

Optimal Modality Selection in Radiotherapy

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Abstract: The goal in external beam radiotherapy (EBRT) for cancer is to maximize tumor-kill, while limiting toxic effects on nearby organs-at-risk. EBRT can be delivered via modalities such as photons, protons, and neutrons. The choice of an optimal modality depends on the anatomy of the irradiated area and the relative physical and biological properties of competing modalities. There is no universally dominant modality. In this talk, I will present a mathematical formulation of the optimal modality selection problem. I will demonstrate that this problem can be tackled by solving the Karush–Kuhn–Tucker conditions of optimality, which reduce to an analytically tractable quartic equation. If time permits, I will discuss an extension of this model, where uncertainty in physical and biological properties is incorporated via an infinite-dimensional robust formulation. I will explain how this robust formulation can be decomposed into a finite set of finite-dimensional problems. Each of these problems is again analytically tractable via Karush-Kuhn-Tucker conditions. I will conclude with numerical results that offer clinically relevant insights into the optimal modality selection problem. This talk is based on published work co-authored with Sevnaz Nourollahi and Minsun Kim.

Bio: Archis is a Professor and Associate Chair in the Department of Industrial & Systems Engineering at the University of Washington in Seattle, where he currently holds the College of Engineering Professorship in Healthcare Operations Research. He joined the University of Washington as an Assistant Professor in 2006 after receiving a PhD in Industrial and Operations Engineering from the University of Michigan in 2006, and an MS in Management Science and Engineering from Stanford in 2003. He completed his undergraduate education at the Indian Institute of Technology, Bombay, India, in 2001. His field of study is Operations Research with a methodological focus on stochastic optimization. Archis is a recipient of the NSF CAREER award, and of the award for Excellence in Teaching Operations Research from the Institute of Industrial Engineers.