Semi-automatic Segmentation of MRI

Project Update

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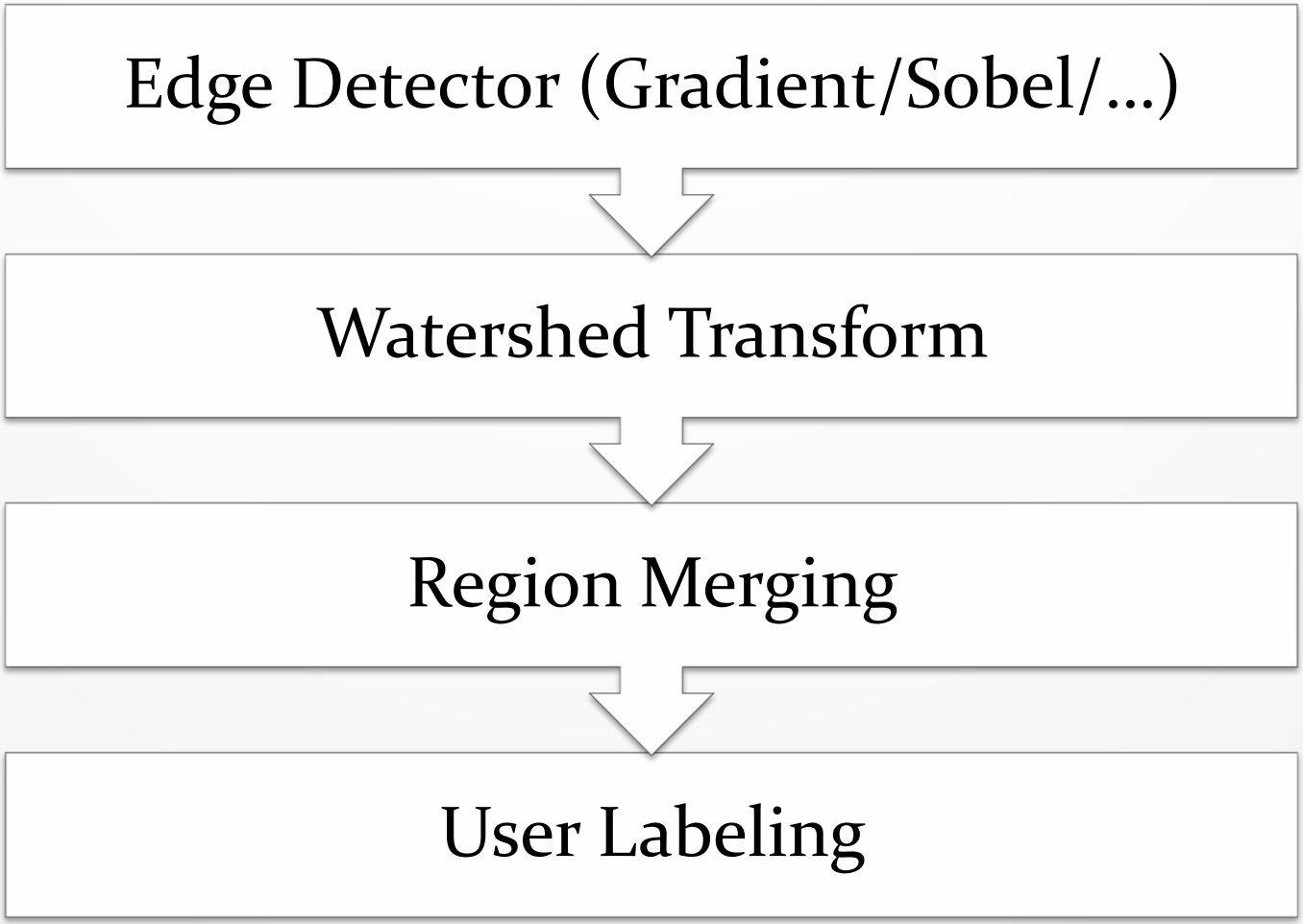
Goals

- Make tool for volumetric quantification of glioblastoma multiforme (GBM)
  - Must be fast and accurate before it will be adopted
- Validate tool on patient data

How does this help?

