

ISTI Young Researcher Award "Matteo Dellepiane" – Edition 2019

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Abstract

The ISTI Young Researcher Award (YRA) selects yearly the best young staff members working at Institute of Information Science and Technologies (ISTI). This award focuses on quality and quantity of the scientific production. In particular, the award is granted to the best young staff members (less than 35 years old) by assessing their scientific production in the year preceding the award. This report documents the selection procedure and the results of the 2019 YRA edition. From the 2019 edition on the award is named as "Matteo Dellepiane", being dedicated to a bright ISTI researcher who prematurely left us and who contributed a lot to the YRA initiative from its early start.

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, 2, 3]. 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 Researcher – Beginner*: it is awarded to PhD students and PhD researchers less than 32 years old;
- *Young Researcher – Advanced*: 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

2019 edition, three ISTI members in each category are awarded with a research funding of 1,000€.

From this edition on, the award is named as "Matteo Dellepiane" in memory of a bright scientist largely contributing to the development of the award and the rest of initiatives dedicated to ISTI young researchers.

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:

Paolo Barsocchi (Wireless Networks Laboratory);

Leonardo Candela (Networked Multimedia Information System 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 Process

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 is automatically acquired by the *ISTI Open Portal*¹, the dashboard operated by ISTI for collecting and making available the Institute scientific production by promoting open access practices.

Demographic

A total of 15 applications have been received: 9 for the Young Researcher - Beginner category and 6 for the Young Researcher-Advanced category.

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

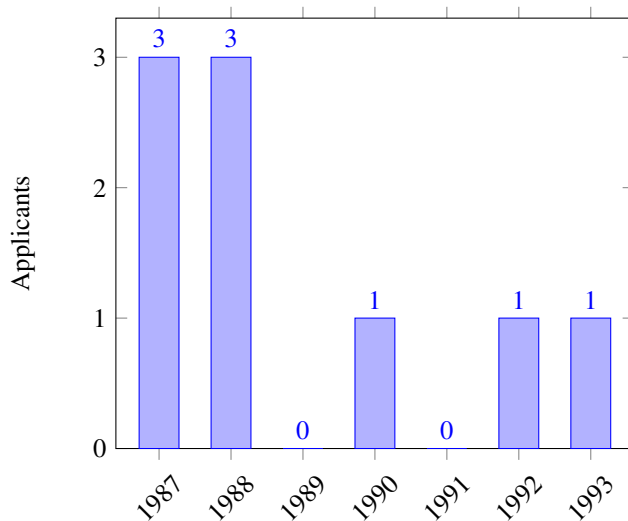


Figure 1. Young Researcher - Beginner: Applicants per Birth Year

Selection Process

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;

