Towards Correlation of Clinical Outcomes with Radiation Therapy Dose Distributions

Group 14
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Computer Integrated Surgery II
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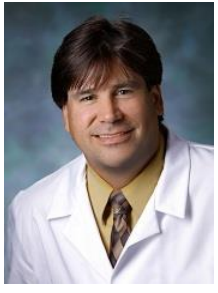
Team and Mentors

Alex Mathews



Dr. Todd McNutt

Pranav Lakshmi

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

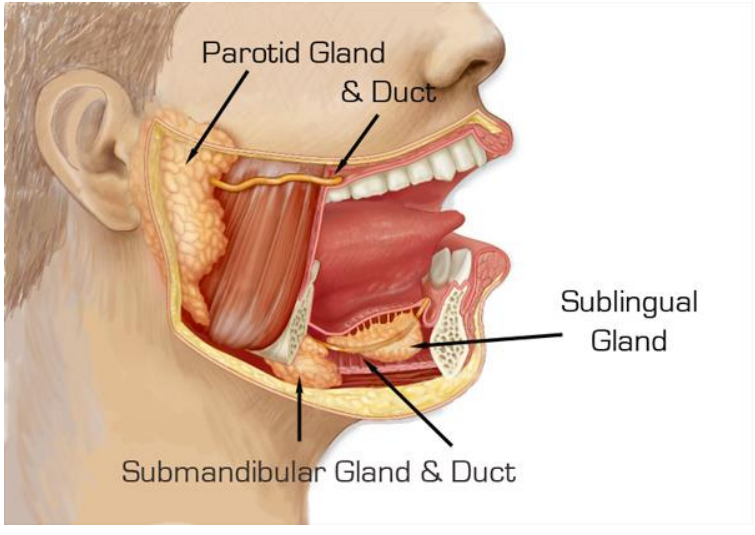
With cancer treatments, there is a tradeoff between clinical **effectiveness** and deleterious **side effects**.

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.

Importance and Relevance

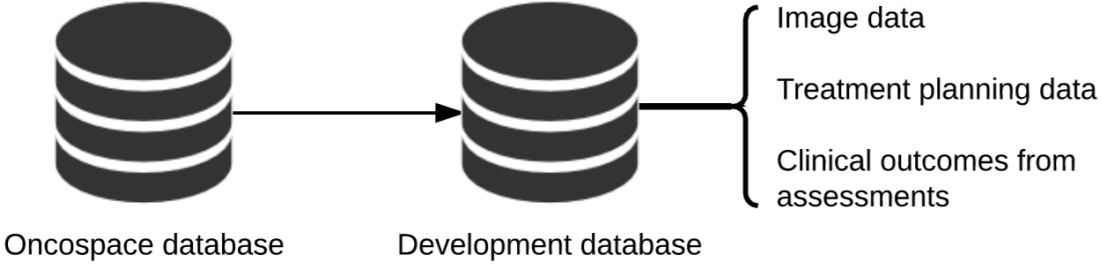
In Radiation Oncology for the Head and Neck region, one common side effect is **Dysphasia**, also known as swallowing dysfunction**.**

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



Technical Summary

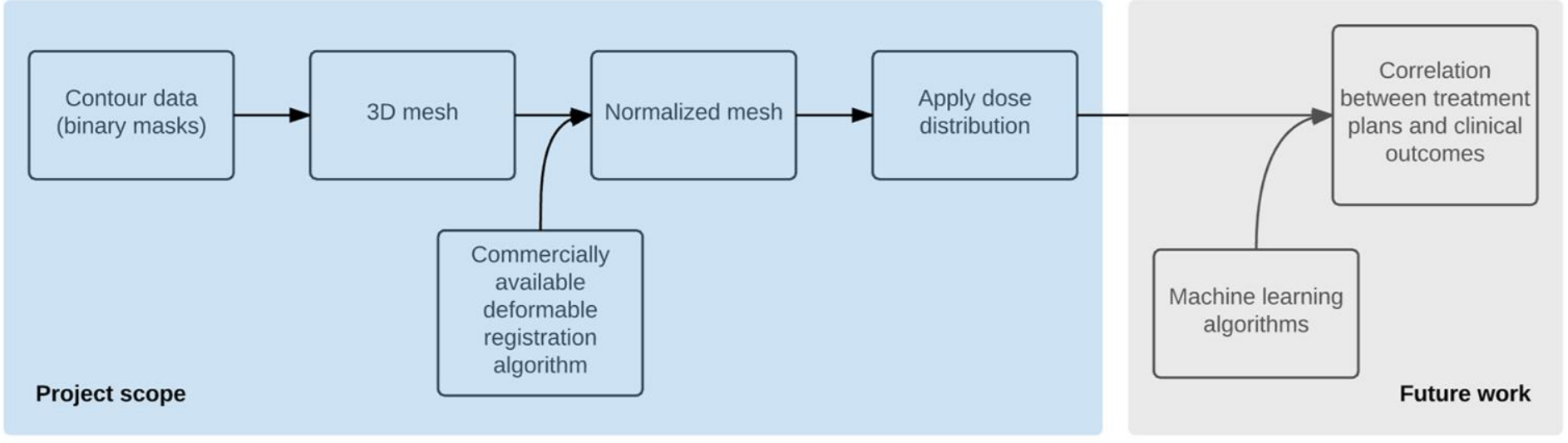
1. Set up development database within Hopkins network
    - Store anonymized patient data, images and scans, and clinical outcomes
    - Must be queryable and accessible by other services



