On Some Scientific Results of the ICPR-2020

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Abstract—This special issue of *PRIA* is devoted to some scientific results and trends of the 25th International Conference on Pattern Recognition (Virtual, Milano, Italy, January 10–15, 2021). Two important events of ICPR-2020 are represented in this special issue: (1) The paper of Professor Ching Yee Suen (Centre for Pattern Recognition and Machine Intelligence, Department of Computer Science and Software Engineering, Concordia University, Montreal, QC, Canada)—the recent winner of IAPR very prestigious K.S. Fu Prize for a year of 2020. The paper based on his lecture "From handwriting to human personality and facial beauty" presented at the ICPR 2020; (2) Special issue "ICPR-2020 Workshop "Image Mining. Theory and Applications." The analysis of the scientific contribution of IMTA-VII-2021 allows us to draw the following conclusions: (1) The construction of a unified mathematical theory of image analysis is still far from complete. (2) There is considerable interest in the development of new mathematical methods for analyzing and evaluating information presented in the form of images. (3) There is a tendency to expand the mathematical apparatus in the development of new methods of image analysis and recognition by involving in this process areas of mathematics that were not previously used in image analysis. (4) The gap between the capabilities of new mathematical methods of image analysis and recognition and their actual use in solving applied problems remains significant. (5) There is an excessive use of neural networks in solving applied problems of image analysis and image recognition, and quite often without proper justification and interpretation of the results. The special issue includes articles based on the workshop papers selected by the IMTA-VII-2021 Program Committee for publication in *PRIA*. The *PRIA* special issue "Scientific Resume of the 25th International Conference on Pattern Recognition" is prepared by the National Committee for Pattern Recognition and Image Analysis of the Russian Academy of Sciences, the IAPR member society, and by the IAPR Technical Committee no. 16 on Algebraic and Discrete Mathematical Techniques in Pattern Recognition and Image Analysis.

Keywords: automation of data analysis, biomedical applications, biomedical images, conditional generative adversarial networks, data mining, descriptive image analysis, face beauty, identity-preserved, image mining, intellectual data analysis, mathematical theory of image analysis, mathematical theory of pattern recognition

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INTRODUCTION

This special issue of the international journal *Pattern Recognition and Image Analysis. Advances in Mathematical Theory and Applications* of the Russian Academy of Sciences is devoted to some scientific results and trends of the 25th International Conference on Pattern Recognition (Virtual, Milano, Italy, January 10–15, 2021, ICPR-2020).

ICPR-2020 is the flagship conference of the International Association of Pattern Recognition (IAPR) and the premiere conference in pattern recognition, covering computer vision, image, sound, speech, sensor patterns processing and machine intelligence.

IAPR came into official existence in January 1978. Following the 2nd ICPR in 1974 in Copenhagen, Denmark, the Standing Committee approved the proposal to establish a permanent international professional organization; two years later, the Constitution was approved in Coronado and Executive Officers were elected.

Today, the responsibility for the day-to-day running of IAPR is delegated to an Executive Committee, assisted by Standing and ad hoc committees. The authority of the Association is vested in the Governing Board, composed of representatives of the member organizations, who decide all important matters such

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as general policy, the program of activities, admissions, elections, and budget.

ICPR provides an international forum for researchers and practitioners in the broad area of pattern recognition, including pattern recognition and machine learning, computer vision, speech, image, video and multimedia, biometrics and human–computer interaction, document analysis and recognition, biomedical imaging and bioinformatics. The conferences include workshops, tutorials, and contests in various topics.

