IAPR TECHNICAL COMMITTEE 16

"ALGEBRAIC AND DISCRETE MATHEMATICAL TECHNIQUES IN PATTERN RECOGNITION AND IMAGE ANALYSIS"

http://www.ccas.ru/TC16

ACTIVITY REPORT

FOR THE PERIOD 2010-2012
(SINCE ICPR 2010)

Moscow, The Russian Federation

2012

IAPR TC 16

"ALGEBRAIC AND DISCRETE MATHEMATICAL TECHNIQUES IN PATTERN RECOGNITION AND IMAGE ANALYSIS"

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1 TC 16 BACKGROUND INFORMATION

The TC16 was proposed by the Russian Federation "Association for Pattern Recognition and Image Analysis" and created in 1996 (at the meeting of the IAPR Governing Board in Vienna, 13th ICPR).

The main goals of TC 16 are discussion of actual and prospective lines of research and exchange of the results in Algebraic and Discrete Mathematics Problems and Techniques inspired by Pattern Recognition and Image Analysis. The means which TC 16 uses to achieve the goals are more or less standard for IAPR TCs: the organization of workshops and conferences, the preparation of publications (survey articles, state of the art and position papers, tutorials, etc.), the design of databases, support of communication between members, exchange by results, creation and collection of educational materials, etc.

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 image models accepted by efficient pattern recognition algorithms and for constructing standardized representation and selection of image analysis transforms. Automation of image-mining is possible by combined application mathematical techniques for image analysis, understanding and recognition.

Automation of image processing, analysis, 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 determined by its specific and inalienable informational properties. Image is a mixture and a combination of initial (raw, “real”) data and its representation means, of computational procedures results and of the physical nature and of the models of objects, events and processes to be 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 problem solving, the nature of visual perception, ways and means of an image acquisition, formation, reproduction and rendering, and mathematical, computational and technological means allowable for the IAE.

The mathematical theory of image analysis is not finished and is passing through a developing stage. It is only recently came understanding of the fact that only intensive

creating of comprehensive mathematical theory of image analysis and recognition (in addition to the mathematical theory of pattern recognition) could bring a real opportunity to solve efficiently application problems via extracting from images the information necessary for intellectual decision making. The transition to practical, reliable and efficient automation of image-mining is directly dependent on introducing and developing of mathematical means for IAE.

We consider also as a very important matter creation for the Algebraic and Discrete Mathematics community involved in Pattern Recognition and Image Analysis of new opportunities to know each other better and to communicate regularly.

1.1 TC 16 LEADERSHIP TEAM IN THE YEARS OF 2010 – 2012

- Chairman:

Professor Yuri Zhuravlev
Full Member of the Russian Academy of Sciences
IAPR GB Member
Chairman of the National Committee of the Russian Academy of Sciences for Pattern Recognition and Image Analysis
Dorodnicyn Computing Centre of the Russian Academy of Sciences, Moscow, The Russian Federation
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- Vice-Chairmen:

Dr.-Eng. Igor Gurevich
Scientific Secretary of the National Committee of the Russian Academy of Sciences for Pattern Recognition and Image Analysis
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Professor Heinrich Niemann
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Friedrich-Alexander University of Erlangen-Nuremberg, Germany
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Professor Gerhard Ritter
University of Florida, Gainesville, Florida, USA
ritter@cise.ufl.edu

1.2 TC 16 WEBSITE:

http://www.ccas.ru/tc16/

1.3 NUMBER OF MEMBERS (PEOPLE ON MAILING LIST):

279 members (Asia, Australia, Europe, The Russian Federation, USA, Central and South America)

Membership in TC 16 is open to scientists, academics, professionals, PhD students and students who are interested in the advancement of algebraic and discrete mathematics techniques for image analysis and pattern recognition. To request a membership, the online request form should be completed. The form is available at the TC 16 website: http://www.ccas.ru/tc16/ (see section "Membership").