Technical Summary

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



Deliverables

Minimum

Set up queryable infrastructure with anonymized data

Implementation and testing deformable registration algorithm

Expected

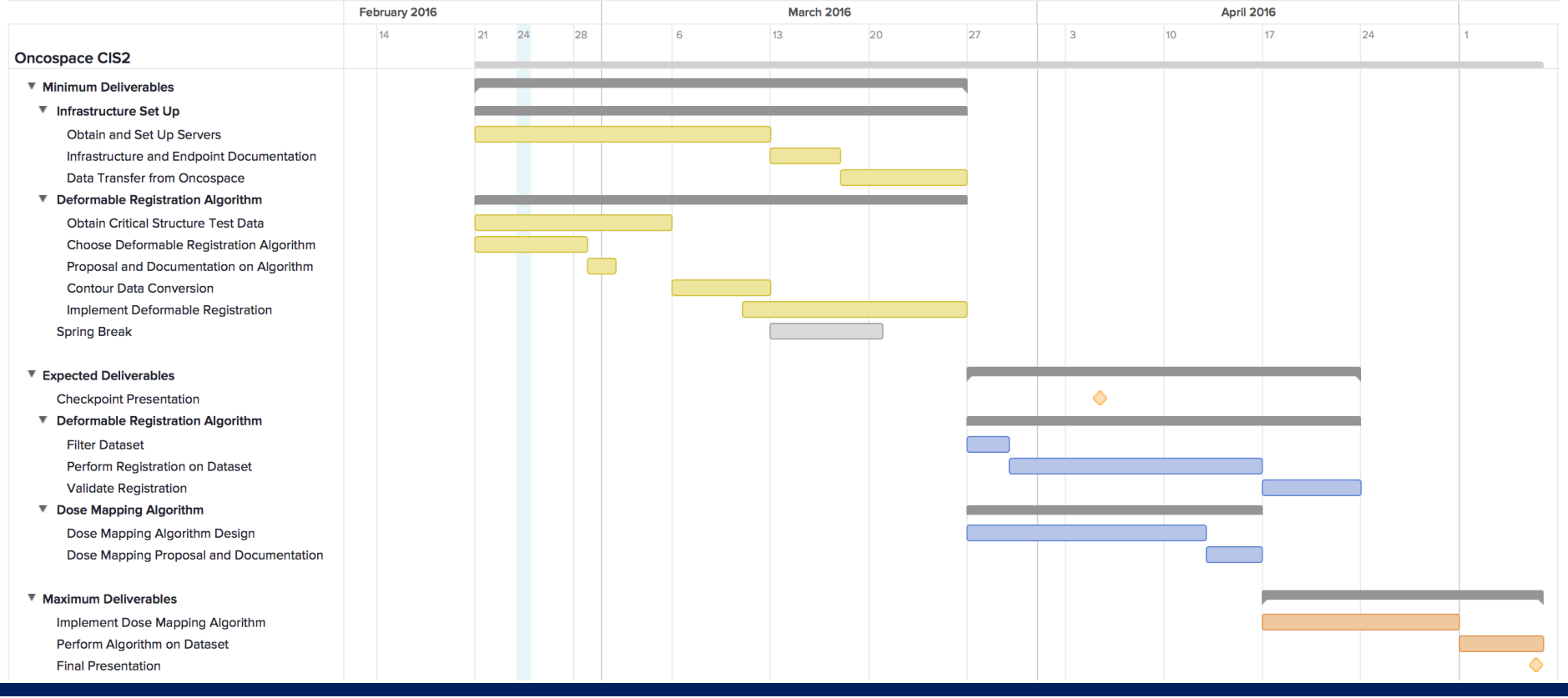
Implementation and validation of deformable registration algorithm on the dataset

Design dose mapping algorithm

Maximum

Implement dose mapping algorithm

Dates and Milestones



Dependencies

Dependency	Status (or necessary date of resolution)
Access to deformable registration algorithm	In progress (Testing ITK packages)
Access to Oncospace database	In progress – will be complete by March 1
Access to space on Hopkins network	In progress – needed by March 6
Github repositories and access to Oncospace codebase	Complete

Management Plan

Weekly meetings with mentors – Tuesdays at 9AM

Team meetings on Mondays and Fridays (and as needed)

Alex	Pranav
Design of development database and data migration	
Testing and implementation of deformable registration algorithm	Design and testing of dose mapping algorithm

Reading List

Bentzen, S. M., Constine, L. S., Deasy, J. O., Eisbrunch, A., Jackson, A., Marks, L. B., Haken, R. K. T., & Yorke, E. D. (2010). Quantitative analysis of normal tissue effects in the clinic (QUANTEC): An introduction to the scientific issues. International Journal of Radiation Oncology Biology Physics, 76(3), S3–S9.

Bhide SA, Newbold KL, Harrington KJ, Nutting CM. Clinical evaluation of intensity-modulated radiotherapy for head and neck cancers. *The British Journal of Radiology*. 2012;85(1013):487-494. doi:10.1259/bjr/85942136.

Fumbeya Marungo, Hilary Paisley, John Rhee, Todd McNutt, Scott Robertson, Russell Taylor, “Big Data Meets Medical Physics Dosimetry” (2014)

Kutcher, G., Burman, C., Brewster, L., Goitein, M., & Mohan, R. (1991). Histogram re- duction method for calculating complication probabilities for three-dimensional treatment planning evaluations. International Journal of Radiation Oncology* Biology* Physics, 21(1), 137–146.

Michael Kazhdan, Patricio Simari, Todd McNutt, Binbin Wu, Robert Jacques, Ming Chuang, and Russell Taylor, “A Shape Relationship Descriptor for RadiationTherapy Planning” Medical Image Computing and Computer-Assisted Intervention 5762/2009(12), 100–108 (2009)

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