

Perspectives of classification of brain MRI: could SVM help extracting the relevant information from the large databases of clinical trials of MS?

D. Delahaye¹, P. Ollé², S. Puechmorel¹, S. Rebbah^{1,3}, I. Berry^{2,3}, P. Maréchal⁴.

1 : ENAC (Ecole Nationale de l'Aviation Civile); 2 : CHU (Centre Hospitalier Universitaire) Toulouse; 3 : ToNIC (Toulouse NeuroImaging Center) UMRS INSERM 1214-Université Paul Sabatier ; 4 : IMT (Institut de Mathématiques de Toulouse) UMR CNRS 5219-Université Paul Sabatier

Image classification has developed in the recent past and promises to provide efficient tools for diagnosis and prognosis determination. For example, in Multiple Sclerosis the latter is still an open question despite the use of multimodality brain MRI exploring various pathophysiological aspects of the disease. Moreover, the synthesis of the multiple sequences appears as a new challenge without global data-processing tools. This is particularly true in the setting of the recent therapeutic trials with larger number of multicenter standardized MRI sequence acquisitions.

We already used modern methods of statistical classification (such as SVM -support vector machines-) to process digital retinal images. Statistical learning appeared to be possible even with a small database as we obtained 80% of exact classification with only 41 images tested. In the experiment, we calculated BV norm (bounded variation) on various domains (Circle and Rectangular). This diagnosis system could help the ophthalmologists to make a diagnosis with a method of classification of vasculitis fundus angiography as vessel appearance is an important indicator for diagnosing MS from other uveites. This method of detection and measurements of vessel caliber allowed automatic recognition of altered vessel morphology in the diseased fundi.

This image processing feasibility study was made on a retrospective data collection. Patients were registered at the clinic of Toulouse ophthalmologic and neurological University Hospital department since 2000. All of them initiated the disease with uveitis. 30 patients with MS and 5 patients with presumed MS (uncomplete criterias). The SUN (Standardization of Uveitis Nomenclature) classification was used for intermediate uveitis and for neurological MS the Mc-Donald criteria 2001 revised 2005 was used. Control Group included patients with other autoimmune diseases (sarcoidosis, behcet, MICI ...).

Pictures were processed to get characteristics of vessels (centrelines, radius, angles) summarized the BV norm along the centrelines with various sizes of regions. Points on centrelines corresponding to BV norm in each interval were counted and then normalized by dividing the total points of centrelines. To classify, we used the libsvm library from Chih-Chung Chang and Chih-Jen Lin. The algorithm achieved accuracy of identification of MS uveitis of 80%

Based on this preliminary experience of retinal image classification, we believe that the discriminant power of support vector machines could be profitable to extract the relevant information from the larger multimodality brain MRI databases of clinical trials of MS. We propose in the near future, to test several methods of similar discriminant analyses on longitudinal studies to extract the efficiency of treatments on brain MRI of clinical trials.