ISTI Young Research Award 2016

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Abstract
The ISTI Young Researcher Award is an award for young people of Institute of Information Science and Technologies (ISTI) with high scientific production. In particular, the award is granted to young staff members (less than 35 years old) by assessing the yearly scientific production of the year preceding the award. This report documents procedure and results of the 2016 edition of the award.

Keywords
Young Research Award

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Introduction

The Institute of Information Science and Technologies (ISTI), an institute of the Italian National Research Council (CNR), promotes the growth of its "young researchers" by means of initiatives aiming at encouraging the scientific production and promoting the visit to major international scientific institutions and research groups. Among these initiatives, the *Young Researcher Award* (YRA) yearly awards the Institute staff of less than 35 years old with the best scientific production [1]. This initiative is funded through self-taxation of all research laboratories of the Institute.

The ISTI YRA is awarded to ISTI members belonging to the following categories:

- *Young*: it is awarded to PhD students and PhD researchers less than 32 years old;

- *Young++*: it is awarded to PhD students and PhD researchers less than 35 years old.

The award is presented each year at the ISTI Day, a yearly meeting where the Director meets the Institute staff. Three persons in each category are awarded with a research funding of 1,000€.

Methods

Submission

Nominations for the YRA Award should be submitted by the candidate by using a dedicated online form. The information collected via the form are very basic. They include name, date of birth, and dates related to PhD activity only. The list of publications will be automatically acquired by the ISTI Institutional Repository[1].

YRA Award Committee

The YRA Award Committee is nominated by the Director of the Institute with the following duties:

- Prepare and develop the call for participation and the related procedures;

- Solicit nominations and assess candidates;

- Provide the ISTI Director with documents underlying the entire process and selecting the award candidates.

The Committee members are:

Matteo Dellepiane (Chair) (Visual Computing Laboratory);

Paolo Barsocchi (Wireless Networks Laboratory);

Leonardo Candela (Networked Multimedia Information System Laboratory);

Vincenzo Ciancia (Formal Methods and Tools Laboratory);

Andrea Esuli (Networked Multimedia Information System Laboratory);

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[1] http://http://pumalab.isti.cnr.it

Maria Girardi (Mechanics of Materials and Structures Laboratory);

Francesca Lonetti (Software Engineering and Dependable Computing Laboratory);

Franco Maria Nardini (High Performance Computing Laboratory);

Davide Moroni (Signals and Images Laboratory);

Salvatore Rinzivillo (Knowledge Discovery and Data Mining Laboratory);

Selection

A total of 35 nominations where received: 18 for the Young category and 17 for the Young++ category.

The following criteria was defined to assess and rank each scientific publication of the candidates:

- diverse ranking systems are going to be used to reduce the effects of any bias;

- for Journal papers it is used (*i*) the Agenzia Nazionale di Valutazione del Sistema Universitario e della Ricerca (ANVUR) Journals ranking[2]; (*ii*) the Computing Research and Education Association of Australasia (CORE) Journals ranking[3]; and (*iii*) the SCImago service[4]. Papers receive a score according to the schema reported in Table 1. In case of multiple scores, the maximum one is used;

- for conference papers it is used the Group of Italian Professors of Computer Engineering (GII) and Group of Italian Professors of Computer Science (GRIN) rating service[5]; papers receive a score according to the schema reported in Table 2;

- "short papers", i.e., papers having less than 6 pages, receive half of the score of the homologous papers;

- papers published in workshops receive a score of 2;

- book chapters not associated to a conference receive a score of 2;

- international conference abstracts receive a score of 1.

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[2]http://www.anvur.org/index.php?option=com_content&view=article&id=254&Itemid=623&lang=it
[3]http://www.core.edu.au/
[4]http://www.scimagojr.com/
[5]http://www.consorzio-cini.it:8080/consultazioneclassificazioni/

YRA 2016 Recipients

The recipients of the award for the "*Young*" category are:

Riccardo Guidotti (Knowledge Discovery and Data Mining Laboratory);

Luigi Malomo (Visual Computing Laboratory);

Luca Pappalardo (Knowledge Discovery and Data Mining Laboratory).

