

Hepatic Tumor Segmentation using the Power Watershed Algorithm

Introductory Presentation

Anna Werner

November 17, 2014

Computer Science Dept. 5 (Pattern Recognition)

Friedrich-Alexander University Erlangen-Nuremberg



FRIEDRICH-ALEXANDER
UNIVERSITÄT
ERLANGEN-NÜRNBERG

TECHNISCHE FAKULTÄT



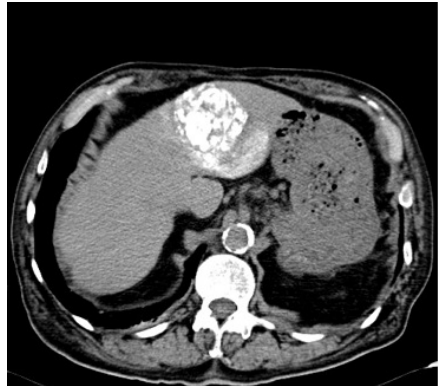
Overview

- Motivation
- Methods
- Summary
- Outlook

TACE - Transarterial Chemoembolization

Requirements on imaging

- size and extent of tumor
- macroscopic angioinvasion into hepatic and portal veins



TACE - follow-up computed tomography. [1]

Methods

Power Watershed: A Unifying Graph-Based Optimization Framework

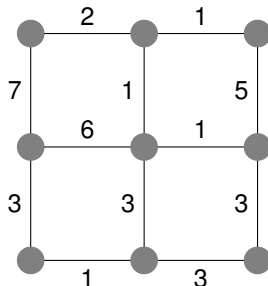
- article by C. Couprie, L. Grady et al. published in 2011
- graph-based segmentation algorithms built using set of core algorithms
 - graph cuts (GC)
 - random walker (RW)
 - shortest paths (SP)
- all placed in common framework
- GC, RW and SP seen as instances of general seeded segmentation algorithm with different choices of one parameter

Power Watershed

Generate weights

Gaussian weighting function

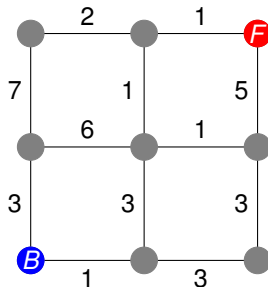
$$\omega_{ij} = \exp(-\beta(\nabla I)^2)$$



Power Watershed

Place seeds

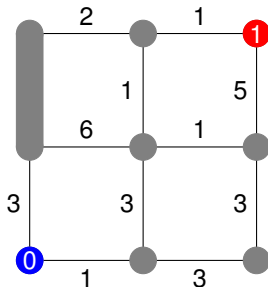
1. generate weights



Power Watershed

Maximum spanning forest

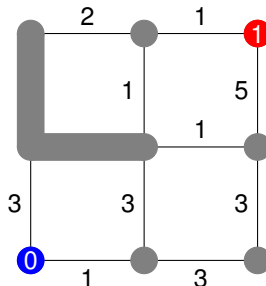
1. generate weights
2. place seeds



Power Watershed

Maximum spanning forest

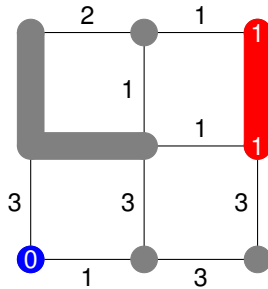
1. generate weights
2. place seeds



Power Watershed

Maximum spanning forest

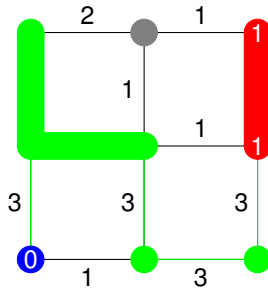
1. generate weights
2. place seeds



Power Watershed

Maximum spanning forest

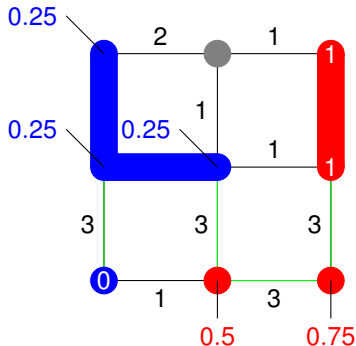
1. generate weights
2. place seeds



Power Watershed

Optimization performed on plateau

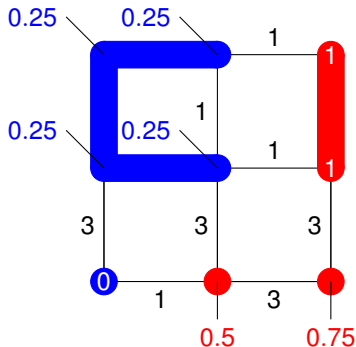
1. generate weights
2. place seeds
3. maximum spanning forest



Power Watershed

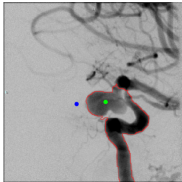
Maximum spanning forest

1. generate weights
2. place seeds
3. maximum spanning forest
4. random walker on plateaus

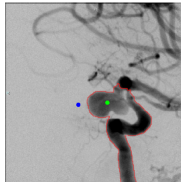


Power Watershed

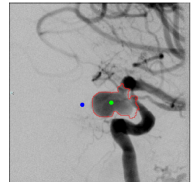
An example



Graph Cut



Random Walker



Power Watershed

Segmentation results using 8-connected lattice. Boundary outlined in red. [2]

Summary

- broadening and complement of established algorithms
- improvement through combination of methods and adjustment of parameters
- advantages
 - not overly committed to balanced partitions
 - no suffer from short-cut problem
 - same speed as standard watershed

Outlook

Bachelor thesis

- adaptation of the algorithm to hepatic tumor segmentation
- possible improvements
 - generating of the weights
 - optimization performed on the plateaus

Thank you for your attention!

- [1] A. Rammohan, J. Sathyanesan, S. Ramaswami, et al.: Embolization of liver tumors: Past, present and future. World Journal of Radiology, Vol. 4 (9), 2012, pp. 405-412.
- [2] A. K. Sinop and L. Grady: A Seeded Image Segmentation Framework Unifying Graph Cuts And Random Walker Which Yields A New Algorithm. In ICCV 2007, International Conference on Computer Vision, Proceedings, Oct. 2007, Rio de Janeiro, Brazil, pp. 1-4, 2007.