AbstractID: 9575 Title: Bayesian Networks Applied to Inverse Planning

Current strategies for plan optimization using inverse planning suffer from several shortcomings, many of which stem from incomplete knowledge. These approaches require quantitative models of effects, however, so that trade-offs between tumor coverage and normal tissue damage are accomplished by means of very accurate mathematical optimization of very imprecise surrogates (e.g. dose-volume constraints) or models (e.g. TCP, NTCP or EUD). Inverse planning is currently plagued by the difficulties that arise from incomplete data (such as in complication probabilities), incomplete or vague prescriptions, and mutually contradictory constraints and objectives. Bayesian, or belief, networks are designed to handle incomplete information that is coupled with a causally-based model, such as is often available in a clinical setting.

There are two applications of Bayesian networks in inverse planning. They can be used in place of a cost function used in the inverse planning process. They can also be coupled with utility functions to form decision networks to aid in the selection of solutions, particularly when no solution can achieve all of the objectives.

We report on our initial work in the application of these networks to problems in inverse planning, beginning with their use as a replacement for cost functions. The advantages include (a) a formal structure for reasoning in the face of incomplete and/or probabilistic knowledge, (b) the ability to combine incommensurable factors, and (c) the ability to use clinical knowledge to build a causal network. Our model will be explained and compared to other approaches such as multi-objective optimization and neural networks.