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Brain Stripping Magnetic Resonance Angiographic Images of Tumor-Bearing Mice

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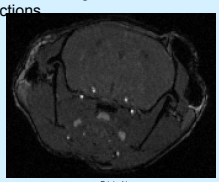
ABSTRACT

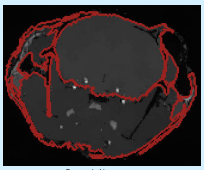
Brain stripping is a difficult task in mice with brain tumors. No group has described a fully effective method. We present a new method of defining the brain envelope from magnetic resonance angiographic (MRA) images of both healthy and tumor-bearing mice.

BACKGROUND

❖ Mean shift segmentation [1] : determine the clusters by merging basins of attractions



Original image

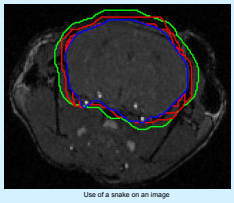


Segmented image

3 parameters :

- ➢ hs : spatial domain
- ➢ hr : range domain
- ➢ M : minimum number of pixel per region

❖ Snake [2] : active contour



Use of a snake on an image

Snake of initialization

Different steps of the snake

Final snake

METHODS

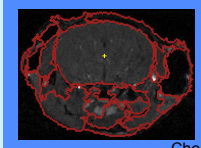
Brain Stripping

❖Mean shift segmentation:

Based on 3 parameters :

- ➢ h_s : spatial domain
- ➢ h_r : range domain
- ➢ M : minimum number of pixel per region

❖Choice "desirable" slice :



"Desirable" slice

➢Brain well delineated by mean shift segmentation

➢Area of the brain: one of the highest of all slices

Choice

- ➢ Manually : find a "desirable" slice, select the region of the brain.
- ➢ Automatically :
  1. selection of 1 region on each
  2. Selection of 1 slice based on shape of the selected region and position of slice in the image.

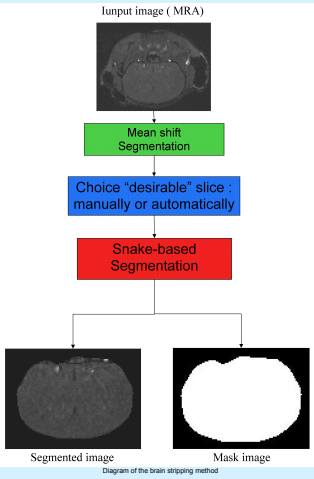


Diagram of the brain stripping method

❖Snake-based segmentation

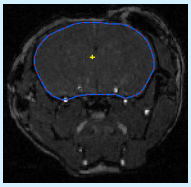
- ➢ On the initial slice ("desirable" slice) :
  1. Initialization of the snake from the contour of the selected region.
  2. Determination of snake parameters automatically
  3. Run the snake until final snake to obtain the stripped brain of this slice
- ➢ Propagation of the snake throughout the image stake on a slice-by-slice basis
- ➢ On the other slices :
  1. Initialization of the snake from the final snake of the previous slice
  2. Determination of snake parameters automatically
  3. Run the snake until final snake to obtain the stripped brain of this slice

Results Evaluation

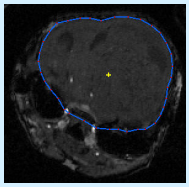
Evaluation : the gold standard a manual segmentation of the brain from each MRA image.We compared our results for both **speed** and **accuracy** to the semi-automated mode and the snake-based segmentation provided by ITK-Snap.

RESULTS

Examples of results obtained

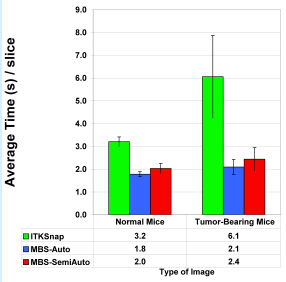


Segmented image of a normal mice

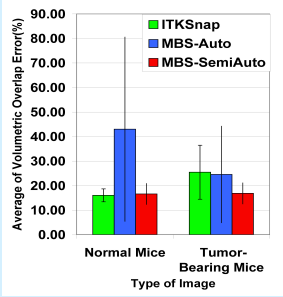


Segmented image of a tumor-bearing mice

Results : speed

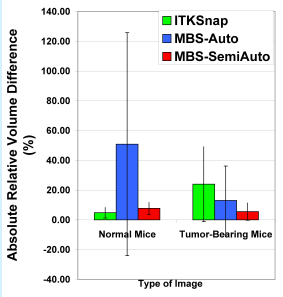


Results : accuracy



Statistical results : ITKSnap [3] vs MBS-SemiAuto

P-value (MBS more accurate than ITKSnap)	Speed	Error overlap	Volume difference
Normal mice	1.10^{-5}	Not significant	Not significant
Tumor-bearing mice	9.10^{-11}	1.10^{-3}	1.10^{-3}



CONCLUSIONS

❖Our method gives good results for brain stripping of MRA images of tumor-bearing mice

❖The same approach could be employed for T1 or T2 images

❖A fully automated approach is under development

References:

[1] Comaniciu, D., Meer, P.: Mean Shift : A Robust Approach Toward Feature Space Analysis. In: IEEE Transactions on pattern analysis and machine intelligence, Vol 24, No. 5, pp. 603-619 (2002).
[2] Kass, M., Witkin, A., Terzopoulos, D.: Snakes:Active Contour Models. In: International Journal of Computer Vision, pp. 321-331 (1998).
[3] Yushkevich, P.A, Piven, J., Hazlett, H. C., Smith R. G. , Ho, S. , Gee, J. C., Gerig, G.: User-guided 3D active contour segmentation of anatomical structures: Significantly improved efficiency and reliability. *Neuroimage* 2006 Jul 1;31(3):1116-28, www.itksnap.org

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