The recipients of the award for the "*Young++*" category are:

Michele Girolami (Wireless Networks Laboratory);

Filippo Palumbo (Wireless Networks Laboratory);

Maria Antonietta Pascali (Signals and Images Laboratory).

A per recipient introduction to the research activity as well as to the set of publications leading to the award is reported in the following sections.

Riccardo Guidotti (Young): Publications 2015

The following publications was produced by Guidotti during 2015 and evaluated for the YRA 2016: [2, 3, 4, 5, 6, 7, 8, 9, 10, 11].

During the year, Guidotti worked on personal big data analytics. While running our daily activities, due to the pervasive use of smartphones, social networks and mobile devices, every one of us leaves behind an enormous amount of digital crumbs. Guidotti's Ph.D. Thesis wants to propose a personal data store framework able to automatically extract valuable knowledge from these individual crumbs. Guidotti's works push towards this direction by producing building blocks of the personal data analytics framework in form of individual models and individual indicators.

Within the study of personal mobility data, Guidotti deeply analyzed the concept of personal points of interest [2] and personal locations [10]. In [2] it is reported an analysis describing the impact of individual and collective points of interest in our everyday mobility. In [10] it is proposed a novel parameter free algorithm for the extraction of personal locations that is able to over perform the competitors in this important and repetitive task in mobility data mining. In [3, 4, 5], individual systematic movements, which are called routines, are exploited to boost traditional journey planners. One direction is to exploit the wisdom of the crowd in terms of routinary movements to propose alternative routes with respect to the classical shortest paths. The other improvement concerns the transportation network by merging public and private means of transport. Finally, in [11] it is described a proposal of a personal data store for mobility data.

Within the study of personal social network, Guidotti developed a framework to predict novel interactions by using only the knowledge coming from the personal community of a user [9]. Moreover [7] reports an analysis of the impact of the social aspect in carpooling exploiting a personal profile

Table 1. Papers in Journal: score

ANVUR	CORE	Scimago	Score
1	A*	Q1	10
2	A	Q2	8
3	B	Q3	6
4	C	Q4	4

Table 2. Conference Papers: score

CORE	Score
A*	8
A	8
B	6
C	4

formed by mobility data, social network information and the user's topics of interest.

Within the study of personal economic transactional data, Guidotti developed two individual indicators [6]. They express for each customer how much he/she is systematic with respect to (*i*) the spatio-temporal dimension and (*ii*) the basket composition. The analysis of these values revealed that the more systematic customers are the more profitable for a retail market chain.

Guidotti have been awarded with the IBM fellowship award 2014-2015 and he was enrolled for an internship at IBM Dublin.

All the researches were performed within the PETRA, ICON, Cimplex and SoBigData EU projects.

Luigi Malomo (Young): Publications 2015

The following publications was produced by Malomo during 2015 and evaluated for the YRA 2016: [12, 13, 14, 15, 16, 17, 18].

During the year, Malomo worked on many research topics, all related to computer graphics and its application.

His main research strand is focused on Computational Fabrication, a topic that aims to apply techniques and approaches traditionally employed in computer graphics for designing and manufacturing tangible objects using, for example, 3D printers. Despite the wide variety of materials and printing technologies available on the market, one of the main limitations of these machines is the fact that most of them can print objects made of a single material only. In order to fabricate complex objects, more expensive 3D printers can use multiple materials but they can only combine a limited, discrete set of base materials. To overcome this limitation a novel approach has been designed to fabricate objects with custom elasticity using a single material 3D printer and this feature can be exploited to design objects with a prescribed mechanical behaviour [14]. In the same context, another work illustrates how to create objects using interlocking planar pieces that can be cheaply produced with laser cutting machines: starting from a digital 3D model, the work in [12] shows how to produce a set of pieces that, assembled to-

gether, create an illustrative representation of the input model.