ICPR2020 is the 25th event of the series, so turning 50 years old since its beginning (2020, Milan, Italy; 2018, Beijing, China; 2016, Cancun, Mexico; 2014, Stockholm, Sweden; 2012, Tsukuba Science City, Japan; 2010, Istanbul, Turkey; 2008, Tampa, Florida, USA; 2006, Hong Kong, China; 2004, Cambridge, England, UK; 2002, Quebec City, Canada; 2000, Barcelona, Spain; 1998, Brisbane, Australia; 1996, Vienna, Austria; 1994, Jerusalem, Israel; 1992, The Hague, The Netherlands; 1990, Atlantic City, USA; 1988, Rome, Italy; 1986, Paris, France; 1984, Montreal, Canada; 1982, Munich, Germany;1980, Miami, Florida, USA; 1978, Kyoto, Japan; 1976, San Diego, California, USA; 1974, Copenhagen, Denmark; 1973, Washington, DC, USA). It provides a great opportunity to nurture new ideas and collaborations for students.

Two important events of ICPR-2020 are represented in this special issue:

(1) The paper of Professor Ching Yee Suen (Centre for Pattern Recognition and Machine Intelligence, Department of Computer Science and Software Engineering, Concordia University, Montreal, QC, Canada), the recent winner of the very prestigious IAPR K.S. Fu Prize for a year of 2020. The paper is based on his lecture "From handwriting to human personality and facial beauty" presented at the ICPR 2020.

(2) Special issue "ICPR-2020 Workshop 'Image Mining. Theory and Applications'" (http://imta.isti.cnr.it/).

The *PRIA* special issue "Scientific Resume of the 25th International Conference on Pattern Recognition" is prepared by the National Commitee for Pattern Recognition and Image Analysis of the Russian Academy of Sciences, the IAPR member society, and by the IAPR Technical Committee no. 16 on Algebraic and Discrete Mathematical Techniques in Pattern Recognition and Image Analysis.

The paper consists of Introduction, Section 1 "The Paper of K.-S. Fu Prize Winner," and Section 2 "Special Issue "IMTA VII-2021. Selected Extended Papers."

1. THE PAPER OF K.-S. FU PRIZE WINNER

This section presents short info on K.-S. Fu Prize and a full list of the winners with corresponding citations.

Each two years the IAPR announces a call for nominations for the King-Sun Fu Prize in honor of the memory of Professor King-Sun Fu. (Professor Fu's biography appeared in the IEEE Trans. PAMI, May 1986, and is also available at http://dataclustering.cse.msu.edu/KSFu_Biography.pdf.)

Videos and slides of talks given by the most recent recipients of the K.-S. Fu Prize can be retrieved from the website http://www.cse.nd.edu/Fu_Prize_Seminars/.

Professor Fu was instrumental in the founding of IAPR, served as its first president, and is widely recognized for his extensive contributions to the field of pattern recognition.

This biennial prize is given to a living person in recognition of an outstanding technical contribution to the field of pattern recognition and consists of a cash amount and a suitably inscribed certificate. The prize is derived from interest income from a special fund set up for this purpose.

The nomination must be made by a member of a national member society of IAPR and by endorsement of at least five members, representing at least two member societies different from that of the nominator. The prize recipient shall be selected by the Prize Committee, subject to approval by the IAPR Governing Board. Members of the IAPR Executive Committee, as well as of the Prize Committee, shall be ineligible for the prize and may not serve as nominators or endorsers.

The full list of the winners with corresponding citations is given below.

2020 AWARD WINNER IN MILAN

Professor Ching Yee Suen

"For pioneering research and exceptional contributions to handwriting recognition and document understanding in theory, practice, and education."

2018 AWARD WINNER IN BEIJING

Matti Kalevi Pietikäinen

"For fundamental contributions to texture analysis and facial image analysis."

2016 AWARD WINNER IN CANCUN

Professor Robert Haralick

"For contributions in image analysis including remote sensing, texture analysis, mathematical morphology, consistent labeling, and system performance evaluation."

2014 AWARD WINNER IN STOCKHOLM

Professor Jitendra Malik

"For contributions to fundamental algorithms and their theoretical underpinnings in computer vision."

2012 AWARD WINNER IN TSUKUBA

Professor Rama Chellappa

"For pioneering contributions to statistical methods for image- and video-based object recognition."

2010 AWARD WINNER IN ISTANBUL
Professor Horst Bunke

"For pioneering work on syntactic and structural pattern recognition."

