SAPIENZA
UNIVERSITÀ DI ROMA

Studio volumetrico mediante freesurfer di pazienti con SPG4

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GRUPPO DI STUDIO

14 pazienti con diagnosi SPG4 di età compresa tra 10 e 68 anni.
Il gruppo era composto da 8 maschi e 6 femmine

GRUPPO DI CONTROLLO

34 Soggetti sani di età compresa tra 19 e 56 anni. 14 maschi e 20 femmine.
Nessun paziente ha una storia di sindrome neurologica o di danni neurologici antecedenti alla MRI

MATERIALI E METODI

2 MPRAGE volumetriche TR 2400 TE 399 160 slice 1.20mm (1.3X1.3x1.2 mm)

Flair TR 9000 TE 86 24 slice 5mm (0.8x0.8x5mm)

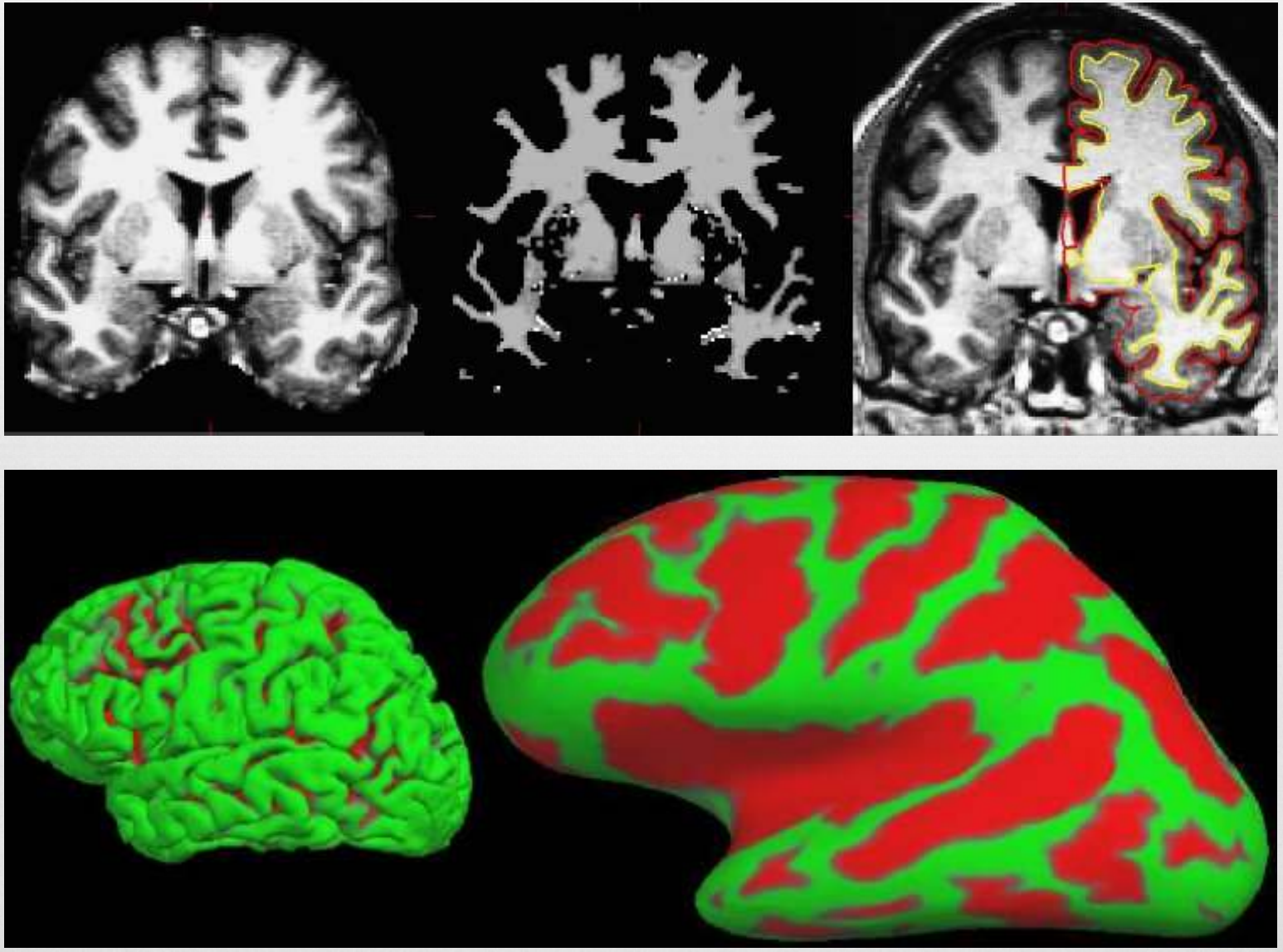
DWI TR 4500 TE 83 30 slice 5mm (2x2x5mm) bvalue1=0 bvalue2 =1000 per 30 direzioni di diffusione

FREESURFER

FreeSurfer is a set of software tools for the study of cortical and subcortical anatomy. In the cortical surface stream, the tools construct models of the boundary between white matter and cortical gray matter as well as the pial surface. Once these surfaces are known, an array of anatomical measures becomes possible, including: cortical thickness, surface area, curvature, and surface normal at each point on the cortex. The surfaces can be inflated and/or flattened for improved visualization. The surfaces can also be used to constrain the solutions to inverse optical, EEG and MEG problems. In addition, a cortical surface-based atlas has been defined based on average folding patterns mapped to a sphere. Surfaces from individuals can be aligned with this atlas with a high-dimensional nonlinear registration algorithm. The registration is based on aligning the cortical folding patterns and so directly aligns the anatomy instead of image intensities. The spherical atlas naturally forms a coordinate system in which point-to-point correspondence between subjects can be achieved. This coordinate system can then be used to create group maps (similar to how Talairach space is used for volumetric measurements). Most of the FreeSurfer pipeline is automated, which makes it ideal for use on large data sets.