The other main topic Malomo pursued during this year concerns the application of Augmented Reality (AR) and Virtual Reality (VR) to the Cultural Heritage domain. In [13, 15] it is described LecceAR, an iOS app that exploit markerless AR that is exhibited at the MUST museum in Lecce, Italy. The app shows a rich 3D reconstruction of the Lecce Roman amphitheatre, which is only partially unearthed. The use of state-of-the-art algorithms in computer graphics and computer vision allows the ancient theatre to be viewed and explored in real-time using a mobile device. The work in [17] shows instead an application of Virtual Reality that is cheaply realizable with mobile devices. The application is used to virtually explore unaccessible sites that are, for example, under restoration or partially destroyed. The app allows to explore in real-time a digitized 3D environment on a mobile device screen, exploiting the device orientation to look around and physical walking to move inside it.

Last but not least, Malomo is also involved in more traditional research topics like Geometry Processing. One of the work produced in 2015 aims to reduce the query time for geodesics computation on 2-Manifold surfaces [16].

Luca Pappalardo (Young): Publications 2015

The following publications was produced by Pappalardo during 2015 and evaluated for the YRA 2016: [19, 20, 21, 22, 23, 24].

During the year, Pappalardo worked on three main scientific topics: human mobility modeling, Big Data analysis for official statistics, and science of success.

In his research on human mobility, he analyzed massive GPS data and mobile phone data to discover that, according to their mobility patterns, individuals split into two distinct profiles: returners and explorers [20]. While the mobility of returners can be reduced to the mere displacements they do between a few preferred locations (home and work places for example), explorers are people whose recurrent mobility is just a small fraction of their overall mobility. Pappalardo developed a novel mobility model to describe the different mo-

bility patterns that characterize returners and explorers, since actual mathematical models where not able to reproduce the observe dichotomy. Moreover, he performed intensive experiments and computer simulations to show that the returners/explorers dichotomy has important consequences. First, explorers cover a larger territory in a shorter time than returners, being the main actors in the diffusion of epidemics and innovations. Second, returners and explorers show a significant degree of homophily, since they preferably communicate with other individuals in the same mobility profile.

The second theme Pappalardo pursued during the year is related to the usage of Big Data as support to official statistics. An intriguing open question is whether measurements made on Big Data recording human activities can yield us 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 his research, Pappalardo designs 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 [23]. He discovered 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. His 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.

The last topic Pappalardo pursued during this year is related to the science of success, i.e., the study of the common patterns leading to success in different contexts, from sports to popularity in social media. In particular Pappalardo focused on soccer analytics, proposing a data-driven approach to evaluate the performance of soccer teams [21]. From observational data of soccer games, he extracted a set of pass-based performance indicators and summarize them in an aggregated indicator. Given the strong correlation among the proposed indicator and the success of a team, he performed a simulation on the four major European championships (78 teams, almost 1500 games). The outcome of each game in the championship was replaced by a synthetic outcome (win, loss or draw) based on the performance indicators computed for each team. Pappalardo found that the final rankings in the simulated championships are very close to the actual rankings in the real championships, and showed that teams with high ranking error show extreme values of a defense/attack efficiency measure. His results are surprising given the simplicity of the proposed indicators, suggesting that a complex systems' view on football data has the potential of revealing hidden patterns and behavior of superior quality. All the researches pursed by Pappalardo was performed within the

Cimplex[6] and SoBigData[7] European projects.

Michele Girolami (Young++): Publications 2015

The following publications was produced by Girolami during 2015 and evaluated for the YRA 2016: [25, 26, 27, 28, 29, 30, 31, 32, 33].

The work of Girolami in 2015 focused on studying how to characterize some aspects of the social dimension of humans for two main research problems: service discovery algorithms and crowdsensing techniques.