2008 AWARD WINNER IN TAMPA
Professor Anil K. Jain

2006 AWARD WINNER IN HONG KONG
Professor Josef Kittler

2004 AWARD WINNER IN CAMBRIDGE
Professor J.K. Aggarwal

2002 AWARD WINNER IN QUEBEC CITY
Professor Thomas S. Huang

2000 AWARD WINNER IN BARCELONA
Professor Theo Pavlidis

1998 AWARD WINNER IN BRISBANE
Professor Jean-Claude Simon

1996 AWARD WINNER IN VIENNA
Professor Teuvo Kohonen

1994 AWARD WINNER IN JERUSALEM
Professor Herbert Freeman

1992 AWARD WINNER IN THE HAGUE
Professor Leveen Kanal

1990 AWARD WINNER IN ATLANTIC CITY
Professor R.L. Kashyap

1988 AWARD WINNER IN ROME
Professor Azriel Rosenfeld

On the name of the National Committee for Pattern Recognition and Image Analysis of the Russian Academy of Sciences, of the IAPR TC 16, and of the *PRIA* journal Editorial Board we congratulate Professor Ching Yee Suen with winning of K.-S. Fu Prize for 2020. We consider this awarding as a triumph of justice and science. His prize is a great example for the whole *PRIA* community.

We are also grateful to Professor Ching Yee Suen and his former student Dr. Zhitong Huang for granting us the paper "Identity-preserved face beauty transformation with conditional generative adversarial networks" based on Professor Suen K.-S. Fu Prize lecture for publishing in *PRIA*.

The paper is published in this special issue.

2. SPECIAL ISSUE "IMTA VII-2021. SELECTED EXTENDED PAPERS"

The special issue published in this issue of *PRIA* continues the long tradition of publishing papers and selected reports of leading international conferences on computer science and cybernetics. The reader is offered the full texts of selected papers presented at the 7th International Workshop "Image Mining. Theory and Applications" (IMTA VII-2020), January 11, 2021, Milan, Italy, organized in conjunction with the 25th International Conference on Pattern Recognition, Milan, Italy, January 10–15, 2021 (virtual).

The IMTA-VII-2021 was conducted by the Technical Committee no. 16 on Algebraic and Discrete Mathematical Techniques in Pattern Recognition and Image Analysis of the International Association for Pattern Recognition and by the National Committee for Pattern Recognition and Image Analysis of the Russian Academy of Sciences.

The main purpose of the IMTA-VII-2021 was to provide the fusion of modern mathematical approaches and techniques for image analysis/pattern recognition with the requests of applications.

The IMTA-VII-2021 continues the successful series of IMTA-workshops devoted to modern mathematical techniques of image mining and to corresponding applications (2008, Funchal, Madeira, Portugal; 2009, Lisboa, Portugal; 2010, Angers, France; 2013, Barcelona, Spain; 2015, Berlin, Germany; 2018, Montreal, Canada).

Automation of image mining is one of the most important strategic goals in image analysis, recognition, and understanding both in scientific and technological aspects.

The main subgoals are developing and applying of mathematical theory for constructing

(a) image models and representations allowable for efficient pattern recognition algorithms;

(b) standardized representations and selection of image analysis transforms.

Automation of image mining is possible by combined application of mathematical theory of image analysis/understanding/recognition and of mathematical theory of pattern recognition.

Automation of image processing, analysing, estimating, and understanding is one of the crucial points of theoretical computer science having decisive importance for applications, in particular, for diversification of solvable problem types and for increasing the efficiency of problem solving.

The role of an image as an analysis and estimation object is defined by its specific and inalienable informational properties. Image is a mixture and a combination of initial (raw, real) data and of its representation means, of computational procedures and of the physical nature, and of the models of objects, events, and processes being represented via an image.

The specificity, complexity, and difficulties of image analysis and estimation (IAE) problems stem from necessity to achieve some balance between such highly contradictory factors as goals and tasks of a problem solving, the nature of visual perception, ways

and means of an image capturing, acquisition, formation, representation, reproduction, and rendering, and mathematical, computational, and technological means allowable for the IAE.