The Surface-based Stream

The surface-based pipeline consists of several stages (described in detail in Fischl, et al, 1999a, and Dale, et al, 1999). First, the volume is registered with the Talairach (Talairach and Tournoux, 1988) atlas (this is an affine registration). This allows FreeSurfer to compute seed points in later stages. The B1 bias field is estimated by measuring the variation in the white matter intensity. The main body of the white matter is used to estimate the field across the entire volume. Likely white matter points are chosen based on their locations in Talairach space as well as on their intensity and the local neighborhood intensities. The intensity at each voxel is then divided by the estimated bias field at that location in order to remove the effect of the bias field. The skull is stripped (Figure 1A; Segonne, et al, 2004) using a deformable template model. Voxels are then classified as white matter or something other than white matter based on intensity and neighbor constraints. Cutting planes are chosen to separate the hemispheres from each other as well as to remove the cerebellum and brain stem. The location of the cutting planes is based on the expected Talairach location of the corpus callosum and pons, as well as several rules-based algorithms that encode the expected shape of these structures. An initial surface is then generated for each hemisphere by tiling the outside of the white matter mass for that hemisphere. This initial surface is then refined to follow the intensity gradients between the white and gray matter (this is referred to as the white surface). The white surface is then nudged to follow the intensity gradients between the gray matter and CSF (this is the pial surface). The white and pial surfaces overlaid on the original T1-weighed image are shown in Figure 1C. The distance between the white and the pial gives us the thickness at each location of cortex (Fischl and Dale, 2000).



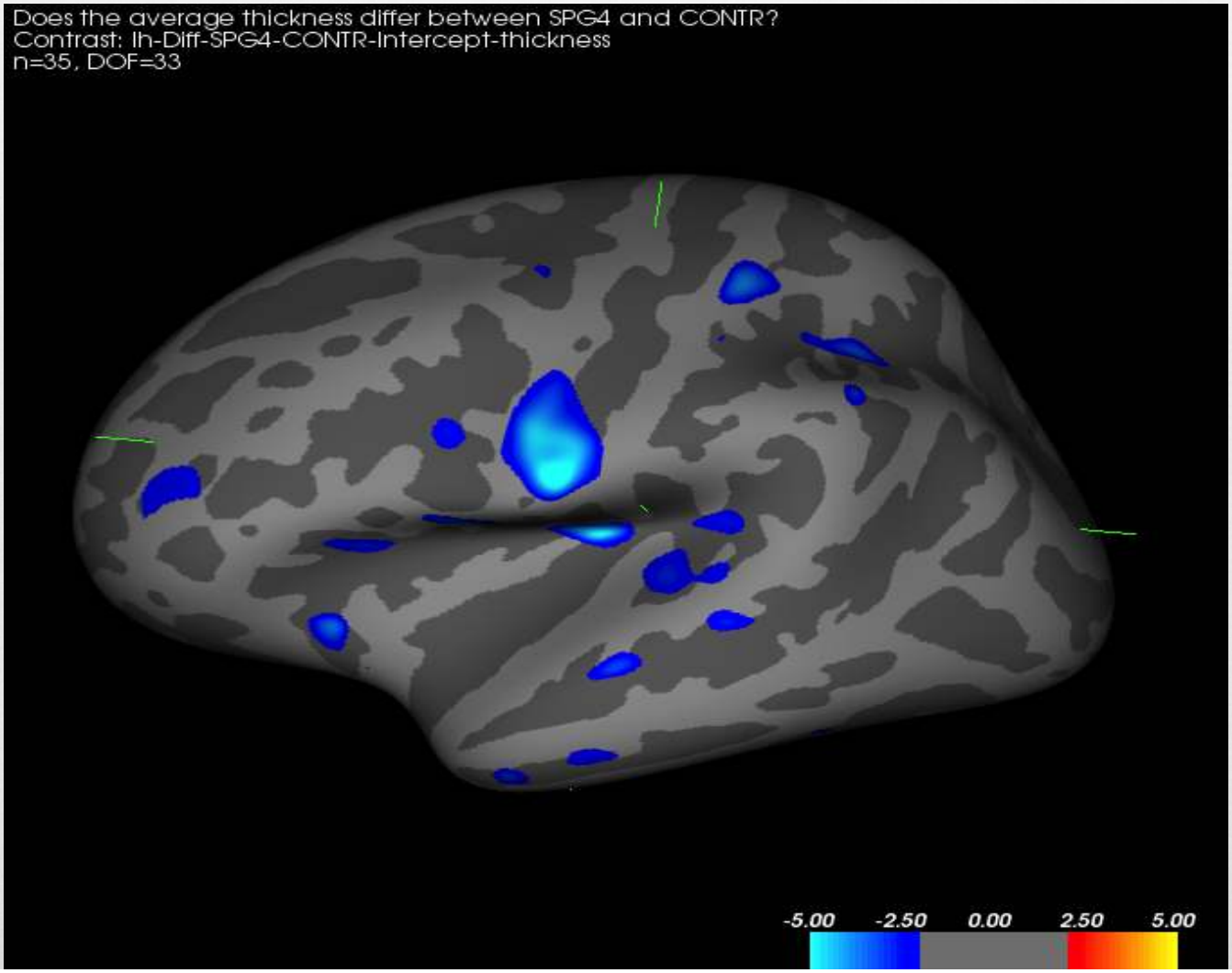
QUESITI DI RICERCA A CUI POTEVA RISPONDERE QUESTA METODICA

1) C'è UNA CORRELAZIONE TRA ETA' E SPESSORE CORTICALE?