1.4 COMMUNICATION TYPES USED (E.G. NEWSLETTERS) AND FREQUENCY:

E-mails associated with current activity and announcements on scientific events of TC16

1.5 KEY EVENTS USUALLY ORGANISED BY THE TC 16:

- International Conference "Pattern Recognition and Image Analysis: New Information Technologies" (PRIA) (biannually)
- International Conference "Mathematical Techniques for Pattern Recognition" (biannually)
- Open German/Russian Workshop on Pattern Recognition and Image Understanding (OGRW) (biannually)
- International Workshop "Image Mining. Theory and Applications" (IMTA) (in conjunction with the International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications – VISIGRAPP) (annually)
- International Conference "Classification, Forecasting, Data Mining" (CFDM)
- International Conference "Intelligent Information Processing" (IIP) (biannually)

2 ACTIVITIES IN 2010-2012 (SINCE ICPR 2010)

2.1 WEBSITE UPDATES

2.1.1. Educational information

- Updated list of research papers on TC16 competence domain.
- Updated list of selected publications on TC16 competence domain (including electronic versions of papers in pdf-format).
- Updated list of journals on TC16 competence domain.
- Updated list of INTERNET resources on TC16 competence domain.

2.1.2. Tutorials

- The tutorial "The Algebraic Approaches and Techniques in Image Analysis. Part II" (presentation in ppt-format)

2.1.3. Description of application areas

- The basic application areas are biology and medicine (hematology, neuro-degenerative diseases and oncology).

2.1.4. Examples of successful projects

- TC 16 continues the construction of bilingual thesaurus for the subject domain "Mathematical Theory of Pattern Recognition and Image Analysis". An updated version of the thesaurus is presented at the TC16 website (electronic version in pdf-format). It is used currently as a base for constructing the ontology of the subject domain "Mathematical Theory of Pattern Recognition and Image Analysis".

2.1.5. Demos

- None

2.1.6. Reference resources (datasets, evaluation tools).

- Since TC 16 activity is mostly devoted to fundamental research, the specific datasets and evaluation tools are not necessary at the current stage.

2.2 RESEARCH INITIATIVES

2.2.1. Events organised

- 10th International Conference "Pattern Recognition and Image Analysis: New Information Technologies" (PRIA-10-2010), St. Petersburg, Russian Federation, December 2010.
- 8th Open German-Russian Workshop on Image Understanding (OGRW-8-2011), Nizhny Novgorod, Russian Federation, November 21-26, 2011.

2.2.2. Publicity / dissemination activities

- TC16 prepares for publication Proceedings of conferences and workshops organized with TC16 participation as well as special issues of the international journal “Pattern Recognition and Image Analysis. Advances in Mathematical Theory and Applications” (Pleiades Publishing Ltd. International Academic Publishing Company “Nauka/Interperiodica” http://www.springerlink.com) devoted to scientific events organized by TC16.

2.2.3. The Meetings of TC16 were organized in conjunction with:

- 10th International Conference "Pattern Recognition and Image Analysis: New Information Technologies" (PRIA-10-2010), St. Petersburg, Russian Federation, December 2010.
- 8th Open German-Russian Workshop on Image Understanding (OGRW-8-2011), Nizhny Novgorod, Russian Federation, November 21-26, 2011.

2.2.4. Monitoring the state-of-the art in algebraization of image analysis and recognition.

2.2.5. Updating and discussing of the list of break-through research topics in the algebraization of image analysis and recognition.

2.2.6. Updating and discussing the list of challenging and interesting research problems.

2.2.7. Collecting, creating and preparing for presentation at the site different kinds of educational materials.

2.2.8. Collecting, creating and preparing for presentation at the site bibliographical lists, lists of INTERNET resources and publications in the fields of TC 16 interests.

3 PLANS

3.1 THE MAIN LINES OF TC16 SCIENTIFIC INTERESTS WILL BE FOCUSED ON THE FOLLOWING TOPICS:

- image algebras, image super-algebras, graded image algebras;
- mathematical techniques for image mining;
- image models;
- image spaces;
- informational nature of an image;
- algebraic models of pattern recognition and image analysis algorithms;
- pattern recognition algorithms based on algebras and discrete mathematics;
- image metrics;
- image equivalence;
- algebraic approach to the knowledge representation and processing in pattern recognition and image analysis problems;
- algebraic and logical techniques application in image databases and knowledge bases;
- image analysis ontologies;
- image algebras applications.

3.2 RESEARCH INITIATIVES

3.2.1. The normalization and regularization of terminology being used in the subject domain "Mathematical Theory of Pattern Recognition and Image Analysis" is a crucial and critical problem for theory and applications of modern Pattern Recognition and Image Analysis techniques and tools. There are, at least, three fields where the absence of widely accepted and logically ordered terminology is a serious obstacle to further development and activity: automation of pattern recognition and image analysis, image mining and data mining, and conference paper reviewing.

