

**Purpose:** We design and implement linear programming based IMRT treatment plan generation technology that effectively and efficiently optimizes beam geometry as well as beamlet intensities.

**Method:** To overcome the limitations of nonlinear and/or mixed integer programs associated with dose-volume constraints, we adapted the conditional value-at-risk constraints (C-VaR constraints) which are popular and commonly used in financial engineering. The use of C-Var constraints has significant computational advantages as they can be handled using linear programming models, which are easily and efficiently solved. However, the parameters controlling the C-Var constraints have to be chosen carefully to get an accurate approximation of the dose-volume constraints. The treatment plan generation technology, which is based on an optimization model using C-Var constraints, embeds an effective and efficient parameter search scheme to ensure high-quality approximations of the dose-volume constraints. We will report on application of the system to three patient cases: head-and-neck cancer, prostate cancer and pediatric brain tumor.

**Results:** The utilization of our system returned optimal treatment plans for a variety of cases. Optimal beam selection, as created by our software, generally improves the coverage and conformity of the treatment plan without sacrificing normal tissue sparing. There are generally limits to how much the solution is improved by adding additional beams which vary from case to case. Computational time was generally a fraction of the time that mixed-integer solutions would take.

**Conclusion:** Developed treatment plan generation technology optimizes both beam geometry and beamlet intensities in a short amount of time. The technology is fully automated and generates several high-quality treatment plans satisfying the provided minimum requirements in a single invocation and without human guidance.