¹ISTI Open Portal <http://openportal.isti.cnr.it>

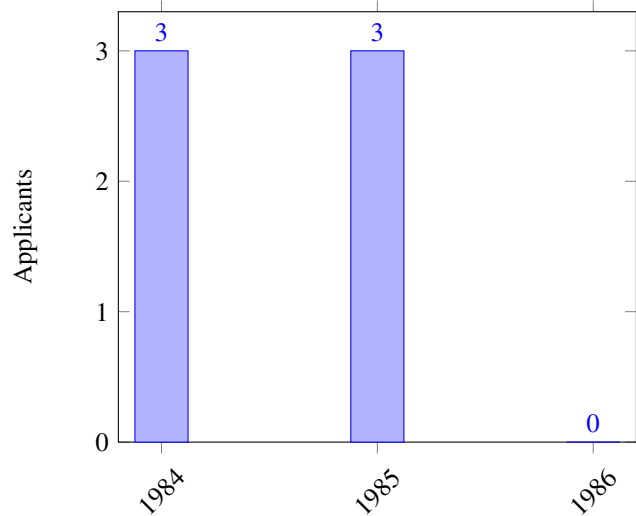


Figure 2. Young Researcher - Advanced: Applicants per Birth Year

- for Journal papers it is used (i) the Computing Research and Education Association of Australasia (CORE) Journals Database²; and (ii) the SCImago service³. 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 (i) the Computing Research and Education Association of Australasia (CORE) Conference Database⁴ and (ii) the GII-GRIN-SCIE (GGS) Conference Rating service⁵. Papers receive a score according to the schema reported in Table 2. In case of multiple scores, the maximum one is used;
- papers in Journals or conferences that are not included in the above databases received a score of 2;
- “short papers”, i.e., papers having less than 6 pages, receive half of the score of the homologous papers;
- papers published in workshops colocated with conferences included in the above databases receive half of the score of the conference. Other workshops receive a score of 1.
- book chapters not associated to a conference receive a score of 2;
- monographs receive a score of 6;

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

²<http://portal.core.edu.au/jnl-ranks>

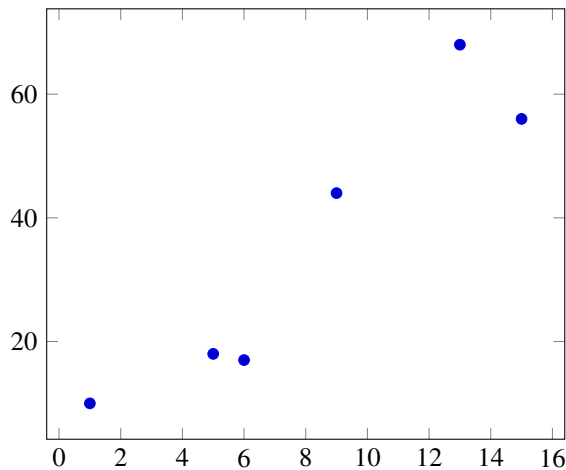
³<http://www.scimagojr.com/>

⁴<http://portal.core.edu.au/conf-ranks/>

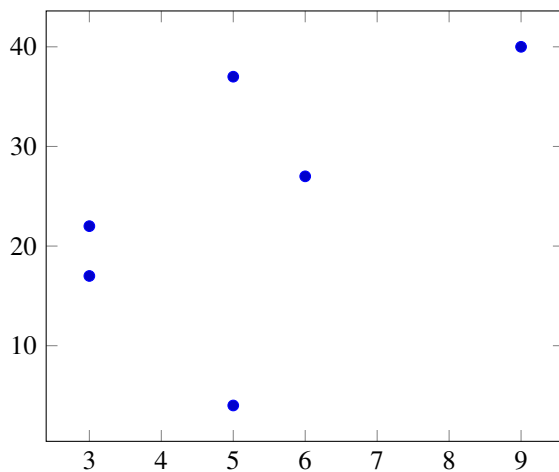
⁵<http://www.consortio-cini.it:8080/consultazioneclassificazioni/>

Table 1. Journal Papers Score

CORE	Scimago	Score
A*	Q1	10
A	Q2	8
B	Q3	6
C	Q4	4


Figure 3. Young Researcher - Beginner: Score vs #Publications

In the case of Young Researcher - Beginner applicants (cf. Fig. 3), it can be observed that those receiving the highest score are the three more productive candidates producing 15 and 13 papers.


Figure 4. Young Researcher - Advanced: Score vs #Publications

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

Table 2. Conference Papers Score

CORE	GGs	Score
A*, A	A++, A+	8
B	A, A-	6
C	B, B-	4

YRA 2019 Recipients

The recipients of the award for the “*Young Researcher - Beginner*” category are:

Antonino Crivello (Wireless Networks Laboratory);

Riccardo Guidotti (Knowledge Discovery and Data Mining Laboratory);

Leonardo Robol (Mechanics of Materials and Structures Laboratory).

The recipients of the award for the “*Young Researcher - Advanced*” category are:

Luigi Malomo (Visual Computing Laboratory);

Luca Pappalardo (Knowledge Discovery and Data Mining Laboratory);

Giulio Rossetti (Knowledge Discovery and Data Mining 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.

Antonino Crivello (Beginner): Publications 2018

Crivello’s 2018 publications contribute to two main research topics, namely (i) *indoor localisation* [4, 5, 6, 7, 8, 9, 10, 11, 12, 13], and (ii) *sleep monitoring* [14, 15]. Both the activities are related to the monitoring of indoor human activities, considering as key information gathered at daytime and nighttime.