Service discovery concerns determining the existence of services in a Mobile Social Network (MSN) by giving the service providers the possibility of announcing the existence of a service, and to those interested in a service the capability to find the services they need. Most of the existing solutions concern general wireless networks, describing centralized and distributed protocols and middleware that do not take into account the peculiar characteristics of MSN. In particular, they do not consider the all-human tendency to keep visiting familiar places and to form communities composed by people with similar interests. The solutions proposed by Girolami overcome such limitations. In particular, it takes into account some aspects characterizing how people move and how people interact with each other. Specifically, the two core operations implemented are: (*i*) Service dissemination, i.e., the distribution of services to the MSN users. This operation is realized by discovering and recognizing social communities and by a proactive diffusion of services among people with similar interests. (*ii*) Service query, i.e., the process of requesting a needed service from a fellow user. This operation is implemented by a controlled query propagation mechanism aimed at avoiding extensive use of indiscriminate flooding.

Concerning the crowdsensing, Girolami investigated the possibility of extending the well-known participatory model of crowdsensing with a novel approach based on the possibility of gathering opportunistically data from the crowd. With the participatory model, people are involved based on their explicitly willingness of joining to the crowdsensing campaign. This model has the main limitation that only a small part of the population can be actively involved. With the opportunistic model, the idea is to exploit people not part of the crowdsensing in order to gather available sensing information. This model can be implemented by using service discovery algorithms designed for MSN. Girolami studied such new model by proposing several metrics assessing the benefits of combing a participatory with an opportunistic approach.

Along with 2015 Girolami analyzed extensively some mobility datasets in order to determine their features in terms of sociality and mobility of users. Such analysis served as a preliminary investigation for both the service discovery and the crowdsensing problems in order to select the best simulation

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[6]CIMPLEX (Bringing CItizens, Models and Data together in Participatory, Interactive SociaL EXploratories) www.cimplex-project.eu

[7]SOBIGDATA (Social Mining & Big Data Ecosystem) www.sobigdata.eu

scenario. Furthermore, Girolami participated to the organization of the 5th indoor localization competition (IPIN Competition 2015) hosted by IPIN 2015 in Banff, Canada. Finally, in December 2015 Girolami got the Ph.D title in Computer Science from the University of Pisa by discussing his thesis titled: "Device Interoperability and Service Discovery in Smart Environments". The work done in 2015 allowed to open to new research lines among which the analysis of the social interactions in working environments thought sensing technologies.

Filippo Palumbo (Young++): Publications 2015

The following publications was produced by Palumbo during 2015 and evaluated for the YRA 2016: [34, 35, 36, 37, 38, 39, 40].

During the year, Filippo worked on the development of context-aware applications in the Ambient Assisted Living (AAL) scenario. AAL aims at the creation of services oriented to the assistance of elderly people. This research area is becoming more and more popular due to the increasing age of population in developed countries. In order to support the occupants, an AAL environment must be able to both detect the current state or context of the environment, and to determine what actions to take based on context information. We define *context* any information that can be used to characterize the situation of an entity, where an entity can be a person, a place, and a physical or computational object. This information can include physical gestures, relationship between the people and objects in the environment, features of the physical environment, identity and location of people and objects in the environment, etc. We define applications that use context to provide task-relevant information and/or services to a user to be *context-aware*.

AAL services are build exploiting contextual information coming from the sensorized home, like the mobility of the user, his activities, and his behavioral patterns. In this regard, one of the most important source of context information is the position of the user in his house. For this reason, the activities of the year were focused on the development of: (*i*) a device-free indoor localization system that opportunistically exploits the capabilities offered by the smart environment [35, 40] and (*ii*) a long-term monitoring application for the detection of behavioral changes of the user [34, 39]. The behavioural profile of a user can be used to detect changes possibly related to a deterioration of the user's physical and psychological status. The proposed system is able to detect behavioural deviations of the routine indoor activities on the basis of a generic indoor localization system and a swarm intelligence method. More specifically, spatiotemporal tracks provided by the indoor localization system are augmented, via marker-based stigmergy, in order to enable their self-organization. This allows a marking structure appearing and staying spontaneously at runtime, when some local dynamism occurs. At a second level of processing, similarity evaluation is performed between stigmergic marks over different time periods in or-

der to assess deviations. The purpose of this approach is to overcome an explicit modeling of user's activities and behaviours that is very inefficient to be managed, as it works only if the user does not stray too far from the conditions under which these explicit representations were formulated.

