

COMPUTATIONAL IMAGE ANALYSIS IN BIOMEDICINE: METHODS AND APPLICATIONS

João Manuel R. S. Tavares

Instituto de Ciência e Inovação em Engenharia Mecânica e Engenharia Industrial, Departamento de Engenharia Mecânica, Faculdade de Engenharia, Universidade do Porto, Portugal

Email: tavares@fe.up.pt, url: www.fe.up.pt/~tavares

SUMMARY

The computational analysis of images, which has become a paramount research topic, is very challenging as it usually comprises complex tasks like as of segmentation, i.e. the detection, of imaged structures, matching and registration, i.e. alignment, of structures, tracking of structures in images, deformation estimation between structures and 3D reconstruction from images. For example, to analyze the behavior of organs from medical image sequences, first the input images should be segmented, then suitable features of the organs under analysis should be extracted and tracked along the sequences and finally, the tracked behavior should be analyzed.

Despite the inherent difficulties, computational methods of image analysis have been more and more used in a wide range of important applications of our society, exceptionally in Biomedicine.

In this talk, computational methods of image analysis that we have developed in order to analyze structures in biomedical images will be introduced; particularly, those developed for image segmentation, matching, registration, tracking and 3D shape reconstruction. Furthermore, their use in several biomedical applications will be presented and discussed.

Keywords: Computer Vision, 3D Vision, Segmentation, Registration, Tracking, Matching, Deformable Models, Stochastic Filters, Volumetric Methods

REFERENCES

- [1] – “Computational methods for the image segmentation of pigmented skin lesions: A Review”, Roberta B. Oliveira, Mercedes E. Filho, Zhen Ma, João P. Papa, Aledir S. Pereira, João Manuel R. S. Tavares, *Computer Methods and Programs in Biomedicine* 131:127-141, 2016
- [2] – “Computational Methods for Pigmented Skin Lesion Classification in Images: Review and Future Trends”, Roberta B. Oliveira, João P. Papa, Aledir S. Pereira, João Manuel R. S. Tavares, *Neural Computing and Applications* 29(3):613-636, 2018
- [3] – “Automatic 3D pulmonary nodule detection in CT images: a survey”, Igor Rafael S. Valente, Paulo César Corte, Edson Cavalcanti Neto, José Marques Soares, Victor Hugo C. de Albuquerque, João Manuel R. S. Tavares, *Computer Methods and Programs in Biomedicine* 124:91-107, 2016
- [4] – “A review of computational methods applied for identification and quantification of atherosclerotic plaques in images”, Danilo Samuel Jodas, Aledir Silveira Pereira, João Manuel R. S. Tavares, *Expert Systems with Applications* 46:1-14, 2016
- [5] – “Segmentation Algorithms for Ear Image Data towards Biomechanical Studies”, Ana Ferreira, Fernanda Gentil, João Manuel R. S. Tavares, *Computer Methods in Biomechanics and Biomedical Engineering* 17(8):888-904, 2014

- [6] – “Medical Image Registration: a Review”, Francisco P. M. Oliveira, João Manuel R. S. Tavares, *Computer Methods in Biomechanics and Biomedical Engineering* 17(2): 73-93, 2014
- [7] – “A Review of Algorithms for Medical Image Segmentation and their Applications to the Female Pelvic Cavity”,
Zhen Ma, João Manuel R. S. Tavares, Renato Natal Jorge, T. Mascarenhas, *Computer Methods in Biomechanics and Biomedical Engineering* 13(2):235-246, 2010
- [8] – “Image Processing and Analysis: Applications and Trends”, João Manuel R. S. Tavares, AES-ATEMA’2010 Fifth International Conference, pp. 27-41, Montreal & Quebec City, Canada, 2010