The mathematical theory of image analysis is not yet finished and is passing through a developing stage. It cleared not so long ago that only intensive creating of a comprehensive mathematical theory of image analysis and recognition (in addition to the mathematical theory of pattern recognition) could bring a real opportunity to efficiently solve application problems via extracting the information necessary for intelligent decision-making from images. The transition to practical, reliable, and efficient automation of image mining is directly dependent on introducing and developing mathematical means for IAE.

The IMTA-VII-2021 participants enjoyed the opportunity to discuss the methodology and mathematical and computational techniques for automation of image mining on the base of mathematical theory for IAE. Another important tasks of the workshop were to discuss artificial intelligence techniques, in particular, linguistic and knowledge engineering tools for image minin, image knowledge bases and image science ontologies, and to estimate the prospects of the algebraic approaches in representation of image analysis knowledge in this environment.

The interpretation of mathematical and linguistic techniques was illustrated by application problems, mainly from biology and medicine, automation of scientific research, industrial applications, and many other domains generating breakthrough and difficult application tasks.

Image mining methods are able to extract knowledge and to highlight patterns, enabling very important applications such as medical diagnosis, robotics, technical diagnosis, and nondestructive testing, precision agriculture, novel industrial support system, remote sensing, and anthropogenic and ecological forecasting and monitoring. The technological advances and the increase of storage capability support the growth of large and detailed, but possibly noisy, image datasets.

Hence, IMTA-VII-2021 topics are of utmost relevance being the perfect ground for rising significant cross-contamination with other emerging fields, both theoretical and applied. We may mention, e.g., computational topology, algebraic lattice methods, machine learning, and also new concepts and trends, such as topological features, invariants and their computation for digital images, representations, compression of nD images based on topology, descriptive image algebras, descriptive image models and representations and, based on them, multilevel multiple image classifiers, lattice-based learning from time series, images by video/image mining, and applications of fuzzy lattices in pattern recognition.

The IMTA-VII-2021 was intended to cover, but was not limited to, the following topics.

(1) Methodological Advances in Image Analysis and Pattern Recognition with a Special Focus on:

(a) Algebras;

(b) Discrete Mathematics;

(c) Computational Topology;

(d) Machine Learning;

(2) New Mathematical Techniques in Image Mining:

(a) Algebraic Approaches;

(b) Image and Lattice Algebras;

(c) Lattice-based Deep Hierarchical Representations and Neural Networks;

(d) Discrete Mathematics Techniques;

(e) Descriptive Techniques and Ill-Structured Data Representation Problems;

(f) Structural and Syntactic Techniques;

(g) Multiple Classifiers and Fusion of Algorithms;

(h) Pattern Recognition Techniques in Image-Mining Environment;

(3) Other Mathematical Techniques;

(4) Image Models, Representations, and Features;

(5) Automation of Image and Data Mining:

(a) Image and Ill-Structured Data Analysis;

(b) Image Mining, Computer Vision, and Knowledge-Based Systems;

(c) Image Databases;

(d) Image Mining Technologies;

(6) Artificial Intelligence Techniques in Image Mining:

(a) Knowledge Representation, Processing, Extracting, and Analysis;

(b) Image Knowledge Bases;

(c) Linguistic Tools for Image Mining (Image Science Ontologies; Image Science Thesauri);

(7) Applied problems:

(a) Bioinformatics;

(b) Bioengineering;

(c) Medical Applications;

(d) Industry and Economics;

(e) Cultural Heritage;

(f) Other important, difficult, and interesting applied problems.

IMTA-VII-2021 has been scheduled as a full-day virtual event, held on January 11, 2021. It consisted of 4 invited talks and 27 contributed talks. There were 34 submissions for reviews from authors from 11 countries.

The review process (single-blind), based on a minimum of two reviews for each paper, focused both on paper quality and prospective interest in the themes of IMTA workshop. The authors themselves presented all the scheduled talks (orally).

