

ISTI Young Research Award 2017

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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 2017 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 e.g., [1, 2]. 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. In the 2017 edition, two ISTI members in each category are awarded with a research funding of 1,000€.

Methods

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);

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);

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 Repository¹.

Demographic

A total of 26 applications have been received: 15 for the Young category and 11 for the Young++ category.

Figures 1 and 2 report the number of applicants per birth year for the Young and the Young++ categories respectively.

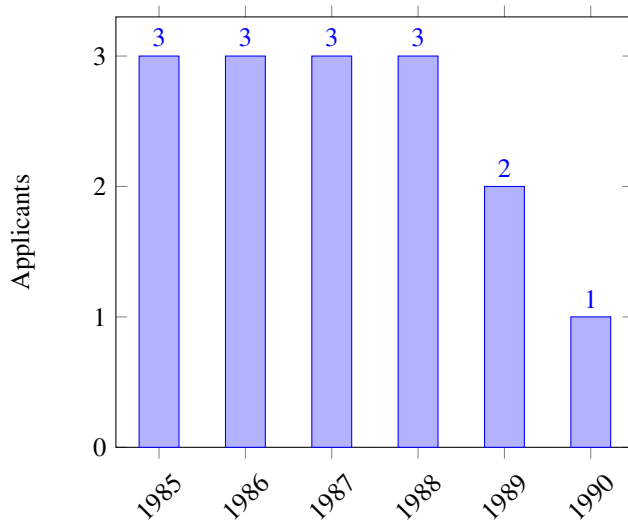


Figure 1. Young: Applicants per Birth Year

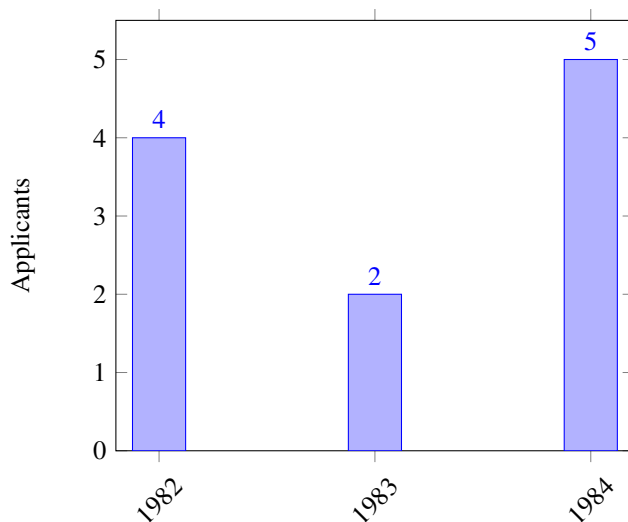


Figure 2. Young++: Applicants per Birth Year

Selection

The following criteria have been 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 ranking²; (ii) the Computing Research and Education Association of Australasia (CORE) Journals ranking³; and (iii) the SCImago service⁴. 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 service⁵; papers receive a score according to the schema reported in Table 2;
- papers in Journals or conferences that are not included in the above databases received a score of 4;
- “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.

Figures 3 and 4 depict the score received by the applicants with respect to the number of evaluated papers.

In the case of Young applicants (cf. Fig. 3), it can be observed that those receiving the highest score are the two more productive candidates both producing 8 papers.

In the case of Young++ applicants (cf. Fig. 4), it can be observed that the typology of publication is actually impacting on the final result.

YRA 2017 Recipients

The recipients of the award for the “Young” category are:

Riccardo Guidotti (Knowledge Discovery and Data Mining Laboratory);

Lucia Vadicamo (Networked Multimedia Information System Laboratory).

The recipients of the award for the “Young++” category are:

²http://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.conorzio-cini.it:8080/consultazioneclassificazioni/>

