Towards Correlation of Clinical Outcomes with Radiation Therapy Dose Distributions

Group 14
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Computer Integrated Surgery II
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Team and Mentors

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Dr. Russell Taylor
Goals

Correlating clinical outcomes with refined dose distributions on critical structures

Goals:

• To refine the datasets and infrastructure required for predicting clinical outcomes using past patient data.

• Make the first steps towards accurate toxicity and outcome predictions in a commercial, cloud computing platform.
Importance and Relevance

With cancer treatments, there is a tradeoff between clinical effectiveness and deleterious side effects.

The ability to predict clinical outcomes for a particular patient (taking into account unique anatomy and condition) would allow oncologists to make more informed decisions regarding patient treatment plans.

- 60-90% Xerostomia
- 15-30% Dysphagia
- 40-60% Hearing Loss
Importance and Relevance

In Radiation Oncology for the Head and Neck region, one common side effect is **Dysphasia**, also known as swallowing dysfunction.

Dysphasia may be caused by excessive radiation applied to the **Parotid Glands**.
Technical Summary

1. Set up development database within Hopkins network
   - Store anonymized patient data, images and scans, and clinical outcomes
   - Must be queryable and accessible by other services
2. Deformable registration of critical structures:
   - Currently, we are looking in the head and neck region, specifically at the parotid glands
   - The deformable registration would bring images into one reference frame

3. Dose distribution mapping
   - Based on how dose is applied, generate a 3D map of received dose over the critical structure
   - Partition the organ in a way to allow for insightful analytics
Technical Summary

**Project scope**

1. Contour data (binary masks)
2. 3D mesh
3. Normalized mesh
4. Apply dose distribution
5. Commercially available deformable registration algorithm

**Future work**

- Correlation between treatment plans and clinical outcomes
- Machine learning algorithms
## Deliverables

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Expected</th>
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<tbody>
<tr>
<td>Set up queryable infrastructure with anonymized data</td>
<td>Implementation and validation of deformable registration algorithm on the dataset</td>
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<tr>
<td>Implementation and testing deformable registration algorithm</td>
<td>Design dose mapping algorithm</td>
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**Maximum**

Implement dose mapping algorithm
Dates and Milestones

Oncospace CIS2

- Minimum Deliverables
- Infrastructure Set Up
  - Obtain and Set Up Servers
  - Infrastructure and Endpoint Documentation
  - Data Transfer from Oncospace
- Deformable Registration Algorithm
  - Obtain Critical Structure Test Data
  - Choose Deformable Registration Algorithm
  - Proposal and Documentation on Algorithm
  - Contour Data Conversion
  - Implement Deformable Registration
  - Spring Break

- Expected Deliverables
  - Checkpoint Presentation

- Deformable Registration Algorithm
  - Filter Dataset
  - Perform Registration on Dataset
  - Validate Registration

- Dose Mapping Algorithm
  - Dose Mapping Algorithm Design
  - Dose Mapping Proposal and Documentation

- Maximum Deliverables
  - Implement Dose Mapping Algorithm
  - Perform Algorithm on Dataset
  - Final Presentation
## Dependencies

<table>
<thead>
<tr>
<th>Dependency</th>
<th>Status (or necessary date of resolution)</th>
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<tbody>
<tr>
<td>Access to deformable registration algorithm</td>
<td>In progress (Testing ITK packages)</td>
</tr>
<tr>
<td>Access to Oncospace database</td>
<td>In progress – will be complete by March 1</td>
</tr>
<tr>
<td>Access to space on Hopkins network</td>
<td>In progress – needed by March 6</td>
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<tr>
<td>Github repositories and access to Oncospace codebase</td>
<td>Complete</td>
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Management Plan

Weekly meetings with mentors – Tuesdays at 9AM

Team meetings on Mondays and Fridays (and as needed)

<table>
<thead>
<tr>
<th>Alex</th>
<th>Pranav</th>
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<tr>
<td>Design of development database and data migration</td>
<td>Design and testing of dose mapping algorithm</td>
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<tr>
<td>Testing and implementation of deformable registration algorithm</td>
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Reading List


Steven F. Petit, Binbin Wu, Michael Kazhdan, André Dekker, Patricio Simari, Rachit Kumar, Russell Taylor, Joseph M. Herman, Todd McNutt,” Increased organ sparing using shape-based treatment plan optimization for intensity modulated radiation therapy of pancreatic adenocarcinoma”, Radiotherapy and Oncology, 102 (2012) 38–44.