Indoor localisation systems have been studied in the literature for more than ten years and are starting to approach the market. Nevertheless, at the moment, no generally accepted solution exists due to the heterogeneity of indoor environments. Currently, state-of-the-art solutions design separate algorithms to process different indoor signals. Outputs of these algorithms are generally used as inputs of data fusion strategies [4].

These methods rely on computationally expensive particle filters, labor-intensive feature analysis, and time-consuming parameter tuning to achieve better accuracies. In [6] the authors explore the feasibility to use the Wi-Fi probe information as input of an indoor positioning system. In [12, 13] Crivello et al. propose a convolutional neural network (CNN) to

implement an accurate and orientation-free positioning system. Authors show that the CNN solution is able to automatically learn location patterns, thus significantly lower the work-force burden of designing a localization system.

The lack of standard evaluation methods is one of the obstacles to the convergence to a global accepted solution. Specifically, the definition of benchmarking methodologies, common evaluation criteria, standardised methodologies useful to developers, testers, and end users is an open challenge. The need for common benchmarks has been tackled by some initiatives in recent years: EvAAL, EVARILOS, the Microsoft competition and the IPIN competition. The first formal attempt at defining a standard methodology to evaluate indoor localisation systems is the ISO/IEC 18305:2016 International Standard, which defines a complete framework for performing test and evaluation of localisation and tracking systems. In [10, 11] Crivello et al. propose a critical reading of the standard and introduce metrics and methodologies intended to be a key contribution to the standardization of indoor localisation systems. Finally, in order to promote an open-source framework for smartphone-based indoor localization solutions, in [5], the authors propose the first attempt of a shared software for researcher and stakeholders in developing indoor localisation techniques.

Regarding sleep monitoring, considering human activities performed at night-time, a deep understanding of the human sleep characteristics represents a key factor. In fact, the human sleep behaviour, and consequently, the sleep characteristics relies on several factors, both physiological and mental. An objective recognition is performed through clinical approach (hospital settings) or by commercial devices (home settings). In [14, 15], the authors propose a general purpose sleep monitoring system that can be used for the pressure ulcer risk assessment, to monitor bed exits, and to observe the influence of medication on the sleep behaviour. Experimental results obtained by comparing the selected supervised algorithms show that we can accurately infer sleep duration, sleep positions, and routines with a completely unobtrusive approach.

Riccardo Guidotti (Beginner): Publications 2018

Guidotti’s 2018 publications [16, 17, 18, 19] [20, 21] contribute to three main research topics, namely *explainable artificial intelligence*, *personal data analytics* and *music listening analytics*.

In recent years, many accurate decision support systems have been constructed as *black boxes*, which is as systems that hide their internal logic to the user. This lack of explanation constitutes both a practical and an ethical issue. The literature reports many approaches aimed at overcoming this crucial weakness, sometimes at the cost of sacrificing accuracy for interpretability. The applications in which black box decision systems can be used are various, and each approach is typically developed to provide a solution for a specific problem and, as a consequence, it explicitly or implicitly

delineates its definition of interpretability and explanation. Guidotti reviewed recent (and less recent) literature on the topic of Explainable Artificial Intelligence in a survey [16] realizing a taxonomy that organizes the problems faced in state of the art. Given a problem definition, a black box type, and the desired explanation, the survey can help researchers to find the proposals more useful for their work. With respect to the specific issue of transparent decision models, Guidotti designed different versions of an interpretable classifier [17] based on decision/regression trees and decision rules, for estimating the popularity of a Docker image, and for understanding how to improve a Docker image to increase its popularity. Docker images are distributed in public registries, which also monitor their popularity. The popularity of an image directly impacts on its usage, and hence on the potential revenues of its developers. The results presented in [17] can provide valuable insights to Docker developers, helping them in spreading their images.