Future works will further analyze the possibilities offered by smart environments equipped with distributed sensor network and the middleware infrastructure developed coming from the EU FP7 GiraffPlus [37] and DOREMI project [38].

Furthermore, also a survey on the application of wireless communication, identification, and sensing technologies to the harbor logistics has also been conducted [36].

Maria Antonietta Pascali (Young++): Publications 2015

The following publications was produced by Pascali during 2015 and evaluated for the YRA 2016: [41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51].

The research activity of Pascali in 2015 was devoted to the development of computer vision methods and tools for underwater cultural heritage, and to the shape analysis of 3D faces for wellbeing applications.

A first set of publications documented the Arrows project's outcomes (ARchaeological RObot systems for the World's Seas, EU FP7, 2012-2015). The Project was aimed at the design and development of a modular autonomous underwater vehicle (AUV), to support the search and monitoring of underwater archaeological sites and artefacts (see [41, 48]). The specific contribution of Pascali, reported in [43, 44, 46], was focused on the AUV survey and detection tasks. A method for the detection of manmade objects has been studied and implemented: this method is based on the frequency of regular 2D curves in the seabed and it has been tested on both optical and acoustic images. Also, underwater video sequences and colocated acoustic data (acquired with a side scan sonar) were acquired and processed in order to integrate such multimodal underwater data for the characterization of the inspected area: features of colour, texture, 2D and 3D shape, both from acoustical and optic sensors were fused in a multidimensional map. The data collected in the Arrows acquisition campaign and test, were further exploited to obtain a 3D reconstruction of the underwater scene. Moreover, the most recent techniques were used to obtain a 3D underwater scene which is immersive, interactive, informative, and easy to navigate. The reconstruction pipeline and some case studies are described in [45, 47].

The SEMEOTICONS project (SEMEiotic Oriented Technology for Individual's CardiOmetabolic risk self-assessmeNt and Self-monitoring, EU FP7, 2013-206) is the framework of the activity carried out by Pascali in the wellbeing application domain [42, 49, 50]. The overall aim of the project is to build an interactive mirror able to read (acquire and interpret) the signs of the human face which are related to the cardiometabolic risk. Such complex information is integrated into a wellness index: it is used to monitor the individual wellness

evolution, and finally to provide a tailored guidance towards the individual lifestyle improvement. In more detail, Pascali worked in the development of an automatic system for the acquisition and analysis of the 3D facial data. One of the most important factors of the cardio-metabolic risk is overweight and obesity; hence, the first relation to be studied is that between 3D face shape and body weight. In this perspective, the work in [51] is a preliminary study: a synthetic dataset 250 human faces (25 subjects, 10 steps of fattening) is generated using the Basel Face Model, a morphable and parametric 3D model; computational descriptors from the theory of Persistent Homology are defined and tested on these data. By analysing the position of thin and fat subjects in the shape space, it is clear that persistent homology is able to identify features which are well-related to overweight. Also, by analysing the shape patterns of single individuals as trajectories in shape space, it seems that such technique may also support the assessment of trends in weight change on individuals.

Conclusion

This brief report document the 2016 edition of the ISTI Young Research Award, one of the initiatives promoted by the Istituto di Scienza e Tecnologie dell'Informazione to support the young members of its staff. This is the fourth edition of the award that started in 2013. In the reality, it continues similar initiatives promoted in the previous years.

YRA goes in tandem with the Grants for Young Mobility (GYM), a program enabling the ISTI staff of less than 34 years old to carry out research in cooperation with foreign Universities and Research Institutions of clear international standing. It complements CNR similar programs.

Both the initiatives are funded through self-taxation of all research laboratories of the Institute thus demonstrating the willingness to incentivise the activity and growth of young researchers. In fact the initiatives will be likely in place in 2017 also and they are going to be further reinforced by a third initiative aiming at supporting project proposals having principal investigators that are both young and belonging to diverse laboratories.

Acknowledgements

Author contributions

Contributions to the paper are described using the taxonomy described in [52]. Writing the initial draft: LC, RG, LM, LP, MG, FP, MAP. Critical review, commentary or revision: LC.

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