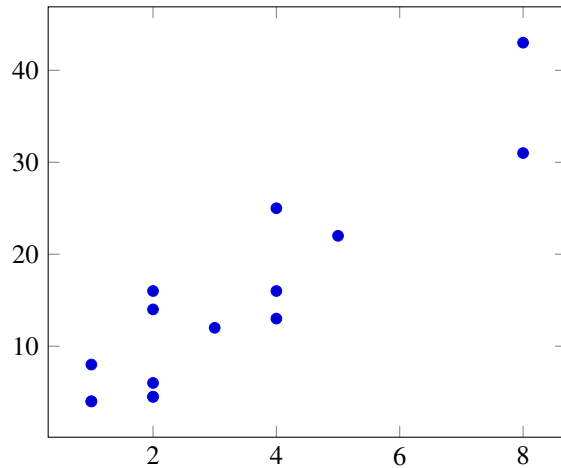
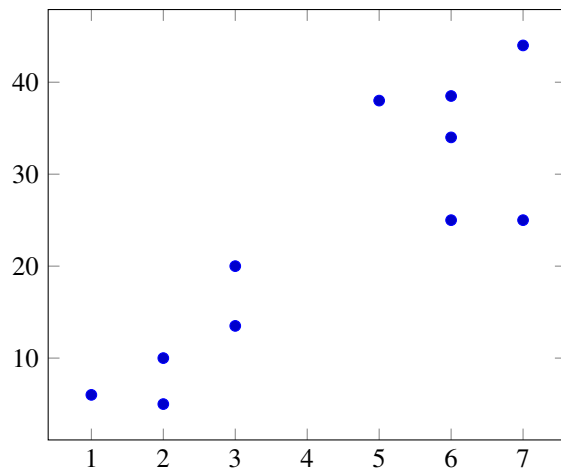
¹<http://pumalab.isti.cnr.it>

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

**Figure 3.** Young: Score vs #Publications**Figure 4.** Young++: Score vs #Publications

Davide Basile (Software Engineering and Dependable Computing Laboratory);

Alessio Ferrari (Formal Methods and Tools 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 2016

The following publications were produced by R. Guidotti during 2016 and evaluated for the YRA 2017: [3, 4, 5, 6, 7, 8, 9].

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 breadcrumbs. Guidotti's Ph.D. Thesis proposes to extend the common Personal Data Store with a Personal Data Analytics approach able to automatically extract the systematic patterns hidden in the individual digital breadcrumbs and to exploit this knowledge for developing tailored services which are able to return also benefits for the collectivity in which the individual live.

Within the study of personal mobility data, Guidotti deeply analyzed the carpooling problem [10]. By exploiting individual systematic movements, which are called routines, extracted with Personal data Analytic methodologies, we construct the network of potential carpooling, where nodes correspond to the users and links to possible shared trips, and analyze the structural and topological properties of this network, such as network communities and node ranking, to the purpose of highlighting the subpopulations with higher chances to create a carpooling community, and the propensity of users to be either drivers or passengers in a shared car. We also analyze the aggregated outcome of carpooling by means of empirical simulations, showing how an assignment policy exploiting the network analytic concepts of communities and node rankings minimizes the number of single occupancy vehicles observed after carpooling. The system proposed in [10] was extended in [3] into what-if analysis tools using a reinforcing learning technique which considers for the assignment the fact that two users already shared a car. Finally, in [4] we studied the properties of the networks built on Twitter with respect to a novel indicator of compatibility between two users for location-based services like carpooling.

Within the study of social network related with the personal data ecosystem of a user, in [5] Guidotti extended the framework to predict novel intra and inter community interactions, by using only the knowledge coming from the personal community of a user. In addition, in [6] we analyzed the properties of a bipartite network of users-locations where we calculated topological indicators of sophistication for unveiling the complexity of drivers and visited locations. By adopting the same methodology on the bipartite network of customer-products, in [7] we were able to nowcast the level of well-being of the users analyzed as we found an high correlation between the customer sophistication and the Gross Domestic Product with six month in advance.

Within the study of personal musical listening data, Guidotti developed in [8] a personal data model capturing musical preferences and listening patterns, and grouped the users according to the indicators present in the model showing a various segmentation. Moreover, in [9], by analyzing Spotify data we investigated the peculiarity of regional music and we placed emerging bands within the musical movements defined by already successful artists. The approach proposed and the results obtained are a first attempt to outline rules suggesting the importance of those features needed to increase popularity in the Italian music scene.

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

Lucia Vadicamo (Young): Publications 2016

The following publications were produced by L. Vadicamo during 2016 and evaluated for the YRA 2017: [11, 12, 13, 14, 15, 16, 17, 18].

The research activity of Vadicamo in 2016 focused on Content-Based Image Retrieval (CBIR) and Similarity Search on metric space. CBIR refers to the possibility of organizing archives containing digital images, so that they can be searched and retrieved by using their visual content. The retrieval relies on extracting appropriate representation (feature) of the image visual content such that similar images have similar representations. Appropriate techniques for indexing and searching image features are then required to scale up the search.

In [16, 11] Vadicamo discussed and compared several image representations that can be used to search for cultural heritage objects. In particular, she thoroughly tested aggregations of local features (BoW, VLAD and FV), Convolutional Neural Network (CNN) features, and their mixture to visually recognize ancient inscriptions. In [15, 14] she investigated techniques for aggregating binary local features (e.g., ORBs), whose extraction process is about two orders of magnitude faster than non-binary local features (e.g., SIFTs). In [12] a block-wise *Surrogate Text Representation* was proposed to index VLAD with of-the-shelf text search engines. Moreover, in [13] Vadicamo et al. proposed an approach for representing deep CNN features as permutations, called *Deep Permutations*, and fast indexing them using permutation-based methods.

