

## Authors

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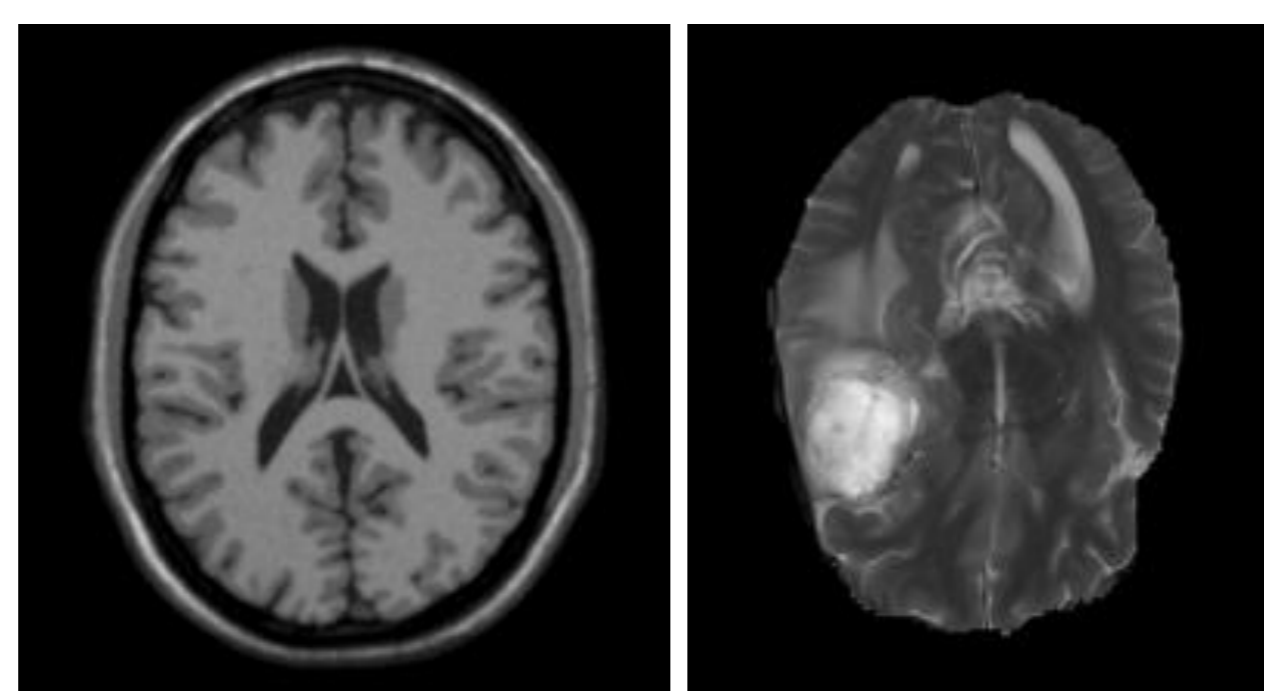
## Supervision

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## MOTIVATION & OBJECTIVES

### Monomodal medical image segmentation

- A challenging task in **Computer-Aided Diagnosis** is to automatically partition images into **tissue classes**, **organs** or other **biologically-relevant structures**
- This requires **segmentation** methods with **sound mathematical basis** able to reliably deal with **radiological** and **anatomopathological variability**
- Candidate methods should be **versatile**, **unsupervised**, **accurate**, **robust**, **fast** and **easy-to-parameterize**



BrainWeb      Sample axial images      BRATS

## MATERIAL

### BrainWeb *Simulated Brain database*

- > Simulated 3D normal brain MRI exams (T1 / T2 / PD) with variable noise

### BRATS *Brain Tumor Image Segmentation database*

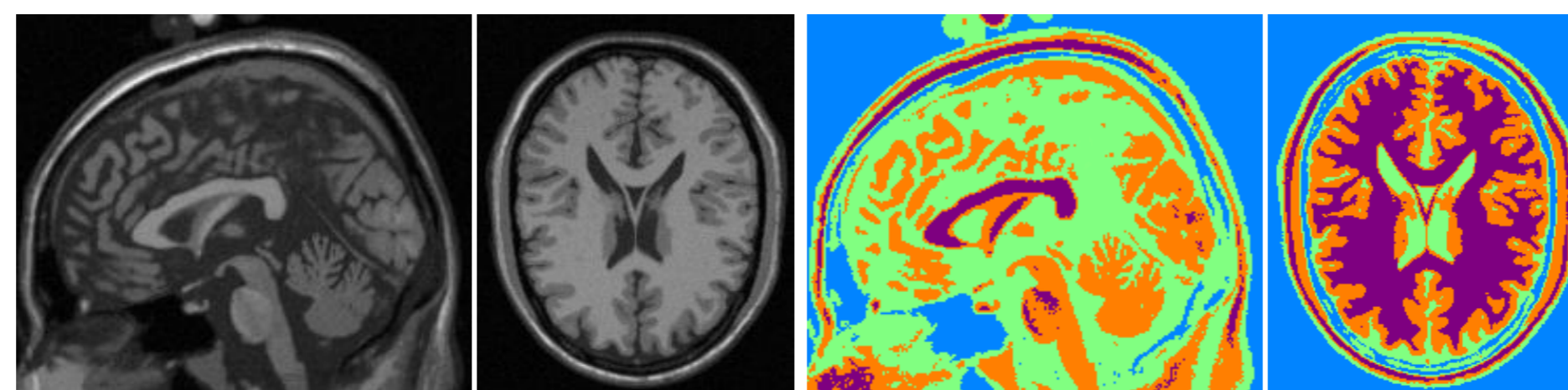
- > Real 3D pathological brain MRI exams (T1 / T1C / T2 / FLAIR) with expert-based ground-truth segmentation (tumor & edema)

## METHODS

- Assessment of **globally convex fuzzy** variational models based on **total-variation** priors
  - > **Denoising**: convex Rudin-Osher-Fatemi model
  - > **Segmentation**: multiphase active contours with **region competition** models
    - piecewise constant / smooth [1]
    - global / local kernel statistics [2,3]
- Efficient **primal / dual** optimization schemes

## RESULTS

- User-friendly prototype software
  - > C++ template programming / Qt GUI / VTK visualization / OpenCL GPU acceleration
- **Gray / white matter / CSF segmentation**
  - > Best qualitative results obtained with **4-phase smooth 3D region competition**
  - > Average processing time / exam ~1 min
- **Brain tumor + edema segmentation**
  - > Preliminary accuracy assessment



Original images      4-phase segmentation

	tumors	edemas
DICE	0.91	0.71

## CONCLUSION & PERSPECTIVES

- Powerful **generic multi-object segmentation framework** tunable to specific **radiological / anatomopathological** contexts via relevant **region competition** models
- **Software platform** with **user-experience** and **computational performances** compatible with **clinical routine practice**
- Extensive experimentation is needed to further refine and assess the **brain tumor segmentation scheme**

[1] X. Bresson, S. Esedoğlu, et al. (2007). *Fast global minimization of the active contour/snake model*. J. Mathematical Imaging & Vision, 28 : 151-157

[2] B. Mory, R. Ardon (2007). *Fuzzy region competition: a convex two-phase segmentation framework*. In SSVM '07 : 214-226

[3] B. Mory, R. Ardon, J. Thiran (2007). *Variational segmentation using fuzzy region competition and local non-parametric probability density functions*. In ICCV '07 : 1-8

