AbstractID: 2222 Title: Image Registration and Data Fusion for Treatment Planning

Acquisition of anatomic and functional data from magnetic resonance imaging and nuclear medicine studies is becoming increasingly common for patient management in radiation therapy. These data can help improve tumor localization and normal tissue delineation for treatment planning and may provide information about treatment efficacy during or after a course of radiotherapy. In order to fully realize the benefits of these data, the different imaging studies must be registered to single coordinate system, typically that of the T_x planning CT. The geometric transformation that is used to register the different image data can range from simple rotate-translate to account for differences in patient orientation to 3D or 4D deformation models to account for changes in internal anatomy during and over the course of therapy. Once mapped to a common coordinate system, data derived from the various studies can be integrated or fused to help construct a more complete and accurate representation of the patient.

A variety of interactive and automated techniques exist to carry out these steps. The general strategy for registration algorithms is to minimize a metric that measures the geometric mis-registration between pairs of datasets. A metric can be derived from extracted geometric structures or exploit information theoretic techniques that use image intensities directly. Once registered, computer graphics and algebraic techniques are used to combine data and create integrated displays.

This lecture will focus on the mechanics of registering and displaying data from different imaging studies using distinct modalities or a single modality over time. A taxonomy of the methods currently implemented in commercial and research treatment systems will be described. Methods for display and interaction with multimodality data will also be presented. The overall goal is to provide the basic knowledge required to understand what is happening “under-the-hood” of the different systems one might encounter in the clinic.

Educational Objectives:

1) Understand the basic mechanics of image registration and data fusion.

2) Understand the different registration algorithms used in commercial and research treatment planning systems.

3) Understand the different techniques used to combine, display and interact with multimodality image data.