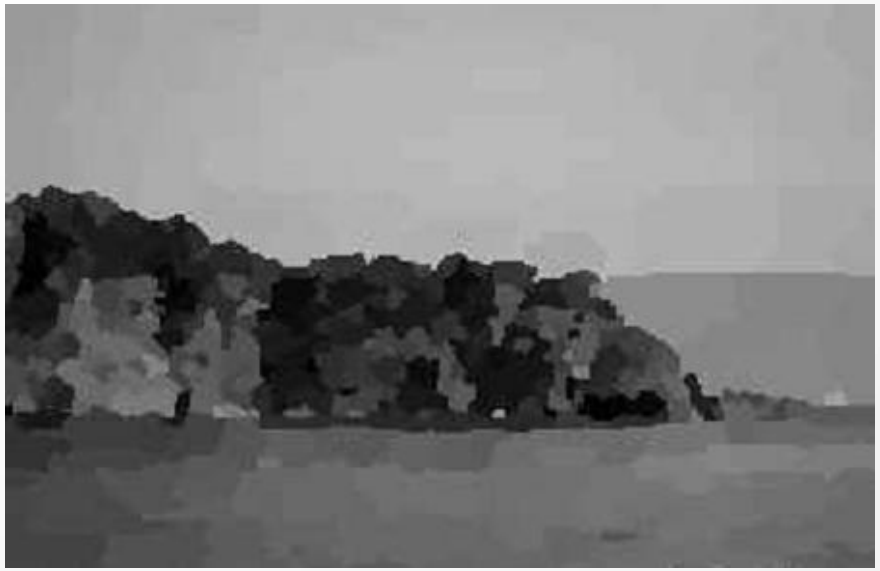
- More accurate variables to judge treatment efficacy
- Future Benefits
  - Volumetric progression tracking
  - Improved radiotherapy targeting and evaluation
  - Adaptable to similar segmentation problems

Interactive Watershed Transform



Interactive Watershed Transform

Region Merging



Merge neighbors with minimum mean difference

Interactive Watershed Transform

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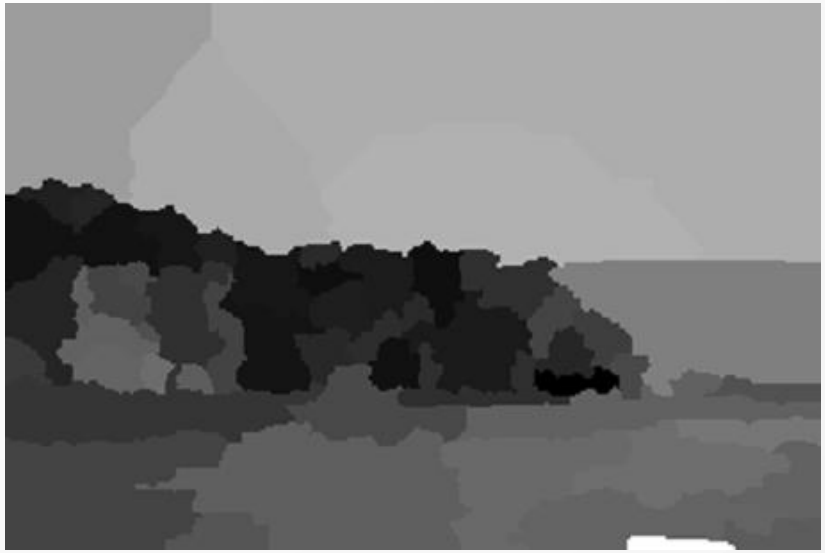

Merge neighbors with minimum mean difference

Interactive Watershed Transform

Stopping Criterion

- Don't merge beyond a specified mean difference
- Potential Alternatives
  - Regional dynamics
  - Statistical hypothesis testing
    - Gaussian mixture to model object signal

Algorithm UI

- Point-to-click user interface
  - Minimal training; adaptable to touch interfaces
- ITK-Snap application framework
  - Simple user interface
  - Direct ITK integration

Interactive Watershed Transform

Demonstration

Current Prototype

- ITK filters written in C++
  - Complies with existing documentation
- Hacked into InsightSNAP
- Shortcomings
  - Gaps in the tumor boundary
  - No shape detection
    - A priori shape information may not be robust enough

