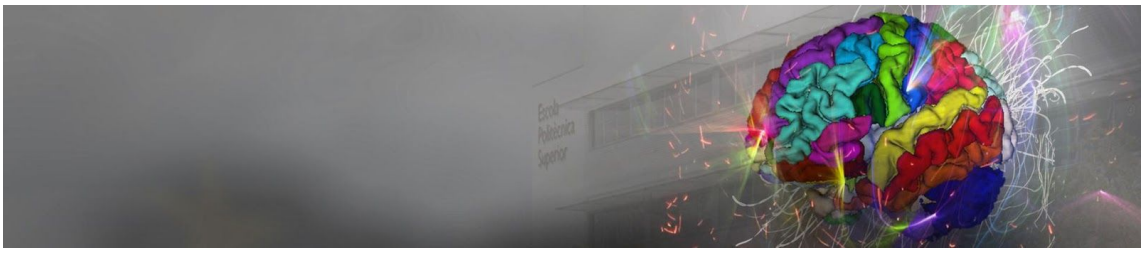
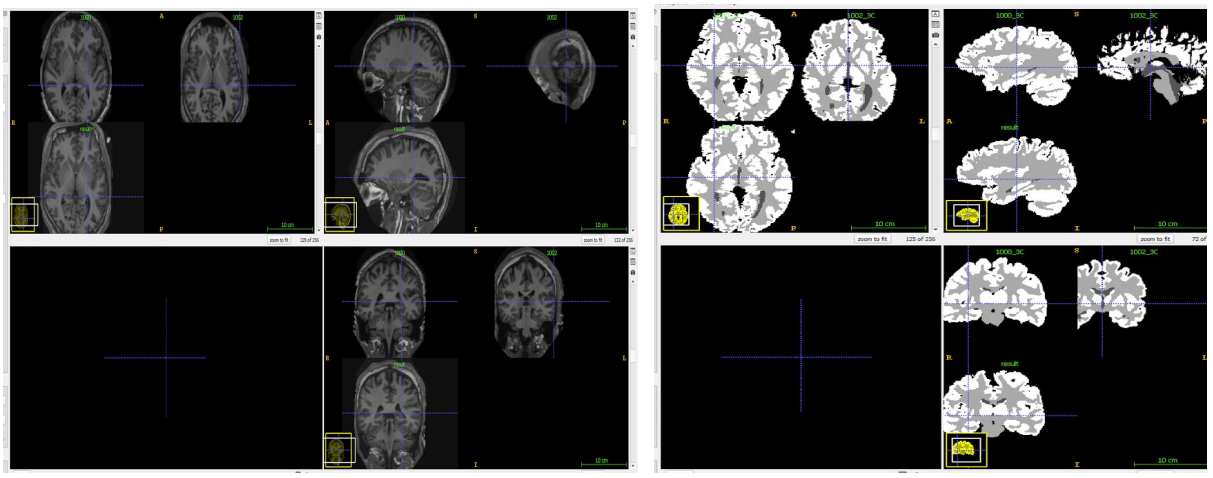
MIRA & MISA project

Atlas based segmentation (integration to the EM algorithm)



Introduction part A (MIRA course)

The primary goal of this first part is to build a probabilistic atlas from a set of brain volumes with the available labels of three classes (WM, GM and CSF). The following figure shows two cases (1000 & 1002) before (1002) and after registration (result) (left: intensity images, right: label images).



You have to implement the algorithm to build a probabilistic atlas from the trained brain images and labels provided. For performing the registration, you can use elastix, an open source toolbox for rigid and nonrigid registration of images (http://elastix.isi.uu.nl/). The final result should be a probabilistic atlas: an intensity volume (used for registering new unsegmented volumes) and a probabilistic label volume (containing tissue probabilities at each voxel).

Guidelines:

1. Download the Elastix software, manual and example of usage (batch file). Make sure that you understand how Elastix runs and works. (see http://elastix.isi.uu.nl/download_links.php)
2. Perform a single registration as the one shown above (register intensity images and transform a label image).

Objectives

A) Information search. Teamwork.

B) To understand how to perform a single registration of two 3D volumes using rigid and nonrigid registration with elastix. See the elastix manual and the elastix example in moodle). Show 3-4 registration results with itk-Snap to illustrate that registration works as expected (qualitative evaluation) for rigid and nonrigid cases.

C) To develop an algorithm to build the probabilistic atlas. The algorithm can be developed with the programming language of your preference (Matlab, C++, Python). Discuss the assumptions and approaches taken.

D) Show 3-4 slices of the final probabilistic atlas (intensities and label probabilities) and the tissue models for each tissue class (histogram distribution).

E) 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 results analysis (qualitative analysis, speed, etc.).
5) Organization and development of the coursework (tasks, time estimations and real dedication).
6) Conclusions.

B) Source code: Elastix commands (batch files and configuration files) and atlas building code with comments.

Coursework Evaluation:

A) During the labs.

B) After the coursework.

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