



# A Novel Method in Extracranial Removal of Brain MR Images

Information Technology and Quantitative Management (ITQM 2014)



# Outline

- o Abstract
- o GVF Snake Model
- o Proposed Algorithm
- o Experiment Result



## Abstract

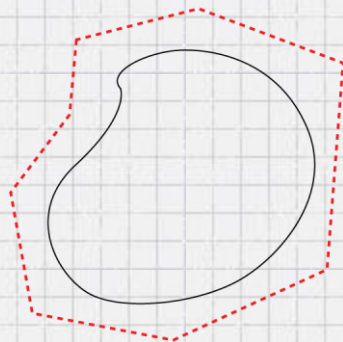
- o This paper proposes an automatic **morphology-based** algorithm to generate the **initial contour** for active contour model to implement the removal.
- o Experimental result shows that with simple steps and little time, the proposed algorithm can finish the segmentation task successfully, and is of good robustness as well as high accuracy.



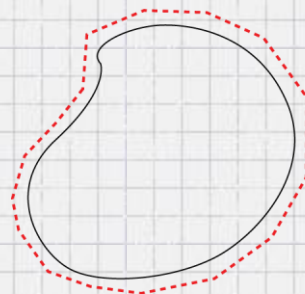
GVF Snake Model

# Overview

A parameter-based deformable model defined within an image in the form of curve that can move under the interaction of **internal force** and **external force** to approach desired features of an object.



Initial State



Deformation



Final State



GVF Snake Model

## Definition

- Traditional model is defined as a **curve**:

$$v(s) = [x(s), y(s)] \quad s \in [0,1]$$

- The corresponding **energy functional**:

$$E_{snake}^* = \int_0^1 [E_{int}(v(s)) + E_{ext}(v(s))] ds$$

- $E_{int}$  is the internal force exists within the curve itself
- $E_{ext}$  is the external force from features of the image
- Deformation means minimize the energy formulation



Proposed Algorithm

## Idea

- o GVF Snake model are implemented by **iteration**, the more it takes, the more resources are required.
- o Orthogonal force field can be found in a small range of space surrounding the true boundary.
- o If initial contour is **close enough to** the described area, the curve converge fast and correctly even iteration is reduced.





Proposed Algorithm

# Introduction

- o We perform a **two-layer** contour generator to dynamically generate the curve shape of the corresponding MR image.
- o Those curve shapes will be **combined** and transformed in a specific manner, and the initial contour is produced.