Work In Progress

- Viscous Watershed

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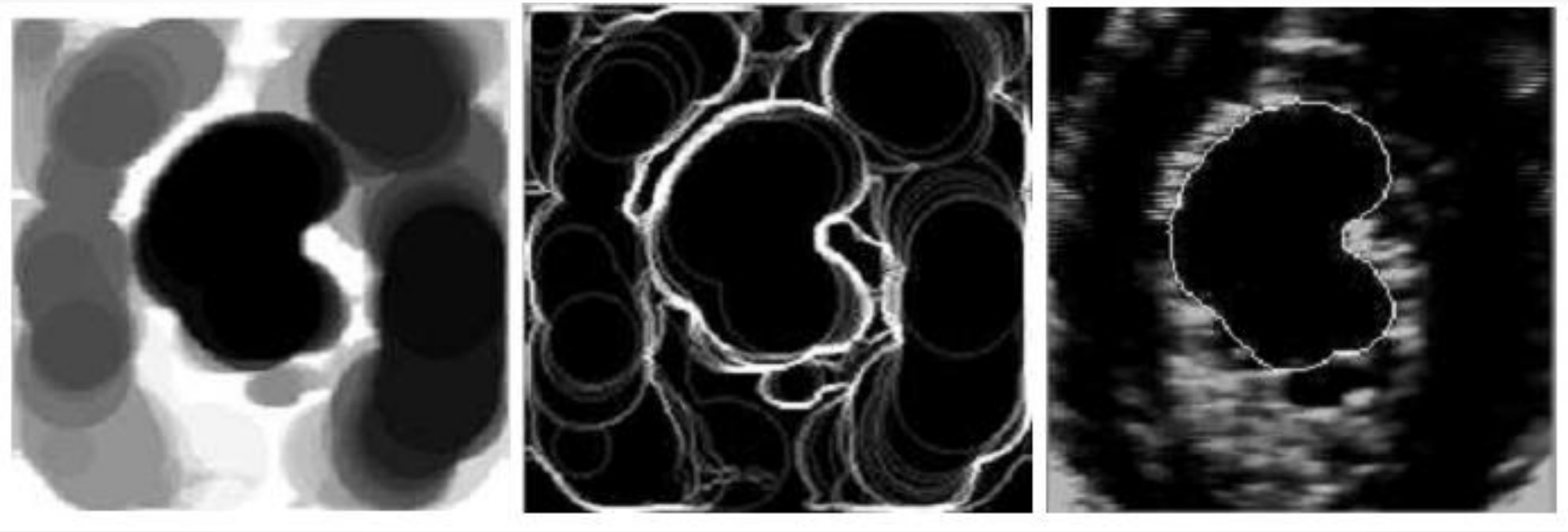

- C. Vachier and F. Meyer. The viscous watershed transform. Journal of Mathematical Imaging and Vision, 22:251–267, 2005.

Progress Update

- **Minimum:**
  - Implement a 2D watershed algorithm in ITK
- **Expected:**
  - Integrate algorithm into ITK-SNAP
  - Test variability and accuracy of the program
  - Perform segmentations on simulated datasets
- **Maximum:**
  - Implement 3D watershed algorithm in ITK
  - Test variability and accuracy of the program
  - Perform segmentations on simulated datasets
  - Investigate inter/intra-observer variability

Plan Updates

- Continue concurrent development
- Meetings as needed with Dr. Alfredo Quiñones-Hinojosa for consultation on software features and (retrospective) patient database access

Dependency Updates

- People
  - Neurosurgical residents for validation study
    - Have become familiar with user interface
    - Awaiting final algorithm
  - Dr. Hadie Adams
    - Weekly teleconference

Timeline

Task	10-Feb	17-Feb	24-Feb	3-Mar	10-Mar	17-Mar	24-Mar	31-Mar	7-Apr	14-Apr	21-Apr	28-Apr
Minimum (Software Implementation)												
Project Proposal and Presentation												
Investigation of Segmentation Techniques												
Investigation of Libraries and Existing Framework												
Implementation of Watershed in Framework												
Code Validation, Testing, and Debugging												
Expected (Accuracy and Variability Assessment)												
Segmentation of Phantoms												
Segmentation with Different Observers												
Segmentation with Public Real Datasets												
Segmentation of Actual Patient Datasets												
Segmentation of Large Dataset of Various Gliomas												

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Progress Update

- **Expected:**
  - Improved Watershed Implementation
  - Perform segmentations on simulated datasets
  - Algorithm Documentation
- **Maximum:**
  - Test variability and accuracy of the program
  - Investigate inter/intra-observer variability

Questions?