

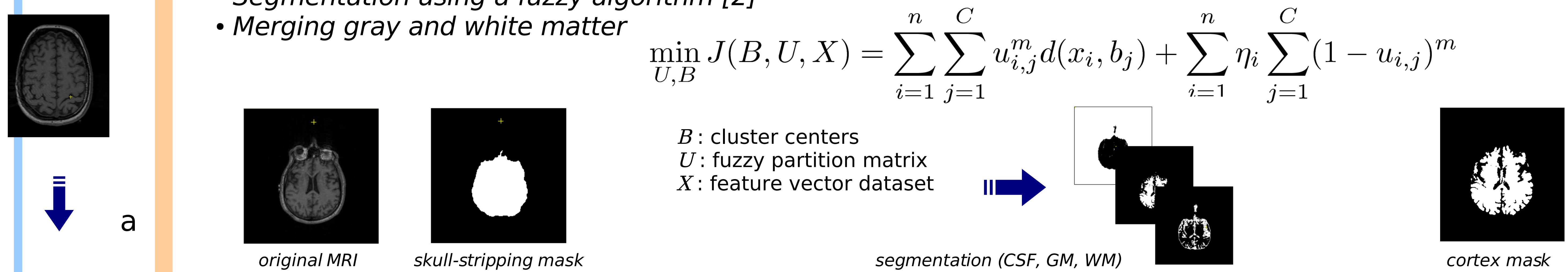
A Tool for Topographic Analysis of Electrode Contacts in Human Cortical Stimulation

(a) Segmentation

- Skull-stripping using Brain Surface Extraction method [1]
- Segmentation using a fuzzy algorithm [2]
- Merging gray and white matter

$$\min_{U,B} J(B, U, X) = \sum_{i=1}^n \sum_{j=1}^C u_{i,j}^m d(x_i, b_j) + \sum_{i=1}^n \eta_i \sum_{j=1}^C (1 - u_{i,j})^m$$

B : cluster centers
 U : fuzzy partition matrix
 X : feature vector dataset



(b) Mesh computation: Marching Cubes

(c) Unfolding using Circle Packing [3]