The invited talks listed below further enriched the program.

(1) "Basic models of descriptive image analysis" by Dr. Sci. (Eng.) I. Gurevich and Cand. Sci. (Phys.–Math.) V. Yashina (Federal Research Center Computer Sciences and Control of the Russian Academy of Sciences, Moscow, Russia);

(2) "Learning topology: Bridging computational topology and machine learning" by Dr. M.A. Pascali and Dr. D. Moroni (Institute of Information Science and Technologies, National Research Council of Italy, Pisa, Italy);

(3) "Automated visual large scale monitoring of faunal biodiversity" by Professor. Dr. B. Radig (Munich Technical University, Munich, Germany);

(4) "Pattern recognition capabilities of lattice based neural networks" by Professor Dr. Gerhard Ritter (University of Florida, Gainesville, USA).

The Co-Chairs of IMTA-VII-2021 would like to thank all the members of the Scientific Committee that, besides helping in the review process, have provided useful comments and remarks contributing to the success of the workshop. Last but not least, we thank ICPR organizers and workshop chairs for having hosted our workshop, for the patience in answering all our questions and, finally, for the courage and determination in continuing to organize such a complex event despite the difficult times.

CONCLUSIONS

The materials of IMTA-VII-2021 present original results in the field of theory and practice of pattern recognition and image analysis.

The special issue includes the articles based on the workshop papers selected by the IMTA-VII-2021 Program Committee for publication in *PRIA*. These papers have been expanded by their authors and have undergone additional peer review. Among the selected works were theoretical papers in the field of image recognition and image analysis, as well as the most interesting and significant applied papers on the application of methods of analysis, processing, and evaluation of information in industry, medicine, and other areas of the economy and social sphere.

The list of articles included in the special issue of IMTA-VII-2021 is given below.

The analysis of the scientific contribution of IMTA-VII-2021 allows us to draw the following conclusions:

(1) The construction of a unified mathematical theory of image analysis is still far from complete.

(2) There is considerable interest in the development of new mathematical methods for analyzing and evaluating information presented in the form of images.

(3) There is a tendency to expand the mathematical apparatus in the development of new methods of image analysis and recognition by involving areas of mathematics that were not previously used in image analysis.

(4) The gap between the capabilities of new mathematical methods of image analysis and recognition and their actual use in solving applied problems remains significant.

(5) There is an excessive use of neural networks in solving applied problems of image analysis and image recognition, quite often without proper justification and interpretation of the results.

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COMPLIANCE WITH ETHICAL STANDARDS

This article is a completely original work of its authors, has not been published before, and will not be published in other publications.

CONFLICT OF INTEREST

The content of the article does not give grounds for raising the question of a conflict of interest.

LIST OF PAPERS INCLUDED INTO THE SPECIAL ISSUE

Invited Papers

1. I. B. Gurevich and V. V. Yashina, "Descriptive models of information transformation processes in image analysis."

2. Davide Moroni and Maria Antonietta Pascali, "Learning topology: Bridging computational topology and machine learning."

3. Bernd Radig, Paul Bodesheim, Dimitri Korsch, Joachim Denzler, Timm Haucke, Morris Klasen, and Volker Steinhage, "Automated visual large scale monitoring of faunal biodiversity."

Contributed Papers

4. N. A. Andriyanov, "Application of computer vision systems for monitoring the condition of drivers based on facial image analysis."

5. N. A. Andriyanov, V. E. Dementev, K. K. Vasiliev, and A. G. Tashlinskii, "Investigation of methods for increasing the efficiency of convolutional neural networks in identifying tennis players."

6. V. E. Antsiperov, "Representation of images by the optimal lattice partitions of samples."

7. P. A. Chochia, "Image decomposition algorithm with a structural constraint of the averaging region."

8. V. E. Dementev, M. N. Suetin, and M. A. Gaponova, "Using machine learning techniques to detect defects in images of metal structures."

