Medical Image Segmentation and applications

Image Segmentation
(EM algorithm)

The next link can be very useful, if necessary.

https://www.elsevier.com/__data/assets/pdf_file/0007/817504/MATLAB_Application_1.pdf

Introduction

The segmentation is an essential part of many computer vision systems and medical applications. The goal is to divide an input image into a set of non-overlapping regions which union is the entire image. Clustering-based methods are a well-known example to perform this task. These techniques (i) are fast and easy to implement and (ii) provide reasonable results even for complex medical applications.

In this coursework, the primary goal is to develop from scratch an Expectation-Maximization algorithm for segmenting brain MRI images (T1-w image) into the three main tissues: white matter (WM), grey matter (GM) and cerebrospinal fluid (CSF). The implemented algorithm should (i) assume mixture of Gaussians is a suitable model and (ii) be extended to process multivariate data (i.e. different image modalities: T1-w, T2-w, PD-w, …). The algorithm will be evaluated using the provided data (ground truth for the three tissue classes is available). In the analysis, use the Dice Similarity measure to report the results quantitatively.

Matlab guidelines:

- Download the Matlab functions to open nii images (Tools for NIfTI and ANALYZE image). You can use: *load_nii and view_nii*
- The segmentation labels should be: 1) CSF 2) GM 3) WM

Objectives

A) Information search. Teamwork.

B) To understand, design, analyse and implement the EM segmentation algorithm in Matlab.

C) To evaluate the performance of the algorithm using the provided images: study the problems and possible improvements, assess the results using the ground truth and the Dice similarity measure.

D) Documentation.

Coursework: 2 sessions (4 hours)

A) Coursework with the following sections:
1) Introduction and problem definition.
2) Algorithm analysis.
3) Design and implementation of the proposed solution.
4) Experimental section and result analysis (qualitative/quantitative analysis, speed, etc.).
5) Project management details (tasks, time estimations and real dedication).
6) Conclusions.

B) Commented Matlab code.

Coursework Evaluation:

A) During the labs.

B) After the coursework.

DEADLINE: It will be the one indicated in the moodle submission link. Late submission will be penalised.