2) C'è UNA DIFFERENZA SIGNIFICATIVA NEI VOLUMI CEREBRALI TRA SPG4 E CONTROLLI?

3) C'è UNA DIFFERENZA SIGNIFICATIVA NELLO SPESSORE CORTICALE TRA SPG4 E CONTROLLI?

Lobo Sinistro Encefalo SPG4 Vs. Controlli



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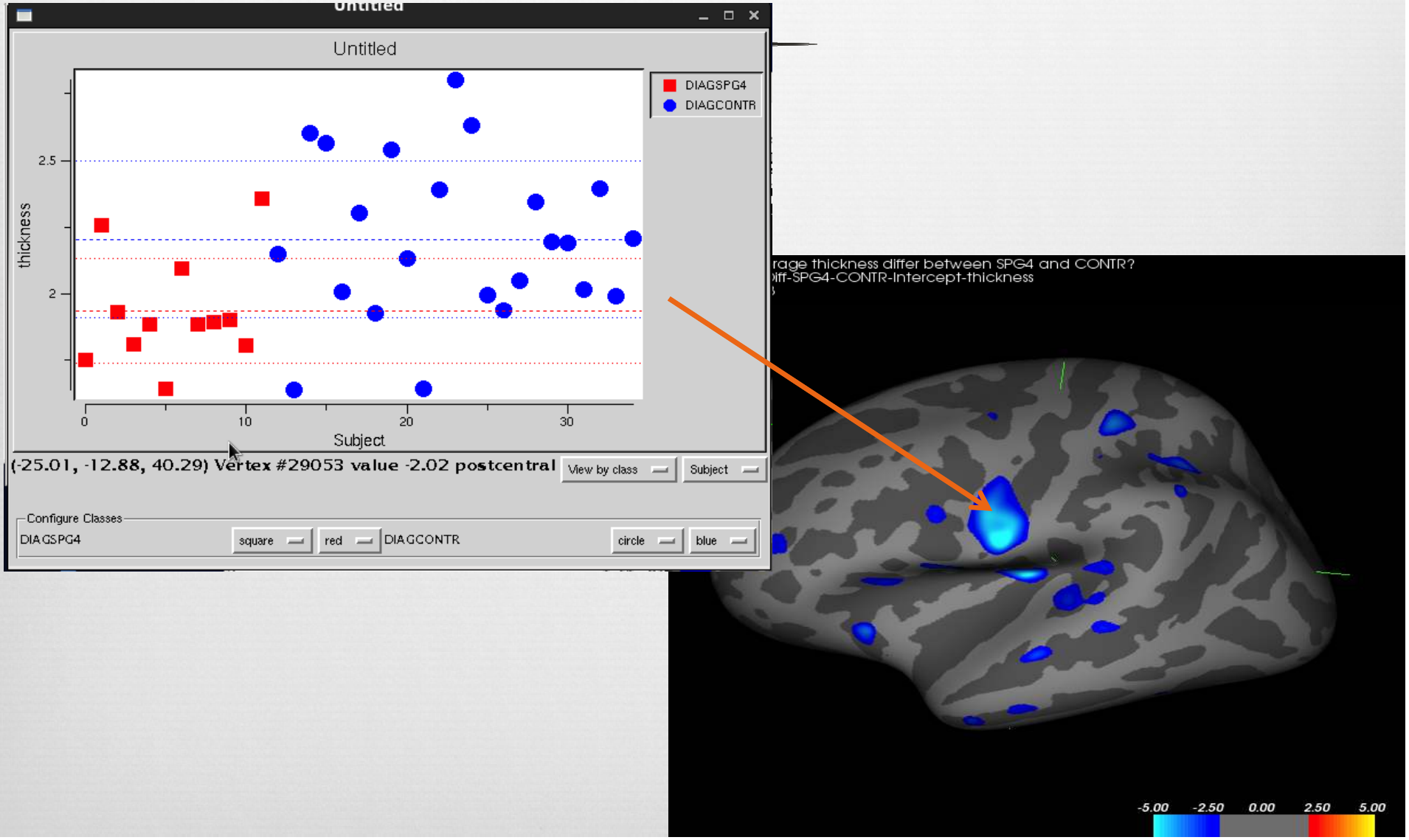

