AbstractID: 8323 Title: Inverse Treatment Planning that Starts with a Rule-based Selection of Apertures

Inverse treatment planning for IMRT finds the weights of radiation beams based on constraints placed on target tissues and on surrounding critical normal tissues. Beamlet-based inverse planning (BBIP) can generate many hundreds of field weights by dividing the problem into a very large number of small pencil beams. A conventional multileaf collimator cannot effectively irradiate this number of beams individually, and a more manageable arrangement of fields is found through the use of interpreter (sometimes called sequencer) software. Or, a narrow window of changing width is swept across the projection of the target(s) with the radiation beam on to generate the desired intensity map. Using any of these dose delivery techniques to go from the planned intensity pattern to the actual delivered intensity distribution introduces various approximations and can increase total monitor units compared to more traditional treatment approaches. The number of field segments and the monitor units can increase if the translation from calculated intensities to MLC delivery is crude and/or if the intensity maps are noisy as a result of the optimization process.

This talk describes a new inverse planning technique that limits the number of apertures used for the inverse planning process. Interpreter software is not needed, and the approximations introduced in this step are avoided. The apertures used for the optimization are established using a set of straightforward rules. There are many advantages associated with this aperture-based inverse planning (ABIP) method for IMRT. 1) The limited number of apertures used for the optimization produces inherently smooth intensity patterns. 2) Intensity patterns are not limited to discrete levels. 3) The number of segments required to solve complex planning problems is significantly reduced relative to beamlet-based inverse planning solutions. Thus, collimator wear is reduced and respiratory gated treatment is simplified. 4) Monitor units (related to patient total body dose) are less than what is required for beamlet-based approaches. 5) Treatment verification is simplified. 6) The planning process uses a precise planning algorithm and does not require recalculation after the optimization is complete. 7) Standard monitor unit calculation schemes are used.

In order to demonstrate that aperture-based planning compares favorably with beamlet-based techniques, a number of treatment plans generated with the two methods are compared. In particular, a number of extremely difficult head and neck cases with one or two simultaneously treated boost regions in close proximity to sensitive critical structures are used as examples. Additional examples will include prostate, brain, lung and breast plans. These planning examples are compared to beamlet-based plans generated with commercial planning systems, and the comparison includes the number of segments needed to solve the particular planning problem as well as the number of monitor units required.

Course Objectives:

1) Introduce aperture-based inverse planning (ABIP) as a new IMRT planning technique.

2) Demonstrate the advantages of aperture-based planning relative to conventional beamlet-based inverse planning (BBIP).
3) Compare dose distributions for ABIP to those generated with BBIP for complex inverse planning cases.