Circle packing

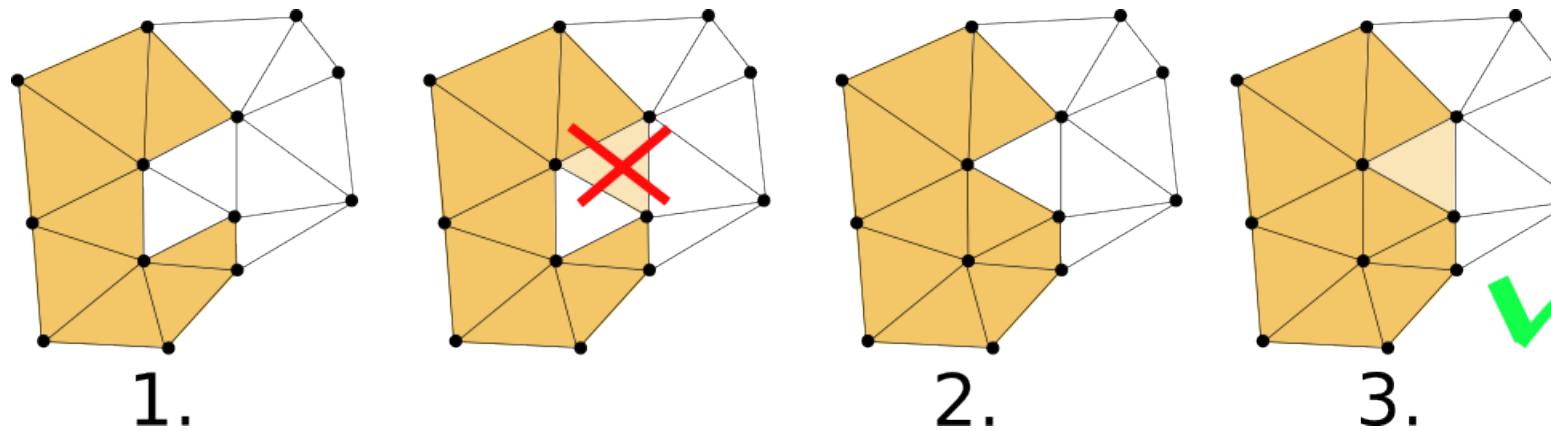


$$\sum_{\alpha_i} \hat{\alpha}_i \neq 2\pi$$