3.2.2. TC16 will continue developing the ontology of the subject domain "Mathematical Theory of Pattern Recognition and Image Analysis". TC 16 needs financial support from IAPR for maintaining the development of the corresponding ontology.

3.2.3. TC 16 will continue collecting and preparing to presentation at the TC 16 website different kind of educational materials. It is planned to use the ontology under development for ordering and structuring of these data.

3.2.4. TC 16 will continue collecting, creating and preparing to presentation at the TC 16 site bibliographical lists, lists of INTERNET resources and publications in the fields of TC 16 interests. It is planned to use the ontology under development for ordering and structuring of these data.

3.2.5. TC 16 will continue to prepare special issues of of the international journal "Pattern Recognition and Image Analysis. Advances in Mathematical Theory and Applications" including selected papers of scientific events organized with TC 16 participation.

3.2.6. TC 16 will prepare a special issue of "Pattern Recognition Letters" devoted to the problems in its competence domain.

3.2.7. The Meetings of TC16 are planned in conjunction with:

- ICPR-2012, Tsukuba, Japan, November 2012.
- 4th International Workshop on Image Mining. Theory and Applications (IMTA-4-2013), Barcelona, Spain, February 2013.
- 11th International Conference "Pattern Recognition and Image Analysis: New Information Technologies" (PRIA-11-2013), Samara, The Russian Federation, September 2013.

3.2.8. Participation in organization of the following scientific events:

- 4th International Workshop on Image Mining. Theory and Applications (IMTA-4-2013), Barcelona, Spain, February 2013.
- 11th International Conference "Pattern Recognition and Image Analysis: New Information Technologies" (PRIA-11-2013), Samara, The Russian Federation, September 2013.
- 9th Open German/Russian Workshop on Pattern Recognition and Image Understanding (OGRW-9-2013), Germany, 2013.

3.2.9. Attraction of new members. Geographical and professional extension of TC 16 membership.

3.2.10. The next leadership of TC 16 will begin their activity from sending to all member societies invitations to delegate their representatives to TC 16 and to potentially interested scientists invitations to enter TC 16.

4 RECOMMENDATIONS

For 2012-2014 term we propose the following nominations:

as Chairman of TC16:

Dr.-Eng. Igor Gurevich
Scientific Secretary of the National Committee of the RAS for Pattern Recognition and Image Analysis
IAPR Fellow
IAPR GB Member
Dorodnicyn Computing Centre of the Russian Academy of Sciences, Moscow, The Russian Federation
igourevi@ccas.ru

as Vice-Chairmen of TC16:

Professor Heinrich Niemann
IAPR Fellow
Friedrich-Alexander University of Erlangen-Nuremberg, Germany
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Professor Dr. Bernd Radig
Technical University of Munich, Germany
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Professor Gerhard Ritter
University of Florida, Gainesville, Florida, USA
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Professor Dr. Ovidio Salvetti
Institute of Information Science and Technologies “A. Faedo”, Italian National Research Council, Pisa, Italy
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as scientific secretaries of TC16:

Dr. Yulia Trusova
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The recommended scientists confirmed that they are ready to serve at these positions.

5 CONCLUSION

We consider that IAPR TCs in general and IAPR TC 16 in particular should be involved directly into ICPR preparation in the following aspects:
a) Defining ICPR program topics in the TC competence domain;

b) Defining ICPR invited speakers in the TC competence domain;

c) Defining ICPR PC members;

d) Defining ICPR program topics in the TC competence domain;

e) ICPR papers reviewing in the TC competence domain.

We consider that TC16 works and made positive contribution into IAPR activity and into development of the algebraization of pattern recognition and image analysis, and to development of mathematical theory of pattern recognition and image analysis in a whole. We are confident that in the future its activity will be intensified and extended.

We would like to stress that we consider the exchange of ideas and informal discussions between scientists and professionals in the field as one of the most important aspects and instruments of TC 16. We ascertain that the TC16 prospers in this line.

Chairman of TC16
Yuri Zhuravlev
Dorodnicyn Computing Centre of the Russian Academy of Sciences, Moscow, The Russian Federation
Full Member of the Russian Academy of Sciences
IAPR GB Member

Vice-Chairmen of TC16:
Dr.-Eng. Igor Gurevich
Scientific Secretary of the National Committee of the RAS for Pattern Recognition and Image Analysis
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Professor Heinrich Niemann
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Professor Gerhard Ritter
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