Most of the literature studying purchasing behavior focuses on what customers buy while giving little importance to the temporal dimension. Nowadays, a hot challenge for supermarket chains is to offer personalized services to their customers. Market basket prediction, i.e., supplying the customer a shopping list for the next purchase according to her current needs, is one of these services. Current approaches are not capable of capturing at the same time different factors influencing the customer’s decision process: co-occurrence, sequentiality, periodicity and recurrency of the purchased items. To this aim, with respect to the study of Personal Data Analytics, Guidotti defines in [18] a pattern Temporal Annotated Recurring Sequence (TARS) able to capture simultaneously and adaptively all these factors. Moreover, the paper establishes the method to extract TARS and develop a predictor for next basket named TBP (TARS Based Predictor) that, on top of TARS, can understand the level of the customer’s stocks and recommend the set of most necessary items. By adopting the TBP the supermarket chains could crop tailored suggestions for each customer, which in turn could effectively speed up their shopping sessions. In [19] Guidotti investigates the regularities characterizing the temporal purchasing behavior of the customers of a retail market chain. To assess this goal is introduced a framework for extracting from personal retail data a temporal purchasing profile able to summarize whether and when a customer makes her distinctive purchases. The individual profile describes a set of regular and characterizing shopping behavioral patterns, and the sequences in which these patterns take place. The paper shows how to compare different customers by providing a collective perspective to their profiles, and how to group the customers concerning these comparable profiles. The privacy risk related to individual models such as those designed in [18, 19]. In particular, it is defined a methodology for empirically assessing privacy risk in the releasing of individual purchasing data. The experiments on real-world retail data show that although individual patterns describe a

summary of the customer activity, they may be successfully used for the customer re-identification.

Another kind of data analyzed by Guidotti first from an individual perspective, and then from a collective one is the one of musical listening [20, 21]. In particular, using a cross-service multi-level dataset we investigated the actual Italian music scene. The investigation in [20] highlights the musical Italian superdiversity both individually analyzing the geographical and lexical dimensions and combining them. Using different kinds of features over the geographical dimension leads to two similar, comparable and coherent results, confirming the strong and essential correlation between melodies and lyrics. The profiles identified are markedly distinct one from another with respect to sentiment, lexicon, and melodic features. Through a novel application of a sentiment spreading algorithm and songs’ melodic features, are highlighted the discriminant characteristics that violate the standard regional political boundaries, reconfiguring them following the actual musical communicative practices. Moreover, the results of [21] highlight the existence of a “fractal” musical structure that relates the technical characteristics of the music produced at regional, national and world level. Moreover, a similar structure emerges also when we analyze the musicians’ popularity and the polarity of their songs defined as the mood that they are able to convey. Furthermore, the clusters identified are markedly distinct one from another with respect to popularity and sentiment.

Leonardo Robol (Beginner): Publications 2018

Robol’s 2018 publications focused on two main topics: the use of certain structure (in particular, Toeplitz and low-rank) to accelerate some algorithms in numerical linear algebra, and the development of reliable methods for model updating in the structural analysis of masonry buildings.

Concerning the first topic, one contribution concerns the computation of the steady-state distribution of quasi-birth-Death stochastic processes on 2D grids, that can be recast into solving certain quadratic matrix equations with semi-infinite Toeplitz matrix plus a compact correction [22, 23]. Similar techniques can be used in a different context, where one is concerned with solving linear matrix equations (of Lyapunov and Sylvester type), where the coefficients have off-diagonal blocks of low-rank [24]. These problems arise, for instance, in the solution of 2D fractional differential equations. Some results for the existence of solution for more general (systems of) Sylvester and Lyapunov equations have been presented in [25].

In the context of model updating, one is concerned with determining the optimal parameter of a finite element model of a structure, based on information retrieved by experimental measurements of its characteristic frequencies. An efficient algorithm for this task, based on a trust-region method, has been developed and tested on a wide range of examples [26, 27].

