**Objective**

To provide a setting for the equipment in terms of geometry and energy which minimizes the absorbed dose in a critical organ while maintaining image quality.

**Introduction**

- Imaging modality: Fluoroscopically Guided Interventional (FGI).
- The X-ray path passes through the patient while attenuated while interacting with the different internal structures of the body, a shadow of the structures constructs the digital image.
- Two major types of risks: deterministic (skin injuries) and stochastic effects (cancer induction).
- Any amount of the absorbed radiation in the body is a risk of cancer induction.

**FGI Modality**

- More than 700,000 fluoroscopic examinations are performed every day in the US.
- A linear, no-threshold (LNT) model illustrates the dose and cancer risk relationship (Nuclear Regulatory Commission (NRC)).
- A study on women who received chest X-rays: young women who receive repeated X-rays with breast tissue included in the beam interception region with body, having about 9 times higher potential risk of breast cancer for the ages ≤40 in compare with ages >40.

**Mathematical Model**

Min $\sum_{(i, j, l), p} \delta_{(i, j, l), p} c_{i, j, l, p}$

Subject to

- Constraints to identify which pseudo pixels of the detector are in the field.
- Constraints to linearize the objective function

**Notations**

- $E_0$: Initial energy of each beam at source
- $E_{ij}$: energy of beamlet $i'j'$ at level $l_p$
- $\gamma_{i'j'}$: indicator of beamlet existence in the field of radiation
- $x_i, y_j, z_l$: table increments in each direction
- $\psi_{(i, j, l), p}$: indicator of voxel $i, j, l, p$ of body interception with beamlet $i'j'$

**Computational Results**

Using polyhedral analysis, we added strong valid inequalities to the lazy cut pool. We solved test problems for cardiovascular exams where patient breasts are critical organs and patient heart is organ of interest. We performed preprocessing search algorithm based on the known angle geometry and corresponding location of the Region of Interest to speed up the computation using CPLEX12 and Concert library. Before preprocessing algorithm, the optimality gap was 100% and the computation speed was very slow.

**References**