

AbstractID: 3525 Title: Progressive Articulation of Radiotherapy Planning Goals Based on Soft-Constraints

Purpose:

Inverse-planning in radiation therapy is involved with multicriteria decision-making problems as it aims to achieve multiple planning goals that are conflicting with each other in target(s) or surrounding healthy tissues. To facilitate an intuitive and explicit way of articulating planning goals, the concept of *soft-constraints* has been implemented into our in-house IMRT planning system using a Goal Programming (GP) technique. In addition, traditional linear GP has been extended to handle nonlinear goal functions so that the nonlinear metrics highly relevant to clinical protocols (such as DVH, EUD, TCP, and NTCP) can be directly utilized in the planning process.

Method and Materials:

In order to achieve a high convergence speed of the optimization, a gradient-based, nonlinear constraint search algorithm has been used in the implementation of nonlinear GP. The system is designed to handle multiple goals either by a weighted-sum approach (*Archimedean GP*) or lexicographic ordering (*Preemptive GP*). For some planning criteria exhibiting poor numerical performance for gradient searches (e.g., min, max, DVH), surrogate models have been used in such a way that the general idea of soft-constraint is consistently maintained.

Results:

For clinical IMRT cases, the nonlinear GP provides a fast and practical approach to articulate planning goals. Moreover, prioritization of planning goals based on their importance significantly simplifies the RT multicriteria problem representations. The Lagrangian Multiplier values obtained after each level of optimization facilitate informed decisions on goal tradeoffs between different priority levels.

Conclusion:

The soft constraint concept has been implemented for clinically relevant nonlinear criteria in RT inverse planning. Due to the fast search convergence exhibited by the present system, the planning process can be interactive with the decision maker in setting or adjusting appropriate goal levels, leading to progressive tailoring of the individual plan results.

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