

From the previous lectures in this series, it is clear that data from imaging modalities other than x-ray CT can help improve overall patient management in radiation therapy. In order to fully realize the benefits of multimodality imaging, however, data provided by different imaging studies must be registered to single coordinate system, typically that of the treatment planning CT. Once in a common coordinate system, data derived from the various modalities 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 from 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.