In parallel, some work has been done concerning numer-

ical treatment of matrix polynomials. For instance, in [28] a novel method has been developed to compute intersection of polynomials (and common eigenpairs of matrix polynomials) expressed in different basis, without the need of switching to a common basis. A family of new linearizations, and a formal description of the well-known class of Fielder linearizations, has been proposed in [29]. The new formalisms introduced in this paper allowed to prove some new theoretical results for this class which were previously not known, such as the presence of some low-rank structures. In particular, this finding can be used to develop fast algorithms for the approximation of the eigenvalues of matrix polynomials, as proposed in [30, 31].

Luigi Malomo (Advanced): Publications 2018

Malomo’s 2018 publications [32, 33, 34, 35, 36] belong to the *Digital Fabrication* context. This research domain concerns the application of computational methods, ranging from geometric analysis to physical simulation, to object manufacturing.

A project developed during the past year focused on the computational design of molds for reproducing multiple replicas of a digital object [32]. A computational geometry algorithm has been devised to automatically generate, given an input 3D shape, two or more Metamolds. Metamolds are special 3D printable containers that can be used to create silicone mold pieces by casting liquid silicone onto them. These silicone pieces can be then assembled together to create a fully functional silicone mold, which in turn can be employed to cast replicas of the input 3D shape. The method is particularly well suited for the cost-effective reproduction of artifacts, and was successfully employed in the context of the EU project EMOTIVE for museum applications [36]. In the same context, a new method has been developed to reproduce a given target 3D shape using just flat 2D panels called FlexMaps [33]. Instead of designing the elastic properties of continuous panels, in the FlexMaps panels the stiffness is controlled locally by varying spiraling geometric mesostructures, which are optimized in size and shape to match the global curvature (i.e., bending requests) of the target shape. As a result with this approach it is possible to obtain desired mechanical properties without changing the material but only by acting on the geometric parameters of the spirals. This method allows to recreate a 3D shape by using a set of automatically generated flat panels, which can be produced using laser cutting such that, once assembled together, they automatically take the shape of the target object.

Malomo research included also the study of stylized fabrication methods, an emerging class of approaches that is becoming popular in recent years. These methods abstract geometric and physical features of shapes to create unconventional representations, to produce optical illusions, or to devise a particular interaction with the fabricated models. Eventually, a representative set of these alternative fabrication techniques has been collected and classified into a state-of-the-art

report [34].

Lastly, during the past year, the research activity of Malomo included also the 3D reconstruction of cables (power-lines) from photographs [35]. In this work, a specialized reconstruction algorithm is devised to reconstruct cables relying on SfM reconstruction, for camera pose estimation, and the segmentation of the input pictures.

The contributions [32] and [33] have been published on the top ranked journal of Computer Graphics and presented, respectively, at Siggraph and Siggraph Asia, the most important venues for the field. The contribution [34] has been presented to the Eurographics 2018 conference. All the research has been performed within the EMOTIVE EU project, the D-Surf Italian PRIN project, and the Regione Toscana PAR-FAS SCIADRO project.

Luca Pappalardo (Advanced): Publications 2018

Pappalardo’s 2018 publications [18, 37, 38, 39] focused on a diverse set of topics, from human mobility analysis to injury prediction in sports.

In [37], Pappalardo proposed an algorithm to forecast the muscular injuries of soccer players based on machine learning and GPS data describing workloads in training sessions. The proposed algorithm, developed in collaboration with professional soccer clubs, has been proven to be significantly more precise than existing techniques used in sports science.

In [38], Pappalardo analyzed the mobility flows between cities in the US, discovering that city-to-city migrations are strongly influenced by the size of the origin and destination cities. Starting from this observation, an algorithm has been developed able to predict the flow between two cities given its population and distance.

In [18], an innovative algorithm based on pattern mining has been developed to predict the next basket of a customer. The algorithm is based on the so-called TARS (Temporal-Annotated Recurrent Sequence) and, tested on massive datasets of customers’ purchases, it has been proven to outperform classical techniques for next basket prediction.

Finally, in [39] an analysis has been conducted on the eating habits of students at the University of Pisa. The study, covering hundreds of students who consume meals at the University canteen every day, found that eating habits are correlated with the presence of gastroesophageal reflux symptoms.