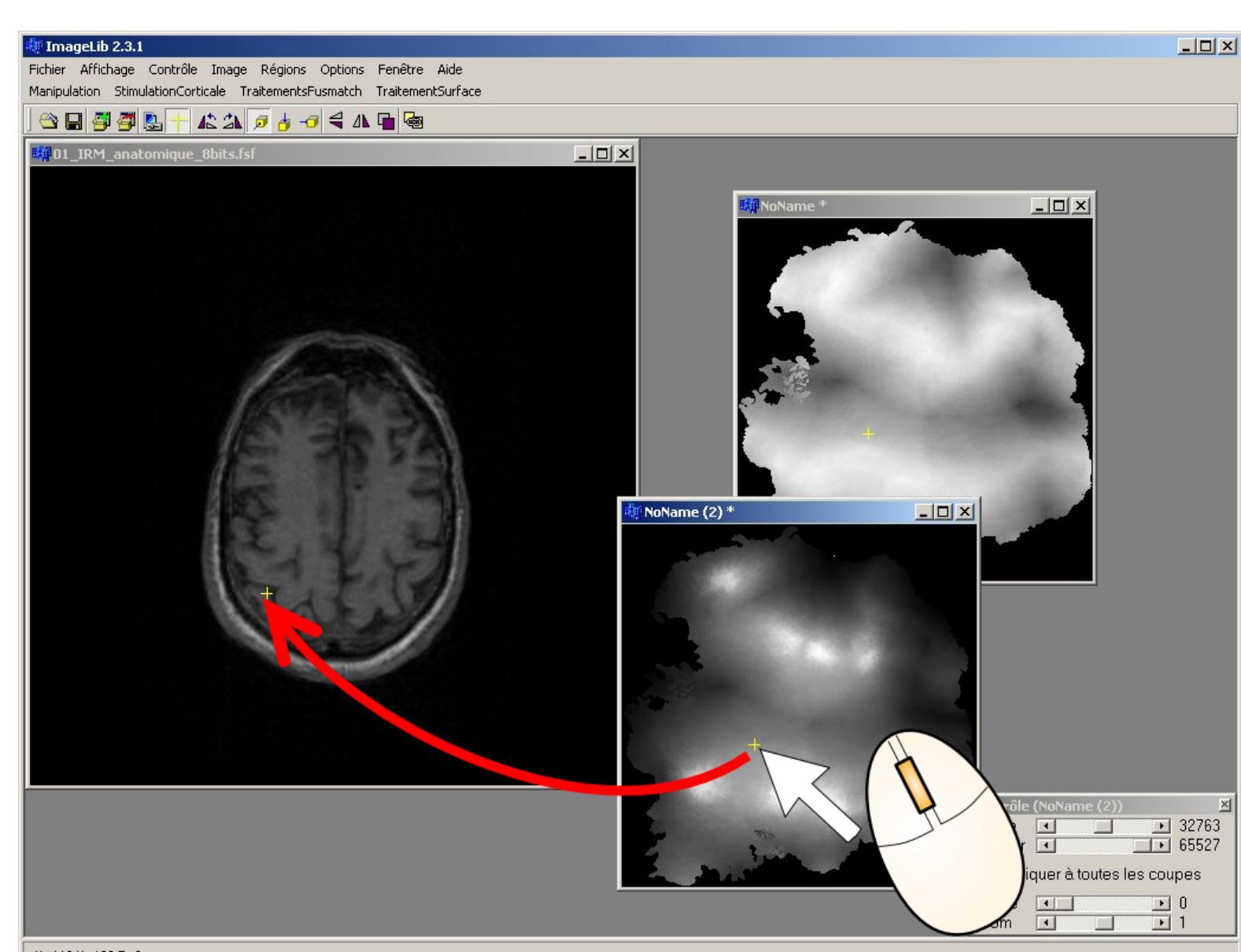
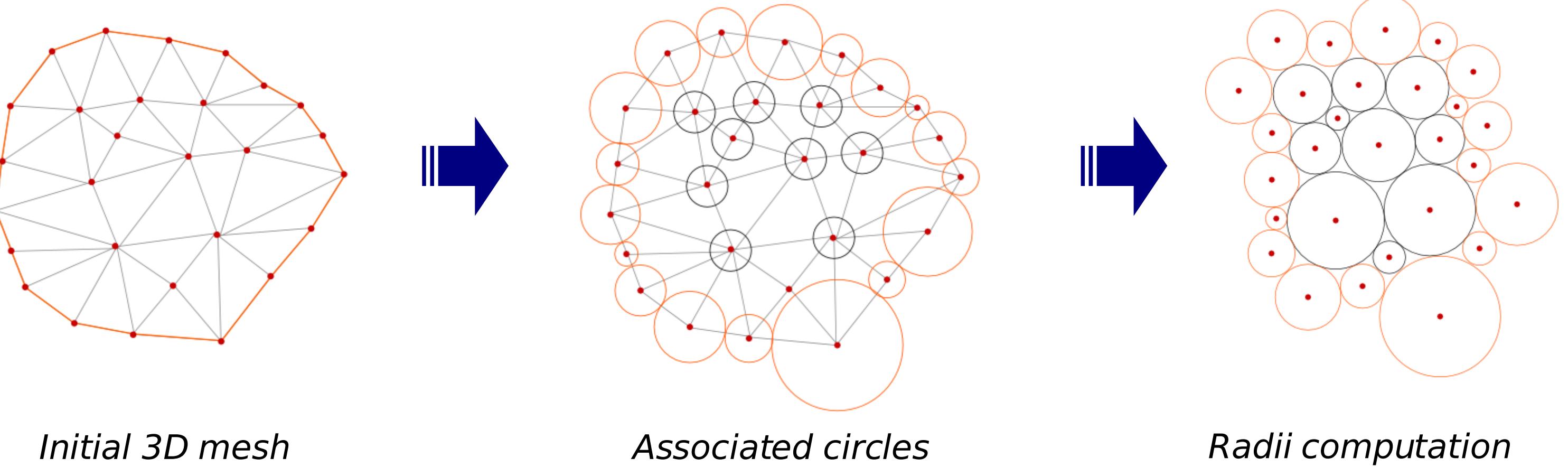
α_i

