

AbstractID: 2063 Title: Theoretical Considerations of Spectrum Reconstruction from Measurements

There are three ways to determine the spectrum of a clinical photon beam: direct measurement, modeling the source, and reconstruction from ion-chamber measurements. We focus on reconstruction because the necessary equipment is readily available and it provides independent confirmation of source models for a given machine. Reconstruction methods involve measuring the dose in an ion chamber after the beam passes through an attenuator. We gain information about the spectrum from measurements using attenuators of differing compositions and thicknesses since materials have energy dependent attenuation. Unlike other papers we're not discretizing or parameterizing the spectrum. With either of these two approximations, reconstruction is a least squares problem. The forward problem of going from a spectrum to a series of dose measurements is a linear operator, the composition and thickness of the attenuators are parameters. Hence its essential features are characterized by its singular value decomposition (SVD). The measurable components are multiples of the right singular vectors corresponding to the singular values that are larger than some characterization of measurement uncertainty. We simulated the reconstruction of a spectrum from sets of measurements using various attenuating materials and thicknesses. Our simulations show that four components of the spectrum are determined using a small set of measurements, but a large number of measurements does not reveal more components of the spectrum.