the crowd, has been seen as powerful tool to discover individual and collective preferences, and use this information to offer services such as recommending relevant and interesting items. This thesis has the objective of taking advantage of the wisdom of the crowd to better understand human mobility behavior to support people with intelligent and effective recommendations. We propose an unsupervised framework, called TripBuilder that leverages large collections of Flickr photos and points of interest from Wikipedia for building tourist plans. This work has received significant interest within the research community, since it is recognized as crucial to understand the needs of tourists when they are planning a visit to a new city. Consequently this led to outstanding scientific results. We also exploited the wisdom-of-the-crowd to recommend groups of friends who can enjoy a location together. We propose GroupFinder to address the novel user-item group formation problem aimed at recommending the best group of friends to enjoy a given location.

A cooperative approach for pattern recognition in underwater scene understanding by multi-sensor data integration

Author: Marco Reggiannini, Scuola di Dottorato in Ingegneria "Leonardo da Vinci", Università di Pisa
Supervisors: Ovidio Salvetti, Andrea Caiti

Surveying the oceans' floors represents a relevant task in the framework of marine biology, engineering and cultural heritage preservation. Scientists and concerned operators combine their effort in order to i) map the seafloors, ii) detect interesting sites and iii) ensure their safeguard.

For these purposes Autonomous Underwater Vehicles, equipped with properly selected sensors, are usually employed to collect data from the surveyed environment. The data is then exploited, both in an online and offline modality, to detect and recognize targets of interest, such as manmade artefacts. The adopted approach consists in laying emphasis on the amount of regularity, such as geometrical shapes or textural surface patterns, contained in the data. These features are used to label the environment in terms of more or less interesting areas, where more interesting refers to higher chances of detecting meaningful objects. This thesis describes the methods developed to fulfill the purposes of mapping and object detection in the underwater scenario and presents some experimental results obtained by the implementation of the discussed techniques.

Welcome aboard!

Felice Manlio Bacco
Research Staff (Tecnologo)
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Emanuele Carlini
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Pietro Cassarà
Research Staff (Tecnologo)
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MMS Lab

Conferences - Co-organized by ISTI

VAMOS 2017 - The 11th International Workshop on Variability Modelling of Software-Intensive Systems Eindhoven, The Netherlands, 1-3 February, 2017

https://vamos2017.wordpress.com/

IS-EUD 2017 – The 6th International Symposium on End-User Development, Eindhoven, the Netherlands, June 13-15 2017

http://iseud2017.tue.nl/

MoCS 2017 – IEEE Management of Cloud and Smart City Systems, Heraklion, Crete, Greece, 03 July 2017

http://mocs.disi.unibo.it/

CHITALY 2017 -Towards the Mediterranean, September 18-20 2017, Cagliari, Italy

http://sites.unica.it/chitaly2017/

AITA 2017 - The 14th International Workshop on Advanced Infrared Technology and Applications, Quebec City, Canada, September 27-29, 2017

http://aita2017.gel.ulaval.ca/

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