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Applications of image processing and machine learning to two non-invasive cancer diagnosis methods

Abstract

In the last decades, a myriad of medical imaging techniques to assist physicians in the medical practice have emerged. In this talk we will discuss two techniques that differ significantly among them in the application and the data to which they are applied, but that broadly follow the same methodology: descriptors are extracted from the data using image processing techniques, and classification or detection is obtained by applying machine learning techniques to these features or descriptors. The choice of the descriptors is, in both cases, strongly based on several years of medical practice. Another common aspect of both applications is the class imbalance problem, a well-known problem in machine learning.

The first application we present is the classification of melanocytic lesions as malignant or benign, using dermoscopic images. The lesion features used in the classification framework are inspired on border, texture, color and structures used in popular dermoscopy algorithms performed by clinicians by visual inspection. The main weakness of dermoscopy algorithms is the selection of a set of weights and thresholds that appear not to be robust or independent of population. The use of machine learning techniques allows overcoming this issue. (*)

The second application we address is polyp detection in Computer tomographic colonography. We present a computer-aided detection pipeline that consists of simple colon segmentation and reconstruction technique that enhances polyps, followed by adaptive-scale candidate polyp delineation, in order to capture the appropriate polyp size. In the last step, candidates are classified based on new texture and geometric features. (**)

(*) Joint work with R. Alonso, A. Bazzano and G. Capdehourat, U de la República.

(**) Joint work with M. Fiori (U. de la República) and G. Sapiro (Duke University).

Biographical Sketch

Pablo Musé received the Electrical Engineering degree from Universidad de la República, Uruguay, in 1999, the M.Sc. degree in Mathematics, Vision and Learning and the Ph.D. in Applied Mathematics both from Ecole Normale Supérieure de Cachan, France, in 2001 and 2004, respectively. From 2005 to 2006 he was with Cognitech, Inc.,

Pasadena, CA, USA, where he worked on computer vision, image analysis and image processing applications. In 2006 and 2007, he was a Postdoctoral Scholar with the Seismological Laboratory, California Institute of Technology, Pasadena, working on remote sensing using optical imaging, radar and GPS networks. Since 2008, he has been with the Division of Electrical Engineering, School of Engineering, Universidad de la República, where he is currently an Associate Professor of signal processing. Dr. Musé has been a regular visiting professor of U. of Buenos Aires, ENS Cachan, Télécom ParisTech, Caltech, U. of Michigan, U. of Minnesota and Duke University.