Knee Cartilage Segmentation

ENGN 2500 – Medical Imaging Analysis

Onur Ulusel

Introduction

- Osteoarthritis – one of the main health issues among elderly population.
- One of its main effects is the degradation of articular cartilage.
- MRI is the leading imaging modality to quantify knee cartilage and detect deterioration.
- Segmentation of the cartilage tissue is an important step in this process.

Segmentation Methods Used

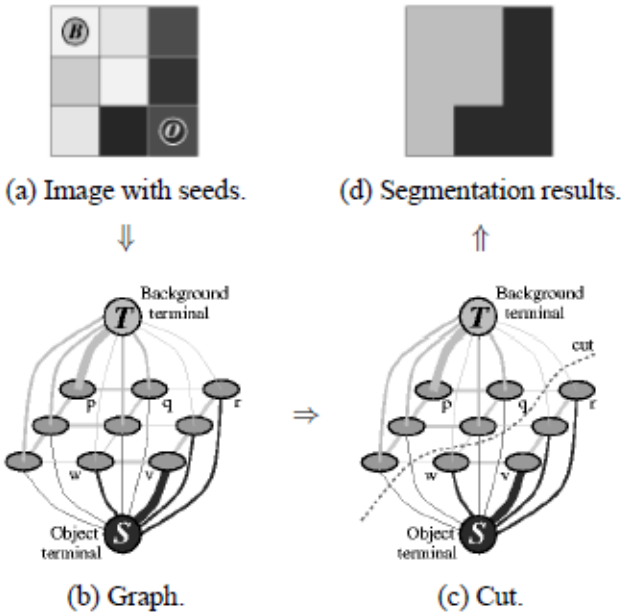
- Manual Segmentation
- Region Growing
- Active Shape Models
- Clustering Methods
- Graph Based Approaches

Clustering Methods

- Voxel Classification Approach
  - Fully automatic apart from initial learning stage
  - The steps used:
    - Grouping voxel values using an approximate nearest neighbor framework.
    - Iterative position adjustment to find the approximate location of the cartilage.
    - Use the position, intensity and geometry features to identify cartilage tissue

Graph Based Approaches

- Basic Graph Cut Algorithm
  - Each pixel is treated as a node in a graph
  - Each node is linked to its neighboring nodes, a strength value is assigned to each edge.
  - Groups of pixels are separated by ‘cutting’ the edges. Graph cut algorithms try to find the ‘cut’ giving least amount of edge strength loss and maximum edge strength within clusters.



References

- Folkesson, J., Dam, E. B., Olsen, O. F., Pettersen, P. C., and Christiansen, C., “Segmenting articular cartilage automatically using a voxel classification approach,” IEEE Transactions on Medical Imaging 26(1), 106–115 (2007).
- Shim, H., Chang, S., Tao, C., Wang, J.-H., Kwoh, C. K., and Bae, K. T., “Knee cartilage: Efficient and reproducible segmentation on high-spatial-resolution MR images with the semiautomated graph-cut method,” Radiology 251(2), 548–556 (2009).
- S. Arya, D. Mount, N. Netanyahu, R. Silverman, and A. Wu, “An optimal algorithm for approximate nearest neighbor searching in fixed dimensions,” ACM-SIAM. Discrete Algorithms, no. 5, pp. 573–582, 1994.
- Bowers, M. E., G. A. Tung, N. H. Trinh, J. J. Crisco, B. B. Kimia, and B. C. Fleming, "Quantitative MRI Using Livewire to Measure Tibiofemoral Articular Cartilage Thickness ", 2008

Project Timeline

- Week 1-2: Implementation of Voxel Classification Approach

-- Progress Presentation

- Week 3: Implementation of Graph Cut approach
- Week 4: Concluding the project by getting the final results and having a comparison between the given two methods.