During the year, Vadicamo also worked on similarity search on metric space. Metric search is concerned with the efficient evaluation of queries in metric spaces. In general, a large space of objects is arranged in such a way that, when a further object is presented as a query, those objects most similar to the query can be efficiently found. Most mechanisms rely upon the triangle inequality property of the metric governing the space. In [17] Vadicamo et al. examined a class of metric space with a stronger property, named the *four-point property*. They showed that this property gives stronger geometric guarantees, and one in particular, which they named the *Hilbert Exclusion property*, allows any indexing mechanism which

uses hyperplane partitioning to perform better. Moreover, in [18], which won the “SISAP 2016 Best Paper Award”, they examined a more general consequence of four-point embeddable spaces and showed some experimental results including new best-performance for Euclidean distance search over two of the SISAP benchmark datasets.

All the researches were performed within the “EAGLE: Europeana network of Ancient Greek and Latin Epigraphy” and “Smart News: Social sensing for breaking news” projects.

Davide Basile (Young++): Publications 2016

The following publications were produced by D. Basile during 2016 and evaluated for the YRA++ 2017: [19], [20], [21], [22], [23].

During this year his research has been mainly based on analysing dependable green IT systems [20, 19, 24, 25, 26, 27] and on specifying and verifying service-based applications [28, 21, 22, 23, 29]. Recently, these two lines of research have been intersected in [30].

Concerning the analysis of green dependable systems, we have mainly focused on systems belonging to the railway domain. A general framework for modelling and evaluating energy-saving cyber-physical systems has been proposed, where Stochastic Model-based Analysis and Statistical Model Checking are the two adopted methodologies for evaluating dependability and energy related parameters of the analysed systems.

Stochastic model-based analysis has been proven to be particularly useful, versatile and cost-effective for manufacturers. The system under analysis is often described through stochastic processes, whilst measures of interest are generally obtained through mathematical analysis (closed-form expressions), numerical evaluation (linear programming techniques) and discrete-event simulation (statistical methods). Formalisms such as (extensions of) Petri Nets and (Non) Markov based models are used for modelling and evaluating such systems, where reward structures are defined in order to evaluate measures of interest (e.g. reliability, performance, energy consumption) at the variation of relevant parameters, either analytically or through simulation. Stochastic Activity Networks and Möbius are well-established formalism and tool, respectively, for modelling and evaluating these systems.

The recently introduced Statistical Model Checking uses results from statistics on top of simulations of a system to decide whether a given property specified in a temporal logic is satisfied with some degree of confidence, and it represents a valid alternative to classical model checking and dependability evaluation, especially in the case of undecidability. PRISM and Uppaal SMC have been proposed as tools that implement the above techniques. An advantage is that quantitative properties are uniformly described through temporal logics, and hence have a well-defined semantics. Moreover, it is possible to assess qualitative as well as quantitative properties to evaluate and validate the proposed models.

Concerning the specification and verification of service-

based systems, several results have been published in collaboration with the Department of Computer Science of University of Pisa and University of Leicester [28, 21, 22, 23], including my PhD Thesis [29] that has been defended in May 2016.

Service-oriented computing (SOC) is a paradigm for building distributed interoperable applications by assembling fine-grained computational units, called services. Services are loosely coupled, reusable and platform-independent, that are built with little or no knowledge about clients and other services involved in their operating environment. Services can be composed to create largely distributed applications that can be delivered to either end-user applications or other services.

Service contracts have been introduced in SOC to provide a behavioural description of services in terms of their obligations (or *offers*) and requirements (or *requests*). They are used to formally characterise a notion of *agreement* among the parties, that is a composition of services satisfying all service requirements through service obligations. Flexibility is fundamental to guarantee the adaptation of services to updates in the composed application. Adaptive mechanisms are used for the activation and deactivation of functionalities that are triggered by updates in the contract agreement. An agreement among contracts should guarantee the fulfilment of all *necessary* requirements and negotiate the maximum numbers of *permitted* requirements that can be fulfilled without spoiling the composition of services. Contracts adapt to the overall agreement by renouncing to those permitted requirements not satisfiable.

Service coordination dictates how services interact to realise the composite application. In particular, in an *orchestration* of services a distinguished component, called the orchestrator, drives their interactions to enforce only the behaviours in agreement. In a choreographed approach, services realise autonomously (i.e. without a central coordinator) the negotiated agreement.

We have introduced Contract automata (CA) as a novel formal model for service contracts; they represent either single services or compositions of several services and are based both on orchestrated and choreographed coordination.

