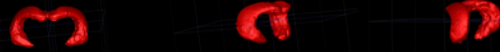


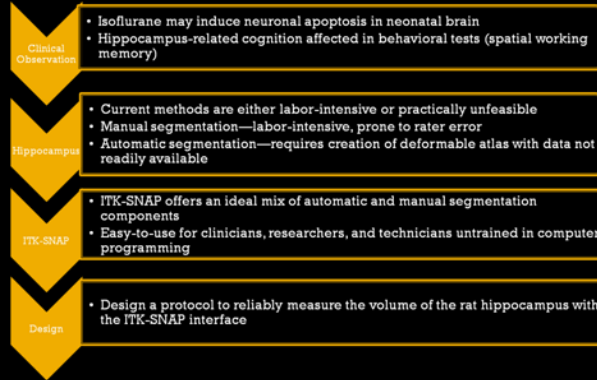
# Design of a Semi-Automatic Segmentation Method for Measurement of the Hippocampal Volume in the Rat Brain from Magnetic Resonance Images



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## Background



## Objective and Design Challenges

**Objective:** To develop a robust semi-automatic computer method that determines the volume of the rat hippocampus from a magnetic resonance image.

### Specifications

- Inter- and intra-rater reliability of at least 0.90, as measured by the Dice's overlap coefficient
- Detection of a rat hippocampal volume difference of less than 25% between image sets
- Segmentation of hippocampus in under 60 minutes

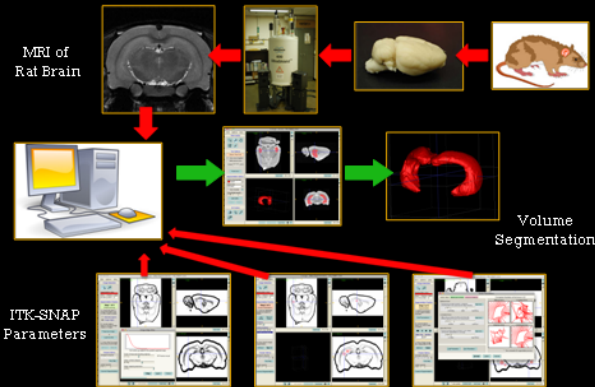
### Risks

- Ambiguous anatomical boundaries of the rat hippocampus
- Discrepancies between users due to previous knowledge of hippocampal shape affecting the ability to make final adjustments to the segmented hippocampus

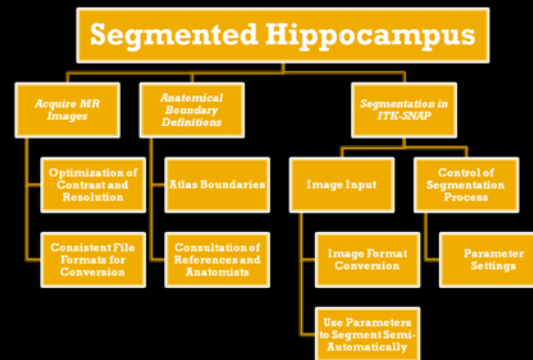
### Constraints

- Low sensitivity
- Small sample size (N=4)
- Barriers in software functionality

## Project Illustration



## Block Diagram



## Results: Segmentation Parameters

Gaussian Blurring	Edge Contrast	Edge Mapping
1.000	0.054	3.000



Balloon Force	Curvature Force	Advection Force
1.600	0.620	0.940



## Results: Volume Measurements

Image	Rater 1 Volume (mm <sup>3</sup> )	Rater 2 Volume (mm <sup>3</sup> )	Rater 3 Volume (mm <sup>3</sup> )
1	75.25±2.51	74.16±1.71	75.96±0.46
2	76.16±1.89	78.71±3.79	76.32±3.81
3	74.75±2.91	74.97±2.93	76.75±0.70
4	78.25±1.44	75.69±1.76	79.59±0.57

## Specifications

Specification	Promised	Delivered	Test Method
<b>Reliability</b>	Inter- and intra-rater reliability of at least 0.90	Inter-Rater Reliability: 0.934 Range: 0.907 – 0.959	Dice Coefficients calculated from ITK-SNAP segmentations using Convert3D
		Intra-Rater Reliability: 0.952 Range: 0.901 – 0.913	
<b>Sensitivity</b>	Detect hippocampal volume difference of less than 25%	Detected 2.62% difference with significance (p=0.0113, two-tailed)	Average hippocampus volumes for each image set (N=4); t-test averages of images with >1.9 mm <sup>3</sup> difference
		Detected 2.66% difference with significance (p=0.0154, two-tailed)	
<b>Sensitivity</b>	Detect hippocampal volume difference of less than 25%	Image 1: 3.528%	Average hippocampus volumes for each image set (N=4); find 95% confidence intervals for each set
		Image 2: 6.132%	
		Image 3: 4.680%	
		Image 4: 4.113%	
<b>Time Optimization</b>	< 60 minutes	49.33±1.32 minutes	Average all trials (N=36) across all three raters (Rater 1, Rater 2, Rater 3)

## Conclusions and Recommendations

### Conclusions

- A segmentation protocol was developed for segmenting the rat hippocampus in MR images
- The protocol allowed for consistent volume measurements between raters, and between measurements from the same rater

### Recommendations

- Modify ITK-SNAP interface to improve manual segmentation portion of the segmentation process
- Use segmentation protocol on MR images from isoflurane-exposed mice

### Acknowledgements

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