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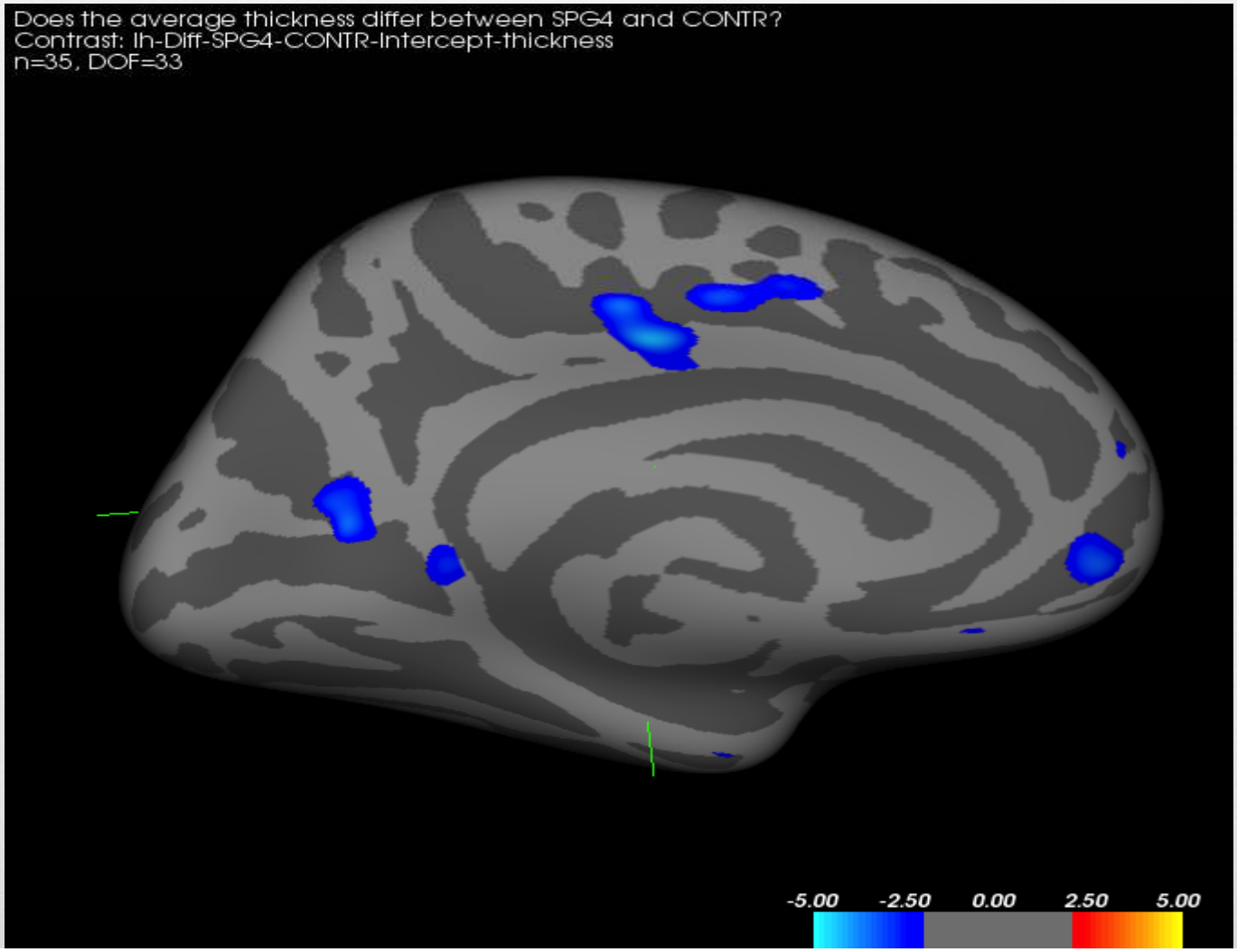