$$\sum_{\alpha_i} \hat{\alpha}_i = 2\pi$$

Preprocessing:
topological step (mesh becomes homeomorphic to a disc)



Circle packing:
adjust the radii of circles associated to the edges



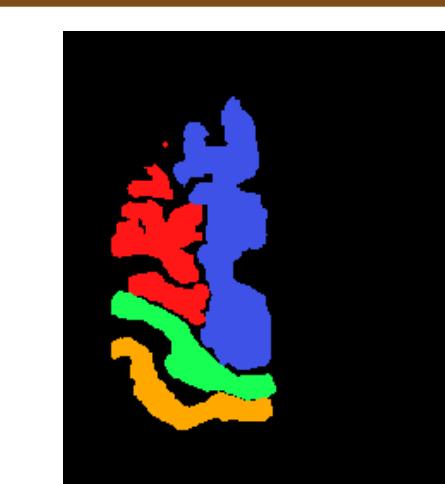
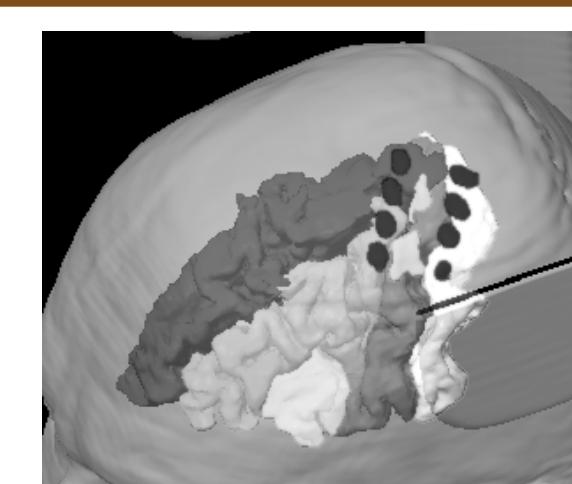
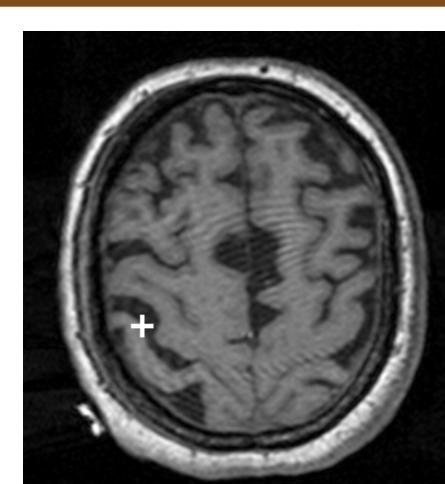
interactive tool (using bijective property)

