Radiation Therapy Treatment Plan Optimization: Models and Algorithms

We consider the problem of determining high-quality radiation therapy treatment plans for cancer patients. Since radiation therapy kills both cancerous and normal cells, the treatment must be carefully planned so that a clinically prescribed dose is delivered to cancerous cells while sparing normal cells in nearby organs and tissues to the greatest extent possible. Since there exists no fundamental model for quantifying the trade-off between the preservation of healthy or functional tissues, and hence the quality of a patient’s life, and the probability of eradication of the patient’s disease, accurately modeling the treatment plan optimization problem is a challenge. The first part of the talk will address this issue by formally comparing many of the models that have been proposed to date. In the second part of the talk, we will focus on a particular family of models and formulate an integrated model for intensity modulated radiation therapy (IMRT) treatment plan optimization that incorporates several treatment delivery aspects that have to date mainly been handled in a post-processing phase. We develop a column generation algorithm for solving this problem, study the associated pricing problem, and present some results on clinical cases.