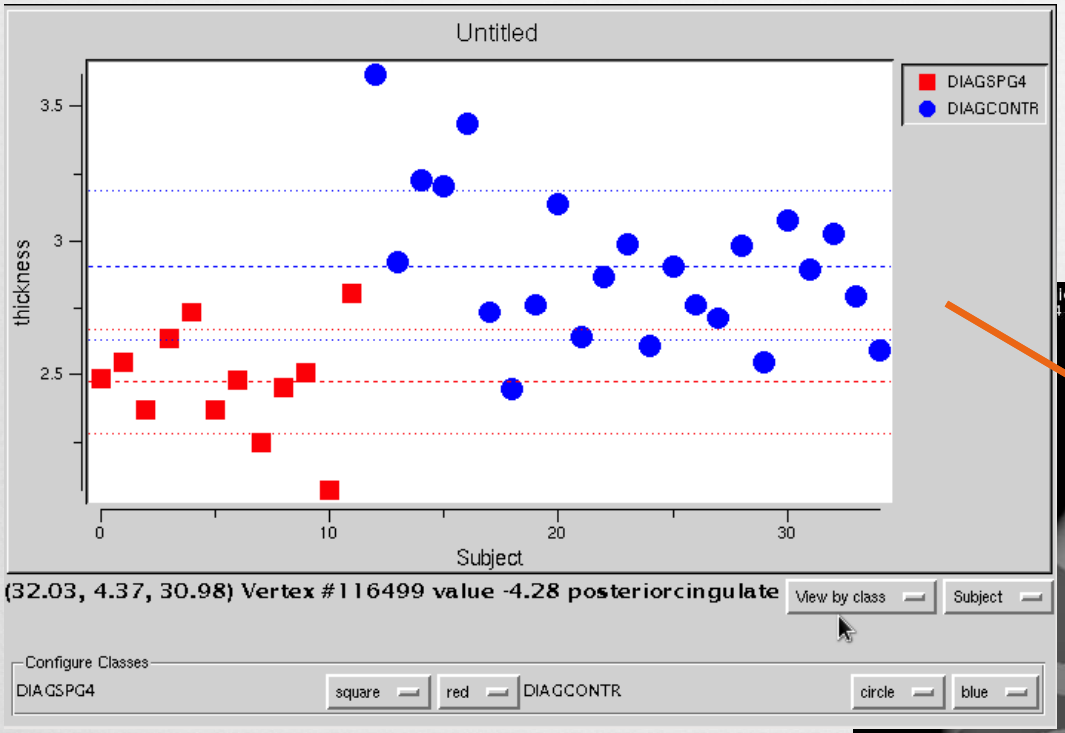
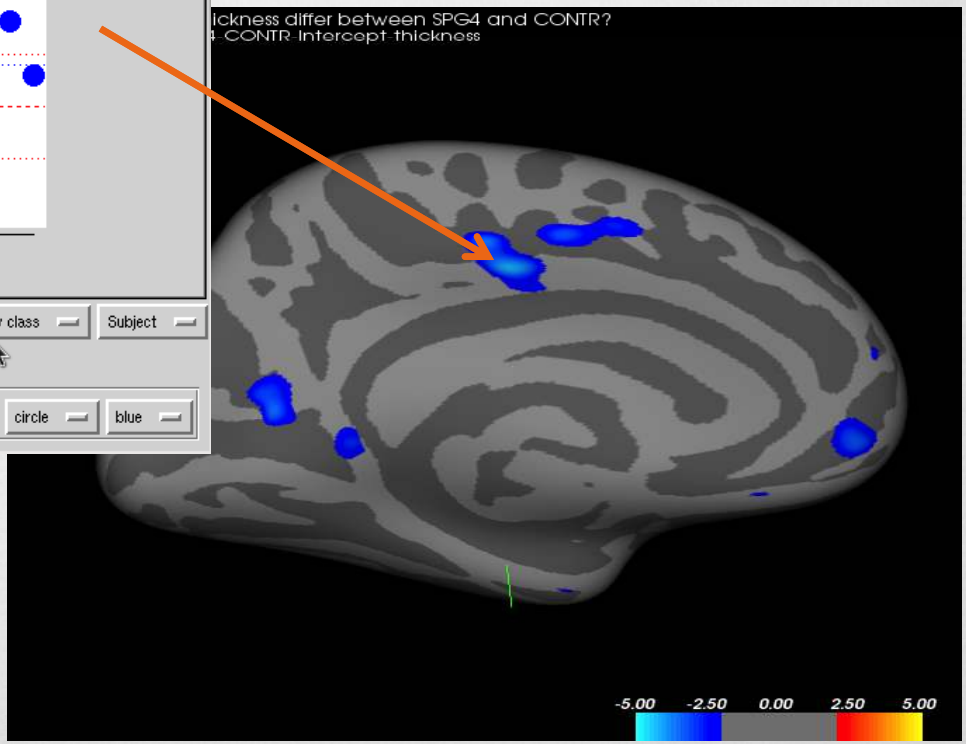
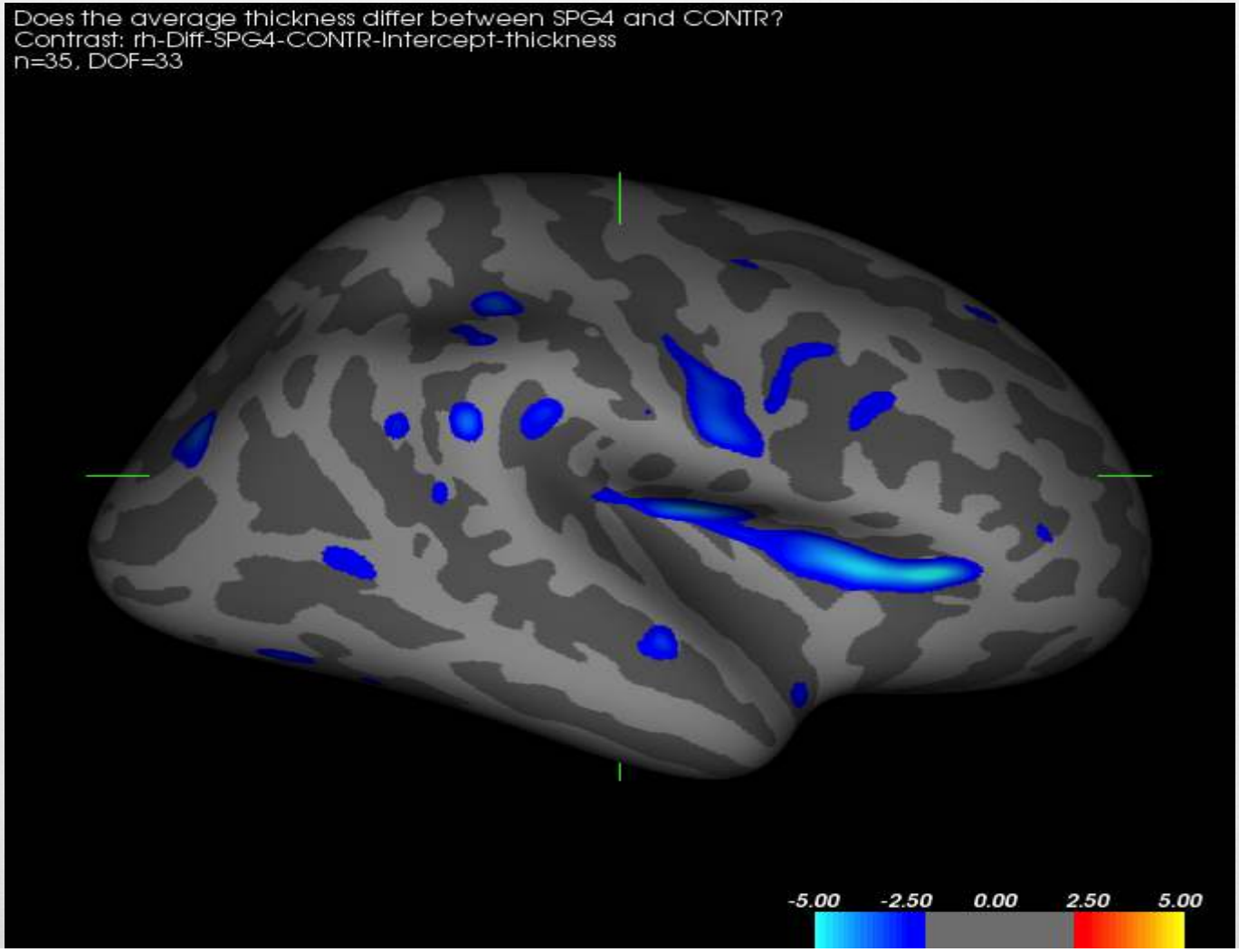


