IMTA-5

Image Mining. Theory and Applications

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FOREWORD

The IMTA-5 workshop continues the successful series of the IMTA workshops associated with VISAPP conferences and is devoted to modern mathematical techniques of image mining and to image analysis applications in different fields including natural and social sciences, engineering, technology and industry, medicine and others. 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 goals are developing and applying of mathematical theory for constructing image models and representations allowable by efficient pattern recognition algorithms and for constructing standardized representation and selection of image analysis transforms.

Taking as a strategic goal the automated image mining it is necessary to provide image analysis professionals and final users with the following opportunities: - automated design, testing and adaptation of techniques and algorithms for image recognition, estimation and understanding; - automated selection of techniques and algorithms for image recognition, estimation and understanding; - automated testing of the raw data quality and suitability for solving image recognition problems; - standard technological schemes for image recognition, estimation, understanding and retrieval.

Automation of image-mining is possible by combined application of mathematical theory of image analysis/understanding/recognition and 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 using an image as an information carrier, 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, logical, physical and semantic 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 a problem solving, the nature of visual perception, ways and means of image acquisition, formation, representation, reproduction and rendering, and mathematical, computational and technological means allowable for the IAE.

Image analysis is a very challenging field for applied mathematics and theoretical computer science. An image is a very inconvenient object for mathematical processing and analysis. We may consider that the main inconvenience and contradiction is related to the "pictorial nature" of an image and the "formal" (symbolic) foundations of IAE: it is well known that to take an advantage from information/mathematical processing of data representation in an

image form is necessary to reduce the latter to a formal representation, i.e. to a "non-image" form.

In IAE we use a wide spectrum of mathematical techniques from algebra, geometry, discrete mathematics, mathematical logics, probability theory, mathematical statistics, calculus, as well as the techniques of mathematical theory of pattern recognition, digital signal processing, and physics (in particular, optics).

The mathematical theory of image analysis is not finished and is passing through a developing stage. It appeared not so long 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 new efficient mathematical means for IAE.

The natural way to overcome the above mentioned contradictions and difficulties is to introduce pattern recognition oriented image models and necessary means and techniques for reducing of an image to a recognizable form without loss of image specificity advantages. The careful study of the challenge revealed the opportunity to solve it via a theory establishing reasonable ties between an image nature, IAE applications, pattern recognition philosophy, formal symbolic image representations and models, IAE transforms, and corresponding information technologies implementing a "combinational and computational" part of these approaches, means and techniques.

The purpose of the workshop is to discuss a methodology, mathematical and computational techniques for automation of image mining on the base of mathematical theory for IAE from the position of mathematical, computer and image sciences..

The interpretations of mathematical and computer science techniques are 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.

We hope that the IMTA-V is an important next step on a way to a comprehensive mathematical theory of image analysis.

The workshop is organized in the framework of the 10th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications - VISIGRAPP 2015 in cooperation with the Technical Committee No. 16 "Algebraic and Discrete Mathematical Techniques in Pattern Recognition and Image Analysis" of the International Association for Pattern Recognition and with the National Committee for Pattern Recognition and Image Analysis of the Russian Academy of Sciences. The IMTA-V is included into the list of scientific meetings and events of the Russian Academy of Sciences in the year of

2015 (the basic organization is the Dorodnitzyn Computing Center of the Russian Academy of Sciences, Moscow, the Russian Federation.

The workshop scientific program includes 2 keynote talks, 1 tutorial paper, a round table, 9 regular papers, 4 short papers, informal discussions, and a wrap-up session. The workshop starts with an opening session to introduce the workshop topics, goals, participants, and expected outcomes. The invited talks give overviews of the key topics. Contributed talks represent a mix of new results based on completed work, work in progress, research challenges, and applications.

In a whole, given the increasing interest on this subject, the IMTA-V workshop is intended to offer the possibility to discuss the most recent advances in this very important and challenging branch of theoretical and applied computer science.

All papers were peer-reviewed by at least 2 members of IMTA-V Workshop Program Committee.

All accepted and registered papers are published in a current version of the pre-workshop proceedings book under an ISBN reference, which is issued by INSTICC Press. There is also a CD-ROM publication. Full revised texts of all papers presented at the workshop will be published in the special issue of the international journal "Pattern Recognition and Image Analysis. Advances in Mathematical Theory and Applications" (MAIK "Nauka/Interperiodica", Moscow, Pleiades Publishing distributed worldwide by SPRINGER), 2015.

We acknowledge the invaluable contribution into the workshop and the Proceedings preparation and organization of IMTA-V scientific secretary Dr. Vera Yashina, Dorodnitzyn Computing Center, the Russian Academy of Sciences, Moscow, the Russian Federation.

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