Recently, we have investigated an extension of CA to variability-aspects for modelling service-based families of softwares, and relations with Stochastic Activity Networks, for managing dependability-related aspects.

Alessio Ferrari (Young++): Publications 2016

The following publications were produced by A. Ferrari in 2016, and evaluated for the YRA 2016: [31, 32, 33, 34, 35, 36, 37].

During the year, Ferrari worked on three main research topics, namely (i) requirements elicitation [31, 32, 33, 34], (ii) applications of formal methods to railway systems [35, 36], and (iii) defect detection in business process specifications expressed in natural language [37].

Requirements elicitation is the process of discovering requirements for a system by accessing available knowledge sources and by communicating with the stakeholders who have a direct or indirect influence on the requirements. Among the available requirements elicitation techniques (e.g., workshops, focus groups, scenarios, prototypes) interviews with customers are the most commonly used and are considered among the most effective for knowledge transfer. During these interviews, ambiguity might hamper communication between the customer and the requirements analyst who performs the interview. In [31] Ferrari performed a set of 34 requirements elicitation interviews with different customers and analysed the ambiguity phenomena occurring in the dialogic discourse. From this investigation, he provided a categorisation of six different types of ambiguity perceived by the analyst. This categorisation is the first one proposed in the literature for requirements elicitation interviews. In [32], he refined the study by looking at the linguistic cues that triggered the ambiguity phenomena, and discovered that the majority of the cases were due to general terms used by customers, i.e., terms that have a high degree of abstraction such as information, area, interface. In [33], Ferrari proposed to look at the customer's side of ambiguity, and planned a study to analyse the ambiguity perceived by customers, and stakeholders in general, during interviews by means of voice analysers and wristbands. The goal was to identify the emotions triggered by the perception of ambiguity from the point of view of an interviewee. This study is currently ongoing. Finally, in [34], within the framework of the FP7 European Project Learn-PAd, he participated to the definition and implementation of an innovative requirements elicitation and analysis technique in the context of the project. The technique employs focus groups with stakeholders for face-to-face requirements elicitation, plus a Wiki for remote requirements elicitation, prioritisation and refinement.

Formal methods are mathematically based techniques for the specification, design and validation of computer-based systems. The literature counts a long history of successful applications of formal methods to the railway domain, and several formal tools exist that can in principle be employed for the design of railway systems. In this context, Ferrari participated to the experimentation with four formal tools in the development of an algorithm for train scheduling [36]. In addition, he edited the curatela for the track named Formal Methods and Safety Certification: Challenges in the Railway Domain, of the ISOLA 2016 Symposium.

The public administration machine builds upon a set of inter-related procedures, which are normally documented in natural language (e.g., English, Italian). Natural language is inherently ambiguous, and therefore the procedures can be implemented in different ways by different civil servants, leading to problems of adherence to laws and regulation, and to potential citizen's distrust. In [37], Ferrari participated to the development of an NLP approach to detect a specific type of defect in the description of public administration proce-

dures, namely the sentences that do not clearly specify the actor that should perform a certain task.

Conclusion

This brief report documents the 2017 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 fifth edition of the award that started in 2013. In the reality, it continues similar initiatives promoted in the previous years.

In this edition 26 applications have been received, 15 for the Young category and 11 for the Young++ category. These figures are lower than those of the previous edition [2] where a total of 35 applications were received, 18 for the Young category and 17 for the Young++ category. This reduction results from the decision of some former colleagues to continue their research activity in other research performing organisations, e.g., University of Amsterdam.

The ISTI Young Research Award is complemented by other initiatives aiming at promoting and supporting the growth of its “young researchers” by encouraging the scientific production and promoting the visit to major international scientific institutions and research groups. In particular: (i) the *Grants for Young Mobility* (GYM) is a program enabling the ISTI staff of less than 35 years old to carry out research in cooperation with foreign Universities and Research Institutions of clear international standing. It complements CNR similar programs; (ii) the *ProgettISTI* is an initiative supporting multidisciplinary and curiosity driven project proposals submitted by ISTI staff members where the principal investigators belong to diverse research laboratories; (iii) the *ISTI Young Open Science Award* is a new initiative aiming at recognising distinguishing scholarly communication activities falling under the Open Science umbrella, namely the release of datasets and/or software accompanying a scientific paper thus to favour their reuse.

All these 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 2018 also.

Acknowledgements

The authors would like to thank the ISTI community for the opportunity and support given by the YRA award.

Author contributions

Contributions to the paper are described using the taxonomy described in [38]. Writing the initial draft: LC, DB, AF, RG, LV. Critical review, commentary or revision: LC.

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