Results

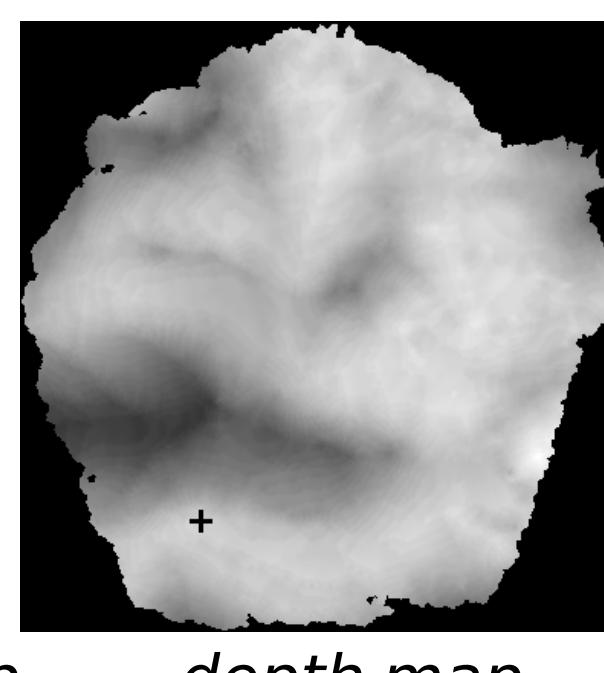
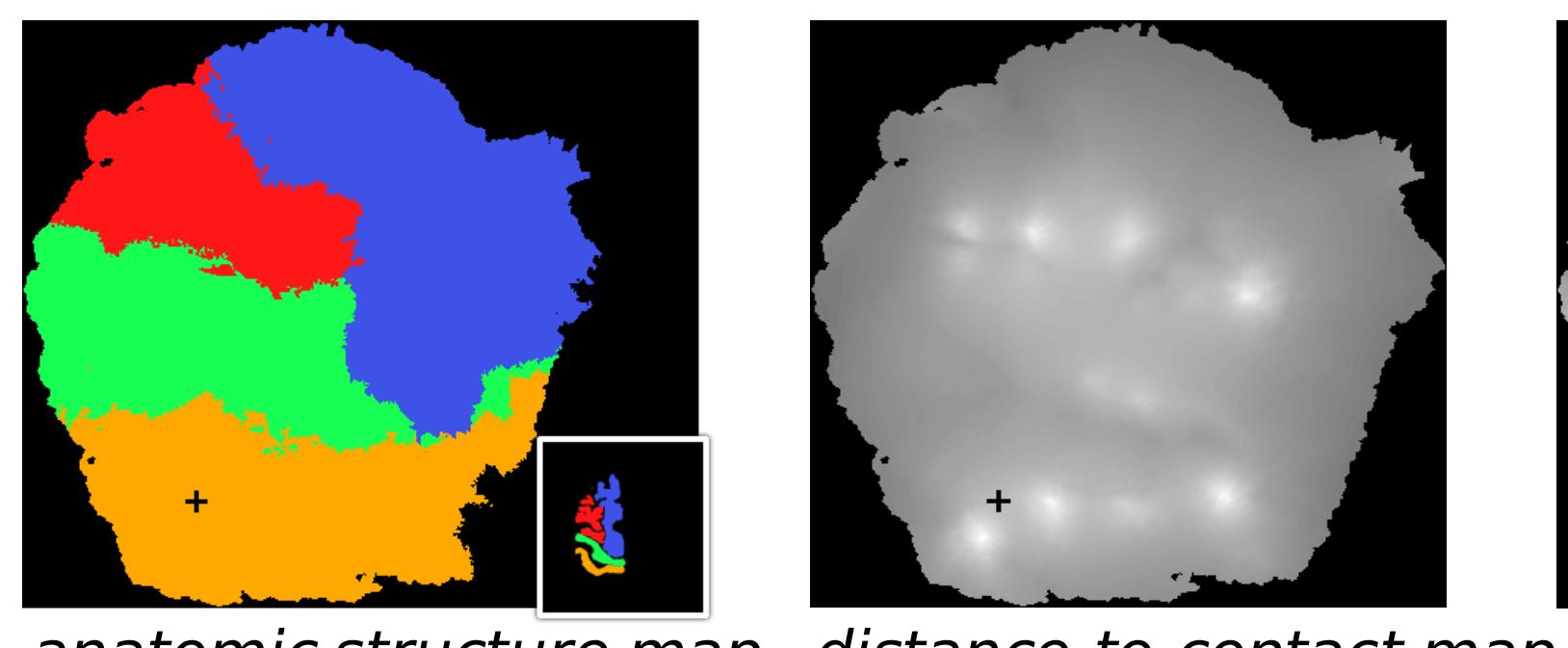
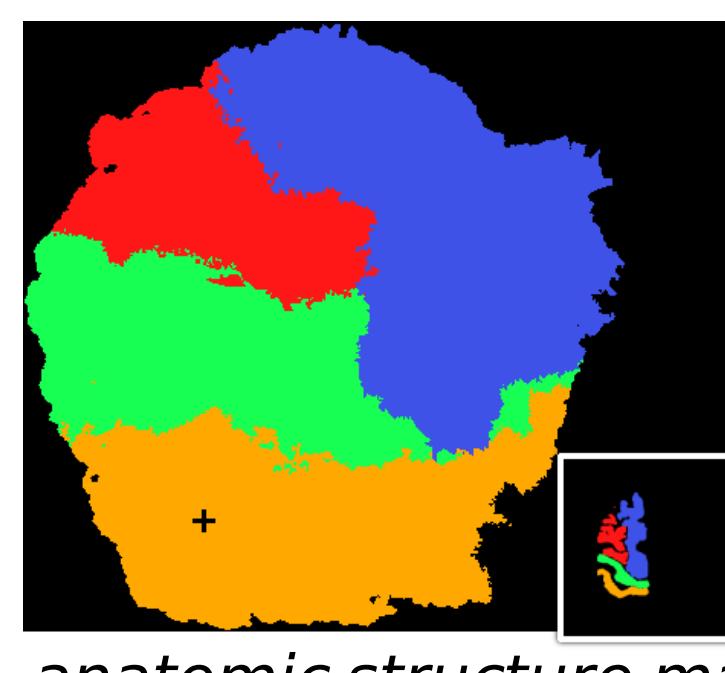
Applied to 12 patients.