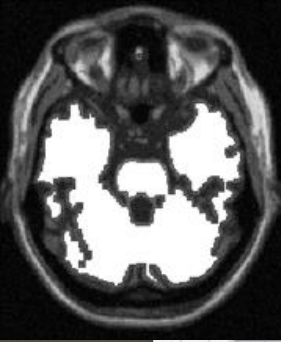
Proposed Algorithm

# Contour Generator - layer 1

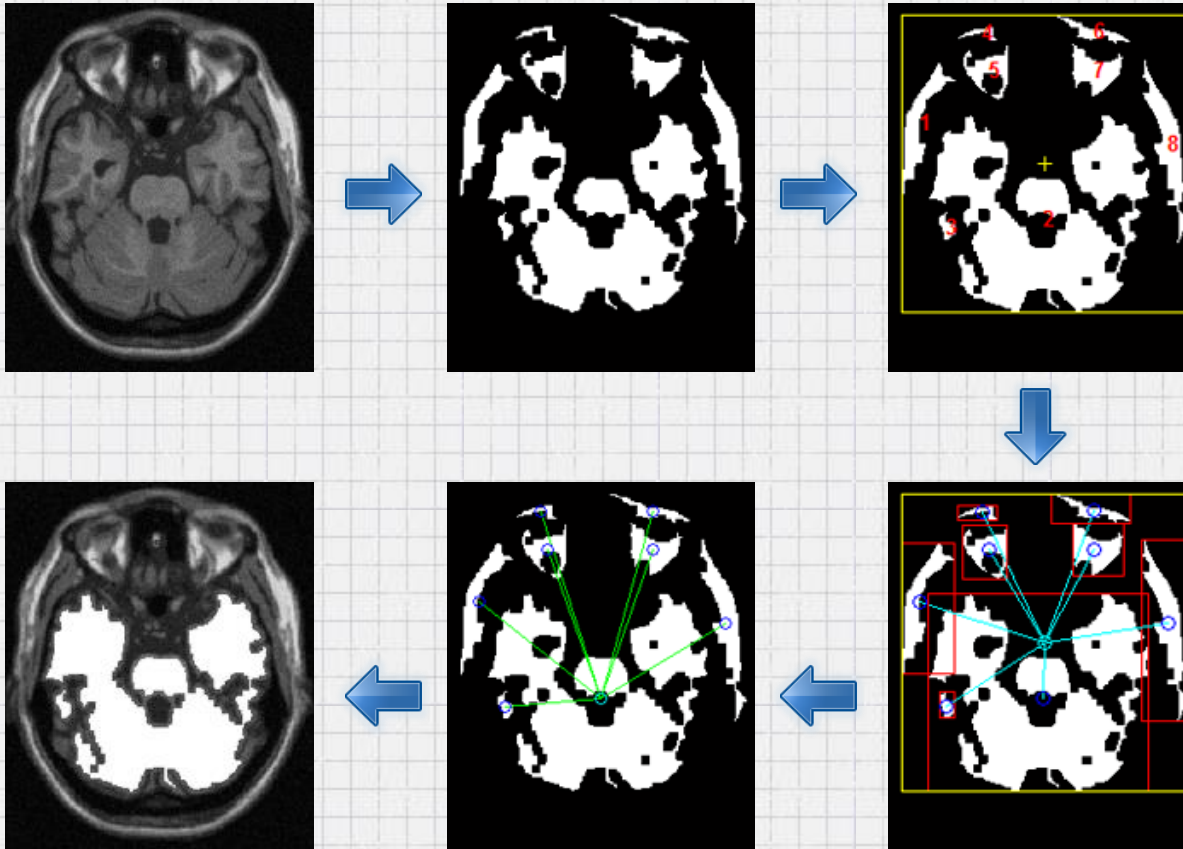
## o Island layer

- o Regard the binary image as a map. The background is ocean and the foregrounds are island collections.
- o Define a center island, while other islands are changing from active to inactive as distance grows.
- o The center intends to find a stable state by attracting all other islands and discarding those are too inactive.





# Proposed Algorithm Island Layer





Proposed Algorithm

## Contour Generator - layer 2

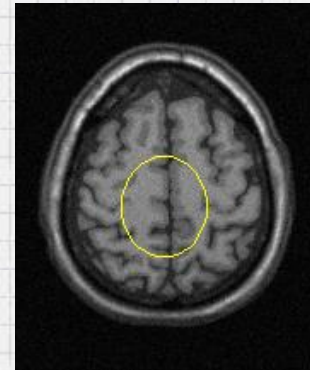
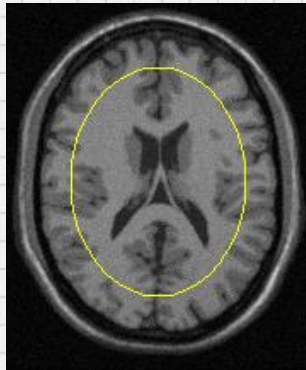
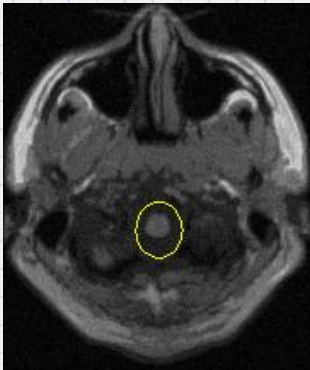
### o Ellipse layer

- o we construct a discrete sphere model based on human brain structure, from which each slice could be obtained.
- o When extracting a slice from the sphere model, the slice are calculated and relocation by aligning the centroid of the MR image.



