ALGORITHMS FOR SATISFYING DOSE-VOLUME CONSTRAINTS IN INTENSITY MODULATED RADIATION THERAPY

Gabor T. Herman
The Graduate Center of the City University of New York
New York, New York, USA

This is joint work with Wei Chen and Yair Censor.

In intensity modulated radiation therapy (IMRT) we need to deliver a sufficient dose to target volumes (e.g., cancerous tumors) to destroy them, but at the same time we have to be careful that we do not destroy sensitive essential organs. In an ideal plan (one in which all target locations get a dose sufficient for destruction and yet all locations within an organ at risk receive the same absolutely safe dose), these dual requirements can be expressed by a system of linear inequalities, in which the unknowns are the intensities to be delivered in the beamlets of the IMRT device (assuming that the dose delivered to any point in the body depends linearly on the unknowns).

It is often the case that the system of inequalities that results from an ideal plan cannot be satisfied. In such a case, it is reasonable to relax the conditions so that a specified percent of the volume of an organ at risk may receive a dose in access of what is absolutly safe, but still not more dose than a specified higher threshold for safety. Finding a solution to a problem that involves such dose-volume constraints is inherently more complex than finding a solution for a feasible ideal plan.

In this presentation we discuss two approaches for solving problems with dose-volume constrains: one involves linear programming and the other is an adaptation of a projection method for solving feasible systems of linear inequalities. The two approaches are experimentally compared according to their ability to find a solution when there is one and according to their computational speed in case both of them succeed to find a solution.