Giulio Rossetti (Advanced): Publications 2018

Rossetti’s 2018 publications [40, 41, 42, 43, 44, 21, 20, 18] focus on complex network dynamics and data mining.

Regarding *dynamic network analysis*, during the last decade, we witnessed a change of perspective in the network science field: researchers started to challenge the widespread quasi-steady state assumption that, in spite of simplifying the formulation of analytical approaches, forced to consider network structures built to model of real-world phenomena as “frozen in time”.

Networks modeling real-world phenomena (either social, economic, biological or of other nature) are not considered

anymore as static entities that can be pinned to the wall and measured once and for all. They are, on the contrary, subject to several dynamic processes that we can group into two categories:

- Dynamics ON the network [41, 44], i.e., all those phenomena that take place over a complex network structure and are constrained by it. Examples are information propagation, epidemics, viral diffusion, word of mouth, etc.;
- Dynamics OF the network [42, 43]. As time goes by, network topology may change, nodes and edges appear/vanish. Such perturbations, reflects the mutable interactions of relations between actors, of the evolution of the actors themselves.

Introducing the temporal dimension within the framework offered by network science acted as a linchpin for the definition of new tasks as well as for the reinterpretation of classical ones under different constraints. Moreover, dynamics on and of networks are often intertwined: as time goes by, topological perturbations and diffusion ones may affect each other. Considering this complex, time-dependent, scenario, Rossetti addressed two well-known network analysis problems: Dynamic Community Discovery [42], e.g., the task of clustering nodes within an evolving graph (with applications to mobility data analysis [43]), and Network Diffusion, e.g., the task of modeling and simulating the spreading of content over a network topology [41, 44].

Finally, to support network scientists, students, teachers, and researchers in [41] Rossetti introduces a novel library that allows defining, simulate and study diffusive patterns over complex (even time-evolving) networks.

Regarding *Data Mining*, Rossetti’s research in 2018 focused on two different application domains: market basket prediction – i.e., supplying the customer a shopping list for the next purchase according to her current needs, is one of these services – and music data analysis.

Under the former theme fall the definition of a novel methodology to extract patterns from customers’ purchase history, TARS (Temporal Annotated Recurring Sequence), developed alongside with Riccardo Guidotti and Luca Pappalardo [18].

Regarding the latter area, Rossetti focused on the study of the fractal dimension of music [21], combining sentiment analysis, geography and popularity indexes to characterize artists at different scales (from regional to national and international viewpoint), thus assessing the existence of superdiversity [20] in the music scene.

Conclusion

This brief report documents the 2019 edition of the ISTI Young Researcher 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 seventh edition of the award that started in 2013 and from this year on the

award is named “Matteo Dellepiane”, in memory of an ISTI researcher contributing to the development of the initiatives supporting ISTI young staff development.

In this edition 15 applications have been received, 9 for the Beginner category and 6 for the Advanced category. These figures are lower than those of the previous editions [2, 3]: 35 applications in 2016, 26 applications in 2017, and 20 applications in 2018. This decreasing trend is due to the issues the Institute is facing in hiring young researchers, a multi-faceted issue including bureaucratic, administrative and budget related aspects.

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.

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Author contributions

Contributions to the paper are described by using the CRediT taxonomy⁶. P. Barsocchi: Conceptualization; Data curation; L. Candela: Conceptualization; Data curation; Writing – original draft; Writing – review & editing; Antonino Crivello: Writing – original draft; Andrea Esuli: Conceptualization; Data curation; Alessio Ferrari: Conceptualization; Data curation; Maria Girardi: Conceptualization; Data curation; Riccardo Guidotti: Writing – original draft; Francesca Lonetti: Conceptualization; Data curation; Luigi Malomo: Writing – original draft; Davide Moroni: Conceptualization; Data curation; Franco Maria Nardini: Conceptualization; Data curation; Luca Pappalardo: Writing – original draft; Salvatore Rinzivillo: Conceptualization; Data curation; Giulio Rossetti:

Writing – original draft; Leonardo Robol: Writing – original draft;

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