Data:

- MRI (T1, 512x512x180)
- Electrode's location
- Manual segmentation

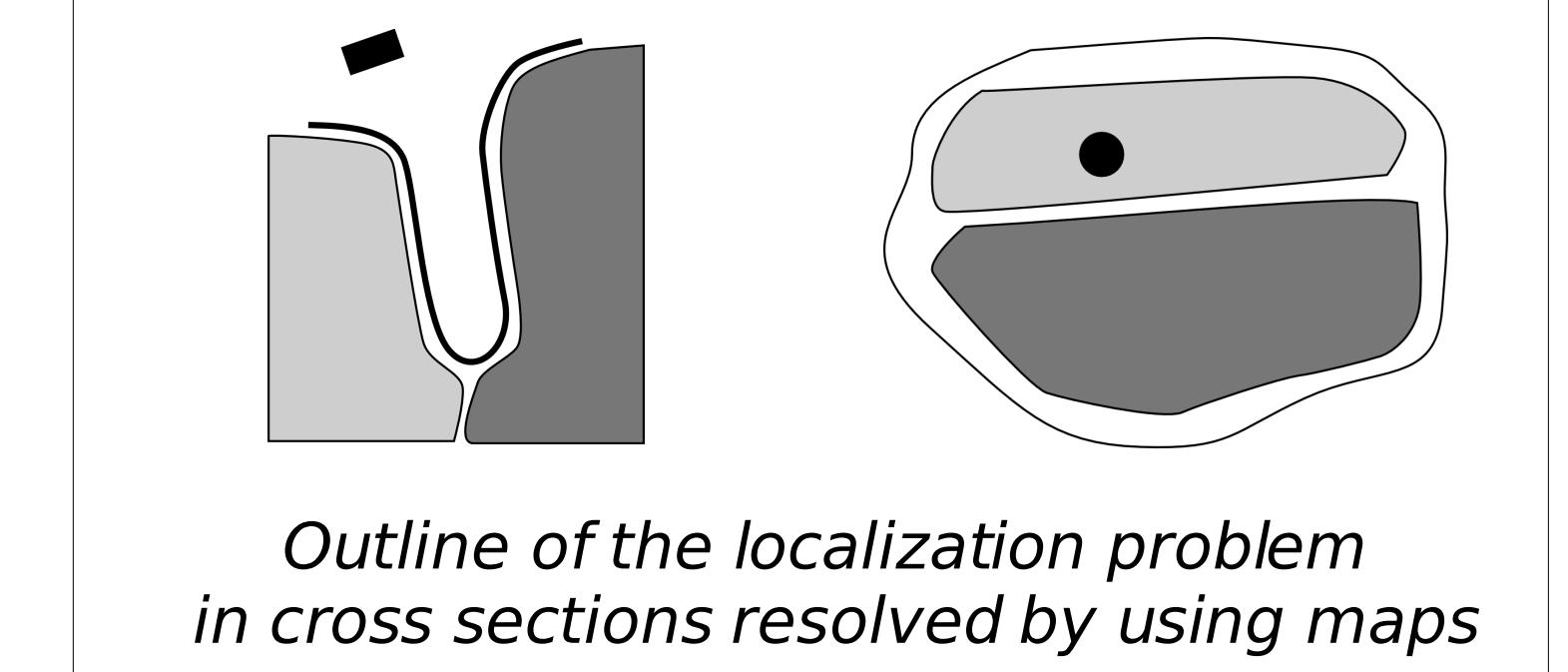


Resulting maps:



References :

- [1] D. Shattuck, S. Sandor-Leahy, K. Schaper, D. Rottenberg, and R. Leahy. Magnetic resonance image tissue classification using a partial volume model. *NeuroImage*, 13(5):856–876, 2001.
- [2] V. Barra and J. Y. Boire. Tissue segmentation on MR images of the brain by possibilistic clustering on a 3D wavelet representation. *J Magn Reson Imaging*, 11(3):267–78, 2000.
- [3] C. R. Collins, K. Stephenson, A circle packing algorithm, *Computational Geometry: Theory and Applications* (2003)



Outline of the localization problem in cross sections resolved by using maps