

# Computational modeling of objects presented in images: fundamentals, methods and applications

(Editorial, Volume 3, Issue 2, 3 April 2015, Pages 61-62)

Images and their analysis play an important role in several field of human science and applications and the more science and technology contribute to enhance the capabilities and the possibilities, the more the application fields grow up in number and in importance.

This multidisciplinary nature of image analysis brings to different specific problems, peculiar for each area, which at a first sight can lead to different ways to approach each problem.

Leaving the visual and, in some sense, human based image analysis and information extraction to the specific problems in which the importance of human experiences and skills are almost the only support to the process, interesting problems can arise when the information must be, or it is wanted to be, extracted from the images in an automatic way.

Therefore, different applications, such as medicine (for diagnostic, surgery support and so on), material science, surveillance, biometric, robotics, defence, satellite data, traffic analysis, architecture and urbanism, history and even humanities, and different methodologies, such as optimization methods, geometry, principal component analysis, stochastic methods, neural networks, fuzzy logic, are involved.

However, in spite of the consequent heterogeneity in the methodological approaches, the relationships between the requirements for each investigation area are higher than they can seem.

The cultural background and the skills of both the researchers and the final users in the different fields in which image analysis are of central importance have forced to look at each problem from a restricted point of view. Moreover, the methodologies like image segmentation, 2D and 3D reconstruction, data acquisition, interpolation and registration, scientific data visualization, remote sensing, modeling and simulation, biometric recognition, medical imaging, motion and deformation analysis, material science, vision in robotics and automation, architecture, just to mention the most important, are developed and used by researchers in each different field remaining too often bounded within the field itself.

To contribute in bridging the gap among researchers involved in different applications, in September 2012 the *International Symposium CompIMAGE 2012: Computational Modeling of Object Presented in Images: Fundamentals, Methods and Applications* was held in Rome, at the

Department of Computer, Control and Management Engineering Antonio Ruberti of Sapienza University of Rome.

The aim was to bring together researchers representing several fields such as Engineering, Medicine, Mathematics, Physics, Statistic and Architecture, presenting new trends in these fields. Researchers coming from about 25 countries all over the world attended the Conference. It was the third edition of the CompIMAGE Conferences, after the edition held in Coimbra (Portugal) in 2006 and the edition held in Buffalo (USA) in 2010. In CompIMAGE2012, following the cultural and historical background of the guesting country, a session on artistic, architectural and urban heritages was included to propose an important field of application of vision and image analysis. Four thematic sessions were proposed on MRI brain image analysis, material science, architectural heritages and surgical planning.

Some of the papers presented at the COMPIMAGE2012 Conference, selected to represent some of the research field involved, are now proposed here in extended form.

In particular, Petersen and Stricker from German Research Center for Artificial Intelligence presented an approach to image-based rendering of articulated objects to give reliable estimates of the object's shape and shading in new poses. A kinematic 3D model with an extension to billboard rendering was combined with a computationally lightweight axis-aligned morphing technique. The approach faithfully approximates both shape and shading of a hand in an unseen target pose even with large unobservable hand parts in the prototype images used for synthesizing. The method does not require any preparation or skin color segmentation or edge extraction but operates directly.

Avola, Placidi and Petracca from the University of L'Aquila continued a previous work to support the three-dimensional reconstruction, rendering and processing of biomedical images. In particular they provided final details of the 3D Bio-IPF framework and, at the same time, they completed the description of the Implant plug-in. The system is of interest and could be employed for semi-automatic surgery if integrated with a position indicator system and a numerically positionable drilling machine

Marinozzi F., Bini, and Zuppante from Sapienza of Rome, Marinozzi A. from Campus Bio-Medico of Rome, Bedini from Istituto Superiore di Sanità of Rome considered by finite element analysis the altered load distribution within femoral head in osteoarthritis, implementing a 2D

(homogeneous) isotropic and linearly elastic model of the proximal half of the human femur from X-ray images

Ribeiro, Bate and Goncalves from Polytechnic Institute of Lisbon, O'Neill from New University of Lisbon and Mauricio from Medical Imaging Centre Tomar (Pt) were interested in computer tomography automated and semi-automated procedures in the assessment of coronary arterial disease; their study aimed to optimise the protocol acquisition in order to reduce the radiation dose and explain the flow of procedures to quantify CAD

Varga, Balazs and Nagy from University of Szeged studied discrete tomography (DT) to propose a new method for multivalued DT, to perform the reconstruction of the inner structure of objects consisting of only few different homogeneous materials as an energy minimisation task. The algorithm was validated by comparing its performance with other cutting-edge reconstruction algorithms from the literature.

Boschetto, Pochini, Bottini, Giovagnoli, Giansanti from Sapienza were interested in digital Digital Pathology, an image-based information environment enabled by computer technology that allows for the management of information generated from an e-slide; two main fields are involved, digital cytology and digital histology. In the proposed study the Digital-Cytology was considered; the problem of the increasing of the memory occupancy was faced and studied using the Mathematica software.

The papers selected for this special issue represent an example of the main problems in image analysis, from methodological and applicative point of view.

P. Di Giamberardino

D. Iacoviello

R. Natal Jorge

J. Tavares