POSTERIOR CINGULATE





Lobo Destro Encefalo SPG4 Vs. Controlli



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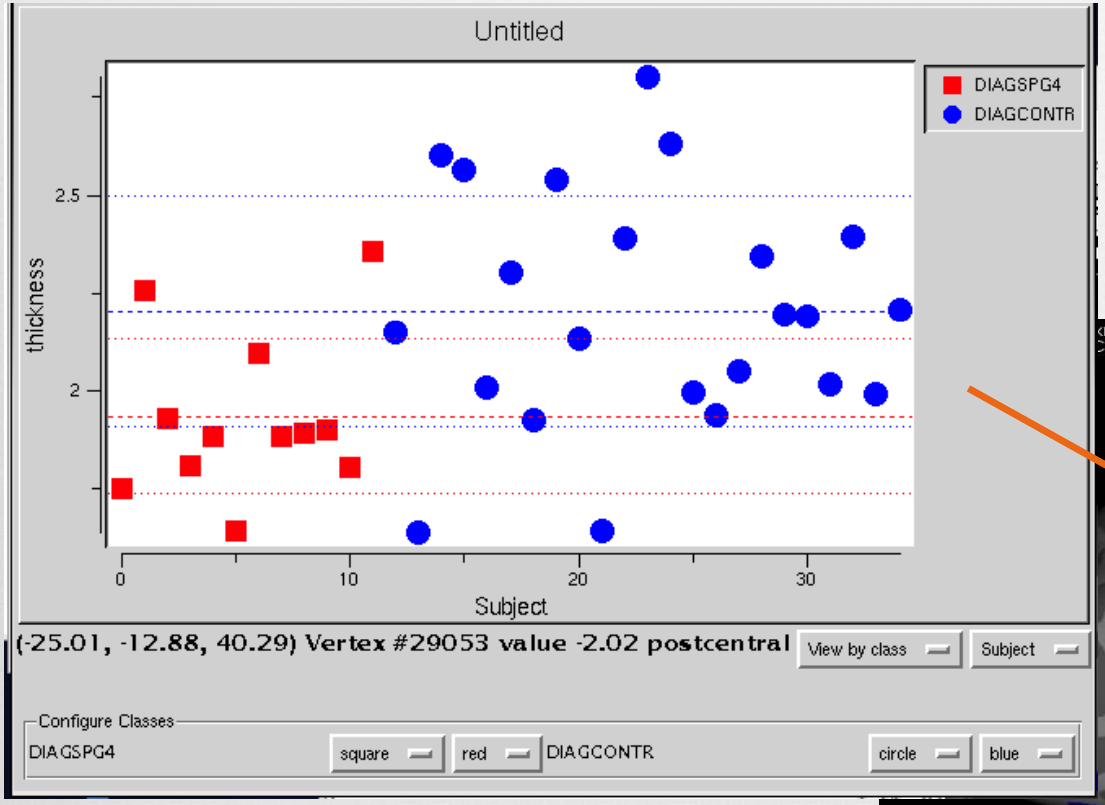

