Internship project / Sujet de stage

AUTOMATIC CLASSIFICATION OF PATIENTS WITH ALZHEIMER'S DISEASE FROM MAGNETIC RESONANCE IMAGING DATA

Alzheimer's disease (AD) is an important cause of cognitive disability and represents a major public health problem, due to aging of the population. Early and accurate diagnosis of AD is crucial in order to develop and test new treatments. Magnetic resonance imaging (MRI) is particularly interesting to assist the diagnosis of AD, because it allows detecting in vivo the anatomical and functional alterations associated with the pathology. In the past years, there has been a growing interest in the use of machine learning approaches to automatically identify patients with AD based on MRI data. However, while a substantial number of approaches have been developed, they are most often evaluated on different datasets, making it difficult to compare their performances.

This year, a challenge is organized on **Computer-Aided Diagnosis of Dementia based on structural MRI data** (http://caddementia.comicframework.org/). The organizers of the challenge will provide a dataset of patients (on March 1st) against which different teams will evaluate their approaches. The diagnoses of the patients are unknown to the participants. The participants will submit their classification results on June 8th. Final results will be presented at a Workshop of the MICCAI conference in September.

The objective of the internship is to participate to this challenge. To this purpose, we will rely on automatic classification methods previously developed by our team. In particular, we will use an approach based on spatial and anatomical regularization of support vector machines (SVM). The intern will be in charge of extending the approach to handle the 3-class classification problem of the challenge. He will also be in charge of developing pipelines to apply this approach on large datasets, of training the classifiers on previously acquired data and of testing the classifier on the data of the challenge. He will experiment with different features (voxel-based and vertex-based) and different learning strategies.

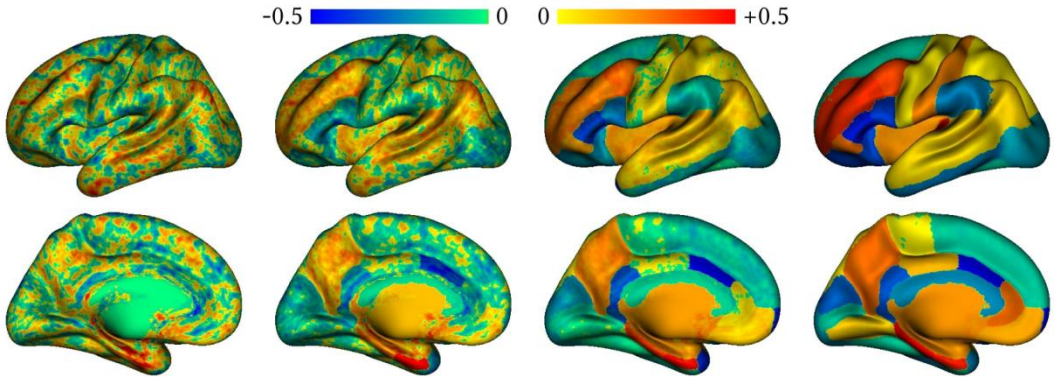

Figure. Anatomical regularization of a support vector machine. In red/orange, regions that increase the likelihood of being classified as AD patient.

Research environment:

The intern will work within the ARAMIS team of the Brain and Spinal Cord Institute (ICM) within Pitié-Salpêtrière hospital in Paris 13th district (www.icm-institute.org).

ARAMIS is a joint research team between CNRS, Inria, Inserm and Université Pierre and Marie Curie. The team is focused on the design of new approaches for the analysis of images and signals of the human brain. The team has a pluridisciplinary composition, bringing together researchers in image/signal processing and medical specialists (neurology, radiology).

The internship will be supervised by Olivier Colliot (CNRS Researcher, ARAMIS). The work will be done in collaboration with Stanley Durrleman (INRIA Researcher, ARAMIS) and engineers of the

CATI project, a joint project between Neuropin and Pitié-Salpêtrière to create a platform for multicenter neuroimaging studies.

Qualifications:

- The applicant must be currently registered as a student in computer science, image processing, applied mathematics or a related field.
- Knowledge on automatic classification methods is highly desirable
- A good programming level (Matlab or C++ or Python) is required
- Experience with the use of Linux environment is necessary

Related publications:

- Cuingnet R, Glaunès JA, Chupin M, Benali H, and Colliot O, The ADNI. Spatial and anatomical regularization of SVM: a general framework for neuroimaging data, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 35 (3), 682-696, 2013
- Cuingnet R, Gerardin E, Tessieras E, Auzias G, Lehéricy S, Habert MO, Chupin M, Benali H, and Colliot O, the ADNI, Automatic classification of patients with Alzheimer's disease from structural MRI: a comparison of ten methods using the ADNI database. *NeuroImage* 15;56(2):766-81, 2011
- Gerardin E, Chételat G, Chupin M, Cuingnet R, Desgranges B, Kim HS, Niethammer M, Dubois B, Garnero L, Lehéricy S, Eustache F, and Colliot O, The ADNI, Multidimensional classification of hippocampal shape features discriminates Alzheimer's disease and mild cognitive impairment from normal aging, *NeuroImage*, 47 (4):1476-86, 2009.

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