# Open Source Software Practice

Project 2 - Image Segmentation: Ventricle Isolation Using Region Growing

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# Image Segmentation

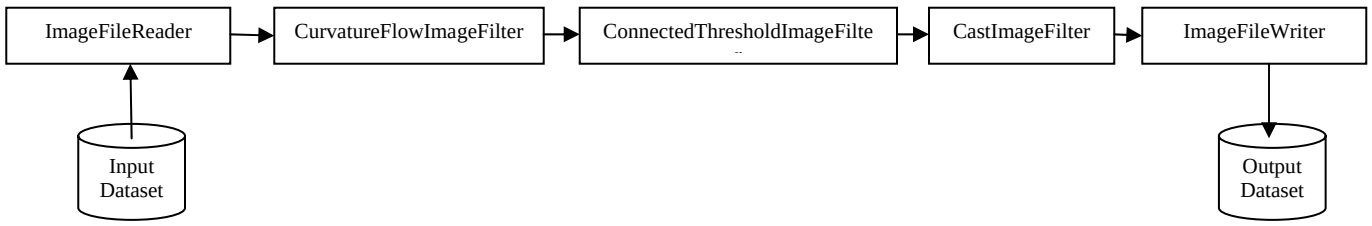
## Abstract

This document describes the process used in implementing image segmentation through a region growing algorithm with the use of the Insight Toolkit (ITK) imaging program. The code used to implement the region growing algorithm is documented in the ITK Software Guide and makes use of the ITK library. This paper is accompanied with all source code, input data, parameters and output data that were originally used in developing the image segmentation application, except where prior laws or agreements prohibit redistribution of such material. The only data subject to not being redistributable was the input file used for testing which was a brain dataset from Kitware's MIDAS collection named **Normal090-T2.mha**. The rest of this scientific publication is written in a manner such that it facilitates reproducibility of the reported results.

## Experiment

### Segmentation Process

This image segmentation application was designed to use the region growing segmentation method described in the ITK Software Guide. Region growing essentially starts off with a single point, the seed index, out which the final segmented region is generated or grown from. The region growing algorithm begins selecting all neighboring points of the seed index as long as their intensity values fall within the range of the intensity threshold region specified by the user. In order to prevent rough edges on the grown region, the brain dataset is first passed through a smoothing filter before being passed into the connected threshold filter which grows the region out from the seed index. The final output is then converted into essentially whichever image file type the user chooses through the use of ITK's dynamic image plug-in capabilities.




### Input Data

The image segmentation application has seven required input components which are used throughout the segmentation process. The table below describes the input component and at which stage of segmentation it is used.

| Input | Segmentation Stage |
|---|---|
| Input Image | Used in the beginning of segmentation when loading a dataset |
| Output Image | Used at the end of segmentation when writing the segmented dataset |
| Lower Intensity Threshold | Used in initializing the region growing filter's lower intensity range |
| Upper Intensity Threshold | Used in initializing the region growing filter's upper intensity range |
| Seed Index X Value | X component of initial seed index used by region growing filter |
| Seed Index Y Value | Y component of initial seed index used by region growing filter |
| Seed Index Z Value | Z component of initial seed index used by region growing filter |

For the purposes of testing the application, the following values were the defaults used:

| Input | Default Testing Value |
|---|---|
| Input Image | Normal090-T2.mha |
| Output Image | Normal090-T2_segmented.mha |
| Lower Intensity Threshold | 2000 |
| Upper Intensity Threshold | 2500 |
| Seed Index X Value | 89.0 |
| Seed Index Y Value | 128.0 |
| Seed Index Z Value | 70.0 |

## Testing

In order to reproduce the results of this experiment, a baseline segmented image **Normal090-T2_baseline.mha** has been included for comparison. It was generated using the above default testing values which isolate the ventricles on the right side of the brain. The CMake file included with this project will automatically run a test again this file when the RUN_TESTS project is run.

## References

E Bullitt, G Gerig, S Aylward, S Joshi, JK Smith, W Lin, and MG Ewend. Vessel tortuosity and brain tumor malignancy: A blinded study. Academic Radiology, 12:1232–1240, 2005.

Elizabeth Bullitt. Normal090-T2. http://hdl.handle.net/1926/1182, 2007.

L. Ibanez, W. Schroeder, L. Ng, and J. Cates. The ITK Software Guide. Kitware, Inc. ISBN 1-930934-10-6, http://www.itk.org/ItkSoftwareGuide.pdf, first edition, 2003.

Image Data made available from http://casilab.med.unc.edu/index.html