Proposed Algorithm

# Ellipse Layer





Proposed Algorithm

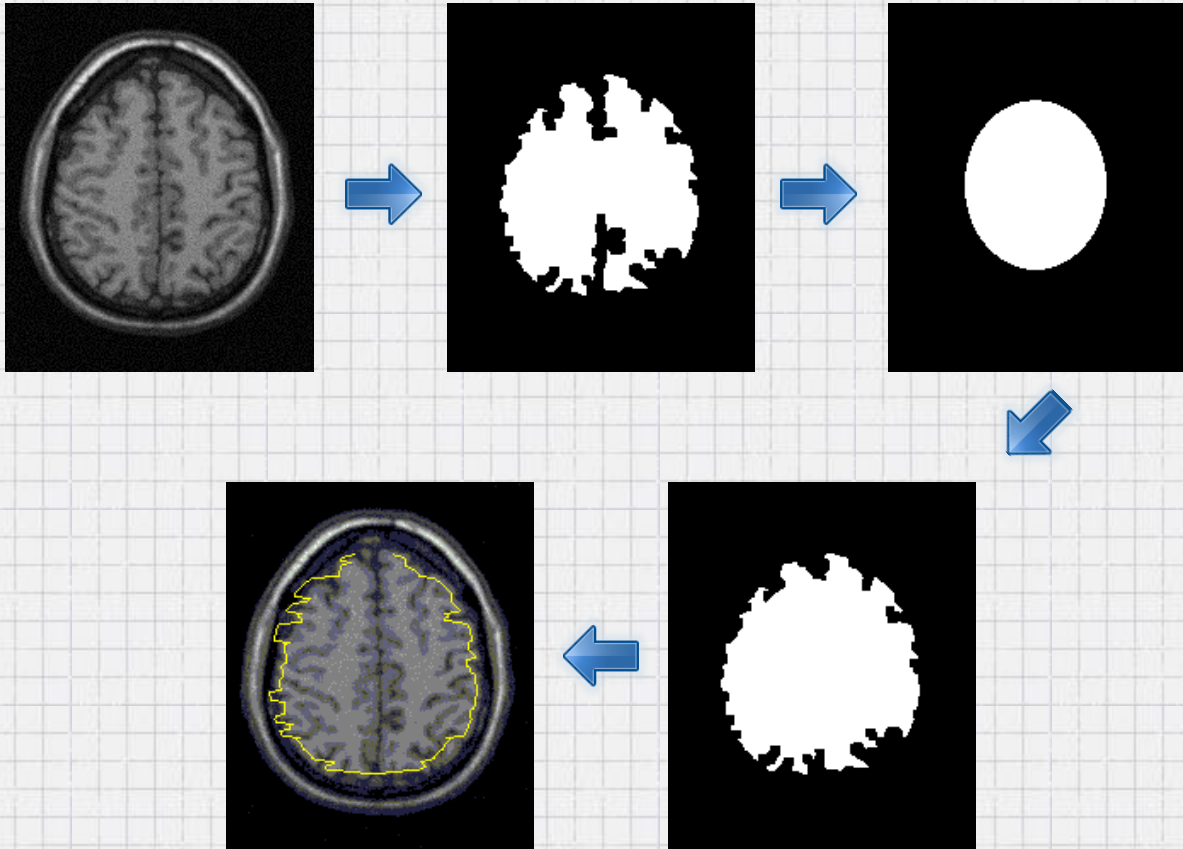
# Final Refinement

- We combine the island layer and ellipse layer together by overlapping to form a new curve shape.
- The Canny's method is introduced to detect and extract the outline of the hybrid layer.
- In order to simplified members of the outline, we use a greedy algorithm to eliminate redundant points efficiently.
- Points will be ordered to yield the initial contour.