9. S. D. Dvoenko, "A developing of the Kemeny median: New types and algorithms."

10. I. B. Gurevich, M. V. Budzinskaya, V. V. Yashina, A. M. Nedzved, A. T. Tleubaev, V. G. Pavlov, and D. V. Petrachkov, "A new method for automating the diagnostic analysis of human fundus images obtained using optical coherent tomography angiography."

11. N. Yu. Ilyasova, A. S. Shirokanev, and N. S. Demin, "Development of high-performance algorithms for the segmentation of fundus images using a graphics processing unit."

12. A. N. Karkishchenko and V. B. Mnukhin, "Reduced sign representations for characteristic points selection in images."

13. V. R. Krashennikov, Yu. E. Kuvaiskova, O. E. Malenova, and A. Yu. Subbotin, "Testing hypotheses about covariance functions of cylindrical and circular images."

14. Eckart Michaelsen, "Explorations on the depth of gestalt hierarchies in social imagery."

15. E. V. Myasnikov, "Comparison of spectral dissimilarity measures and dimension reduction techniques for hyperspectral images."

16. Rodrigo Nava, Duc Fehr, Frank Petry, and Thomas Tamisier, "Tire surface segmentation in infrared imaging with convolutional neural networks and transfer learning."

17. Ghulam-Sakhi Shokouh, Baptiste Magnier, Binbin Xu, and Philippe Montesinos, "Ridge detection by image filtering techniques: A review and an objective analysis."

18. S. A. Usilin, O. A. Slavin, and V. V. Arlazarov, "Memory consumption and computation efficiency improvements of Viola–Jones object detection method for remote sensing applications."

Igor' B. Gurevich. Born on August 24, 1938. He graduated from the Moscow Power Engineering Institute in 1961 (Automatic Control and Electrical Engineering) and defended his Candidate's Dissertation in Physics and Mathematics at the Moscow Institute of Physics and Technology in 1975. Leading Researcher at the Federal Research Center Computer Science and Control of the Russian Academy of Sciences. He works since 1960 till now as an engineer, researcher, and lecturer in industry, research institutions, medicine, and universities, and, since 1985, he works in the USSR/Russian Academy of Sciences. Area of expertise: mathematical theory of image analysis, image mining, image understanding, mathematical theory of pattern recognition, theoretical computer science, medical informatics, applications of pattern recognition and image analysis techniques in biology, medicine, and in automation of scientific research, and knowledge-based systems.

Gurevich suggested, proved, and developed with his pupils the descriptive approach to image analysis and recognition (DAIA). Within DAIA a new class of image algebra was introduced, defined, and investigated (descriptive image algebras); new types of image models were introduced, classified, and investigated; axioms of descriptive theory of image analysis were introduced; a common model of image recognition process was defined and investigated; new settings of image analysis and recognition problems were introduced; a notion "image equivalence" was introduced and investigated; new classes of image recognition algorithms were defined and investigated; an image formalization space was introduced, defined, and investigated.

Listed results were used in development of software kits for image analysis and recognition and for solution of important and difficult applied problems of automated biomedical image analysis.

Gurevich is an author of 2 monographs, 307 papers in peer reviewed journals and proceedings indexed in Web of Science, Scopus, and Russian Science Citation Index on the platform of Web of Science, and 31 invited papers at international conferences and is a holder of 8 patents. Web of Science: 22 papers; SCOPUS: 76 papers, 287 citations in 148 documents; Hirsh index is 10; Russian Science Citation Index on the platform of Web of Science: 129 papers; 910 citations; Hirsh index is 11.

He is vice-chairman of the National Committee for Pattern Recognition and Image Analysis of the Russian Academy of Sciences, Member of the International Association for Pattern Recognition (IAPR) Governing Board (representative of Russia), and the IAPR Fellow. He has been the Primary Investigator of 63 R&D projects as part of national and international research programs. He is Vice-Editor-in-Chief of the *Pattern Recognition and Image Analysis*, the international journal of the RAS, member of editorial boards of several international scientific journals, member of the program and technical committees of many international scientific conferences. He has teaching experience at the Lomonosov Moscow State University, Russia (Assistant Professor), Dresden Technical University, Germany (Visiting Professor), George Mason University, USA (Research Fellow). He supervised of 6 PhD students and many graduate and master students.