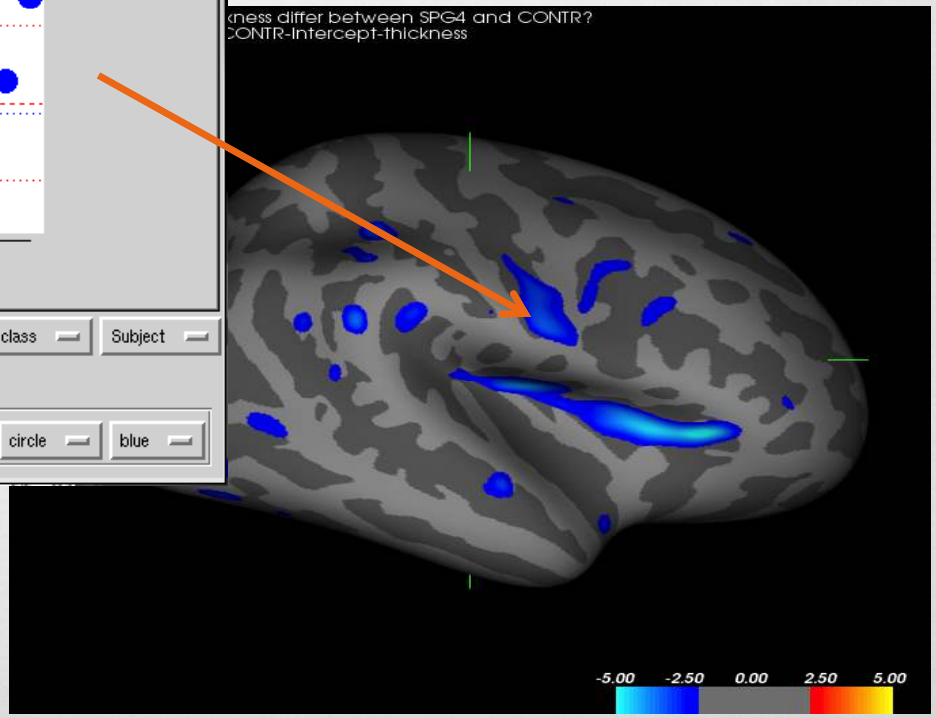

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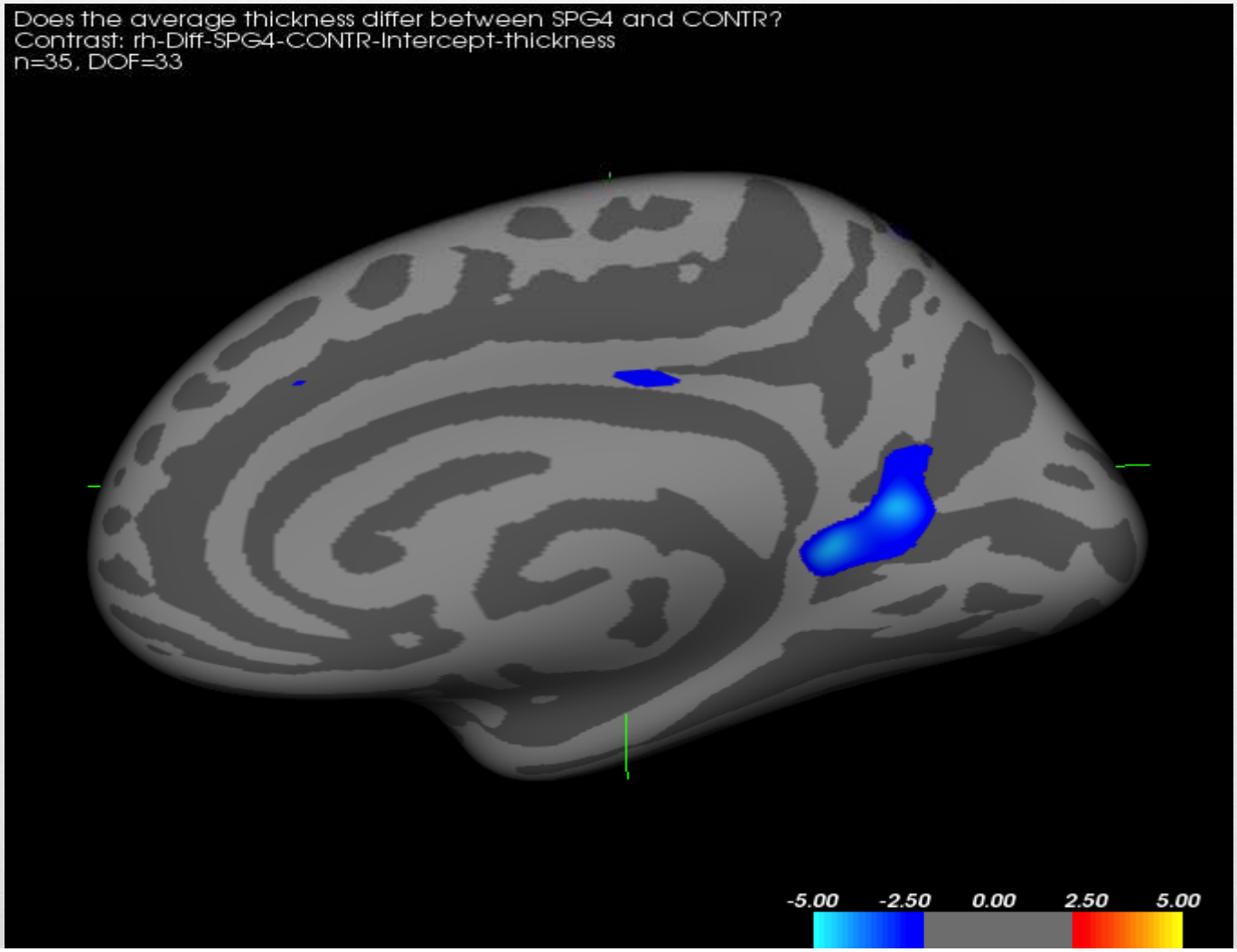
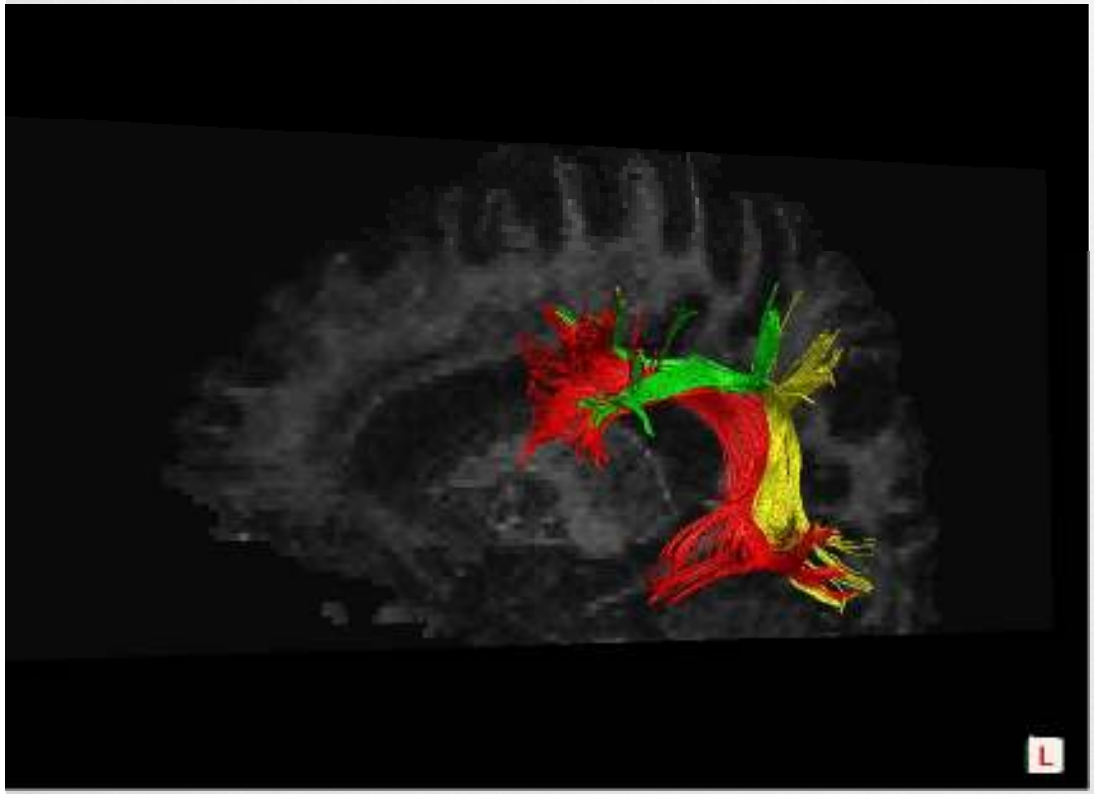
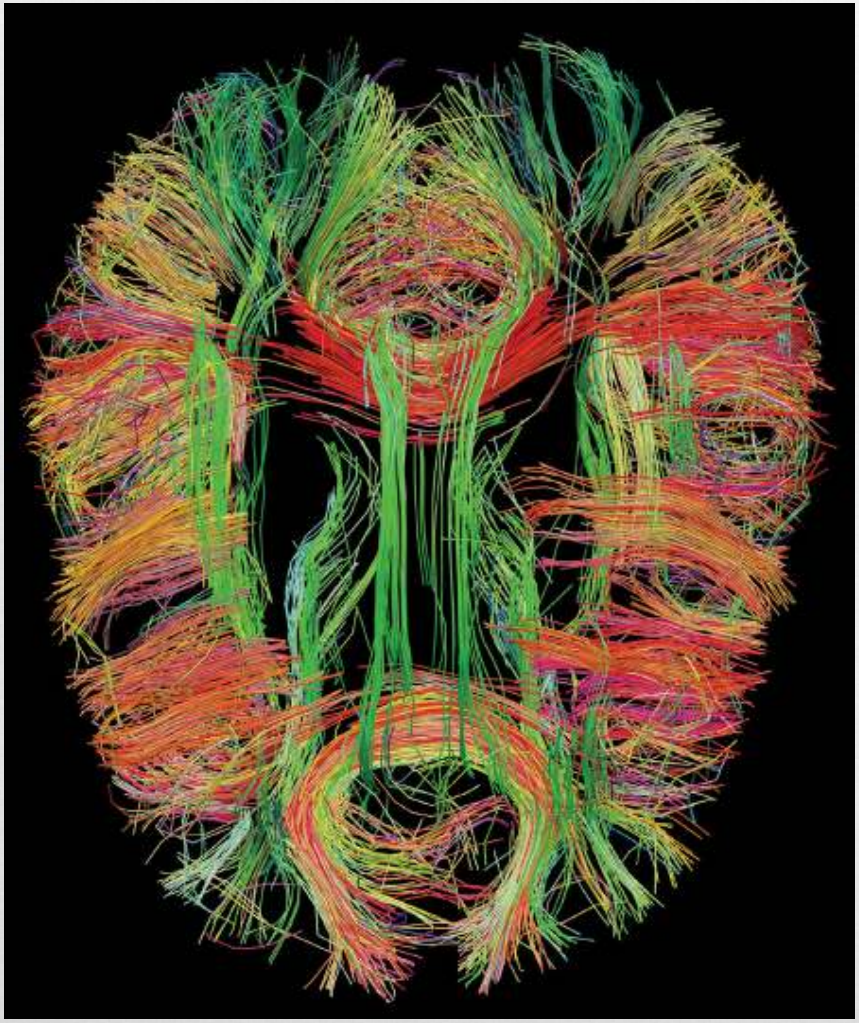


SVILUPPI FUTURI



Le tecniche di risonanza magnetica attualmente utilizzate nella pratica radiologica, forniscono una rappresentazione dettagliata dell'anatomia macroscopica dell'encefalo, ma non permettono uno studio dettagliato dell'anatomia della sostanza bianca. Le tecniche RM avanzate, come lo studio della diffusione anisotropa delle molecole di acqua (tensore della diffusione - DTI) forniscono informazioni sull'organizzazione microscopica del sistema nervoso centrale

SVILUPPI FUTURI



La trattografia (fiber tracking) consente di ricostruire i tratti assonali nel sistema nervoso centrale a partire dalle immagini di risonanza magnetica pesate in diffusione. la trattografia rappresenta attualmente l'unica metodica in grado di studiare in modo non invasivo l'architettura tridimensionale delle fibre assonali in vivo, essa può trovare fondamentali applicazioni nei campi della neurofisiologia, della neurologia e della neurofisiologia per la visualizzazione e la quantificazione dei meccanismi fisiologici e dei processi patologici.

GRAZIE E ARRIVEDERCI