Proposed Algorithm

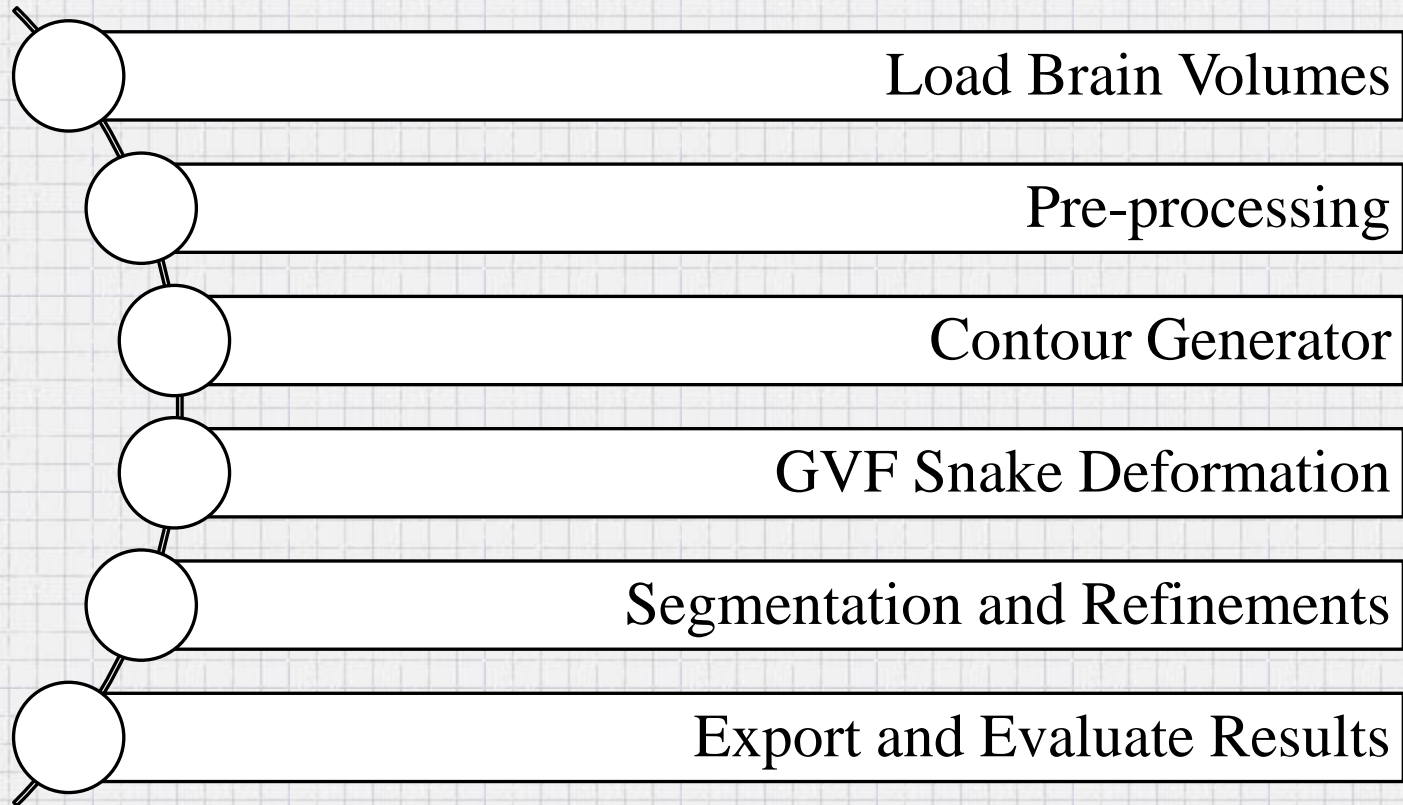
# Final Refinement





Proposed Algorithm

# Flowchart