Vera V. Yashina. Born September 13, 1980. Diploma Mathematician, Lomonosov Moscow State University (2002). Cand. Sci. (Phys.–Math.) (Theoretical Foundations of Informatics), 2009, Dorodnicyn Computing Center of the Russian Academy of Sciences, Moscow. Leading Researcher at the Department for Recognition, Security, and Analysis of Information at the Federal Research Center Computer Science and Control of the Russian Academy of Sciences. She works in the Russian Academy of Sciences since 2001. Scientific expertise: mathematical theory of image analysis, image algebras, models, and medical informatics.

The main results were obtained in mathematical theory of image analysis: descriptive image algebras with one ring were defined, classified and investigated; a new topological image formalization space was specified and investigated; descriptive generating trees were defined, classified, and investigated. Listed results were applied in biomedical image analysis.

She is Scientific Secretary of the National Committee for Pattern Recognition and Image Analysis of the Presidium of the Russian Academy of Sciences. She is a Member of the Educational and Membership Committees of the International Association for Pattern Recognition. She is a Vice Chair of Technical Committee no. 16 on Algebraic and Discrete Mathematical Techniques in Pattern Recognition and Image Analysis of the International Association for Pattern Recognition. She has been the member of many R&D projects as part of national and international research programs. Member of editorial board of *Pattern Recognition and Image Analysis*, an international journal of the RAS. Author of 79 papers in peer reviewed journals, conference and workshop proceedings. Web of Science: 11 papers; Hirsh index is 4; SCOPUS: 40 papers, 162 citations in 75 papers; Hirsh index is 8; Russian Science Citation Index on the platform of Web of Science: 56 papers; 255 citations; Hirsh index is 9. She was awarded several times for the best young scientist papers presented at the international conferences. Teaching experience: Lomonosov Moscow State University. She supervised several graduate and master students.

Davide Moroni received the MSc degree (Hons.) in Mathematics from the University of Pisa, in 2001, the Diploma from the Scuola Normale Superiore of Pisa, in 2002, and the PhD degree in mathematics from the University of Rome La Sapienza, in 2006. He is a Researcher with the Institute of Information Science and Technologies (ISTI), National Research Council, Pisa, Italy. He is currently the Head of the Signals and Images Lab, ISTI. He is the Chair of the MUSCLE working group (https://wiki.ercim.eu/wg/MUSCLE) of the European Consortium for Informatics and Mathematics. Since 2018, he serves as the Chair of the Technical Committee 16 on Algebraic and Discrete Mathematical Techniques in Pattern Recognition and Image Analysis (http://iapr-tc16.eu) of the International Association for Pattern Recognition (IAPR). He is an Associate Editor of *IET Image Processing*. His main research interests include geometric modeling, computational topology, image processing, computer vision, and medical imaging. At the moment, he is leading the CNR-ISTI team in the National Project PON MIUR S4E, working on maritime safety and security, and in the regional Project IRIDE addressing AR technologies and computer vision of Industry 4.0.

Maria Antonietta Pascali received her MSc in Mathematics honours degree from the University of Pisa in 2005, PhD in Mathematics at the University of Rome "La Sapienza" in 2010. She is a Researcher at CNR in Pisa since February 1, 2010. Member of IAPR TC16 on Algebraic and Discrete Mathematical Techniques in Pattern Recognition and Image Analysis. Research interests: modeling the protein 3D motion, 3D virtual environment in cultural heriitage, heterogeneous and multimodal data integration for underwater archaeology; 3D shape analysis for e-health, thermal imaging, statistical analysis of health-related data, applied computational topology; interplay of topological data analysis and artificial intelligence; deep learning applied to mp-MRI images.