Ph.D. topic 2014

# Generic segmentation and classification in biomedical images

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## Presentation of the Ph.D. topic

Accurate characterization and classification of biological and medical structures is essential in biomedical image analysis, since shape contains vital information about the structure. The classical classification scheme is based on first detection and segmentation then secondly classification. This scheme implies a perfect segmentation of structures, that is quite impossible to obtain in practice. We recently developed a new method for performing segmentation and classification simultaneously [GulMohammed2014 BMC BioInformatics]. This method gives quite good results, around 96 % good classification and segmentation score. However the method has room for improvements in order to make it more robust and more generic.

## Expected deliverables

The methods can be improved at different levels. Segmentation is performed by testing all thresholds, extracting objects and trying to classify them according to sample objects given by the user. Two different segmentation procedures have been implemented, the first one is based on iterative thresholding, the second one, more complex, is based on region growing. These two procedures are related to min- and max-trees, and they should be fused into one generic optimised thresholding procedure, maybe using the idea of tree of shapes. Secondly segmentation uses only intensity information for extracting objects, maybe edge information should help to detect more robustly the objects.

The classification procedure can also be greatly improved. The user has to manually points the different objects for training and assign them to their class. A first rough segmentation could be performed using classical methods in order to detect isolated well contrasted objects, unsupervised machine learning methods could detect different classes and assign the objects to them. Since the user may have thousands of data to analyse, the results on first experiment data could be used for improving the training set in order to build a more robust database of shapes, including wrongly detected noise and artefacts. The user intervention should be restrained to

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validation and pointing of difficult cases. Finally new features should be introduced like texture or visual attention primitives.

Finally some *a priori* information should be introduced in the system like spatial organisation of the different structures, and temporal information about the moving structures.

Many applications are planned in different areas with different Singaporeans collaborators, like biomedical imaging, satellite imaging or videos.

## Keywords

Image analysis, classification, segmentation, 3D, video.

## Applicant profile

- Master Degree or Engineer Student (last year of studies).
- Skills in programming, preferably JAVA, C++ or Matlab.
- Notions in image processing and classification.
- Open to work with both French and Singaporean scientists.
- Availability for starting October 2014.

Gratification: Compliant to French Regulation on Ph.D. students (Contrat doctoral)

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