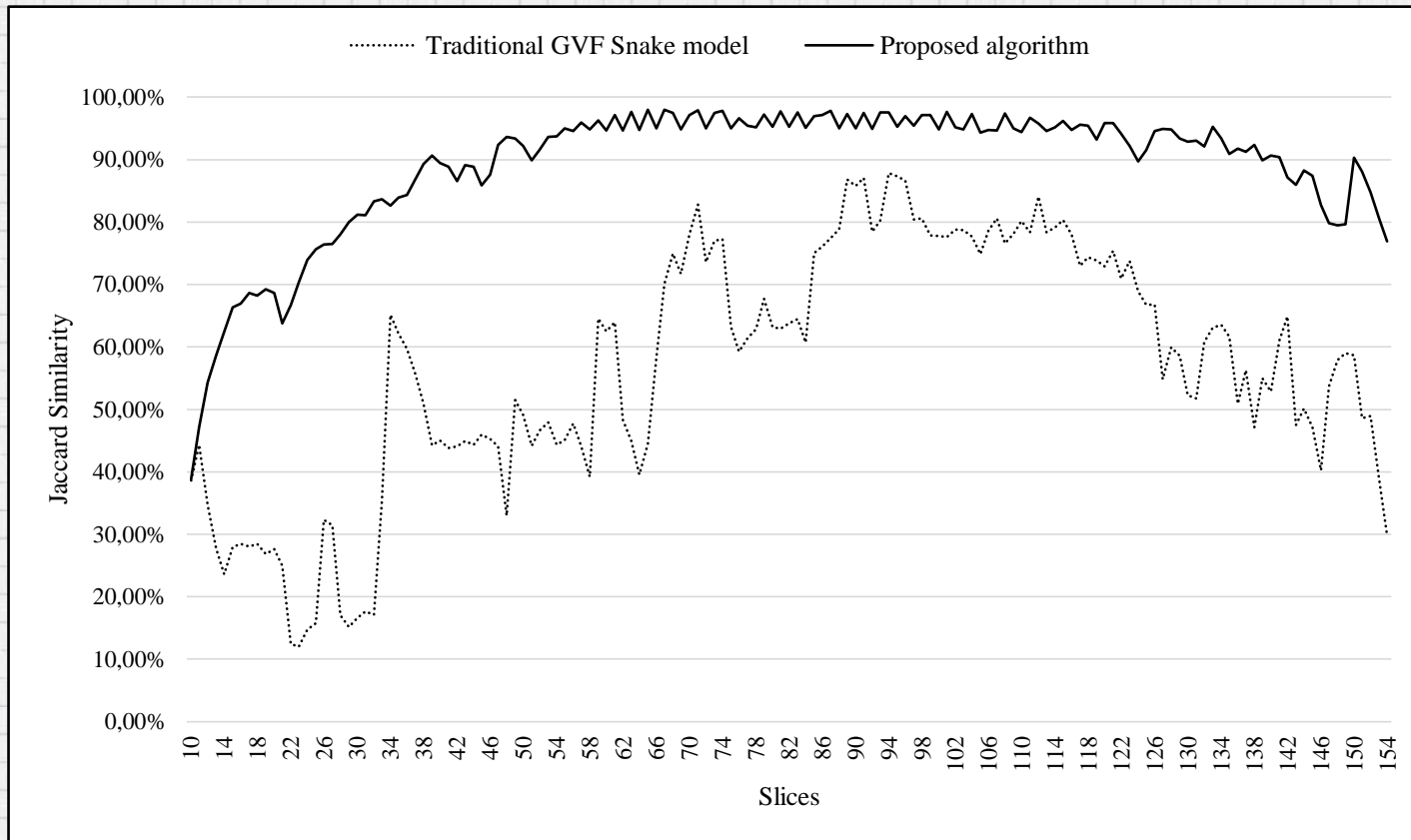






## Experiment Result

# Accuracy





Experiment Result

# Robustness



**Thank You**