

Acquisition of anatomical 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 a fraction course of radiotherapy. Time series data from serial and 4D CT before and during the treatment course, including CT data acquired in the treatment room at the time of treatment, is also helping to estimate motion and shape changes of relevant anatomy. In order to fully realize the benefits of these data, the different imaging studies must be registered to a common coordinate system. The geometric transformation required to register the different images 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 registered, data derived from the various studies such as anatomical outlines and computed dose can be integrated or fused to help construct a more complete and accurate representation of the patient.

This lecture will focus on the mechanics of registering and displaying data from different imaging studies using distinct modalities or as a single modality over time. A taxonomy of the different methods will be described. Methods for display and interaction with multimodal 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 registration systems on which they encounter in the clinic, the different ways these systems are being used for patient management and their limitations.

#### Educational Objectives:

1. Understand the basic mechanics of deformable image registration and data fusion techniques
2. Understand the tools used to combine, display & interact with multimodality/4D image and dose data
3. Understand the clinical uses and limitations of these techniques for Tx planning, Tx delivery and plan adaptation