To automatically optimize the dose distribution of transperineal ^{125}I or ^{103}Pd permanent implants based on minimum peripheral dose, dose uniformity, sparing of urethra and a minimum number of needles.

The minimization cost function takes into account four clinical criteria: 1) a minimum peripheral dose, 2) dose uniformity throughout the target volume, 3) transverse needle scheme distribution (with minimization of their numbers) and 4) prevention of hot dose spots in a region around the urethra. The simulated annealing algorithm allows seed and needle positions to be varied and their number reduced to optimize the cost function.

The optimization can be completed within 100000 iterations, approximately 10 minutes on a Sun SPARC5 workstation. The dose distribution is characterized by the prescribed isodose following the shape of the prostate contours with a proper margin. The prostate DVH for the prescribed dose is generally larger than 99 %. The post-implant DVH (calculated with TG43 constants) was found to be higher than 90% with a maximum dose to the urethra at 200% of the prescribed dose.

The cost function closely related to the clinical criteria and fast simulated annealing allow for consistent and automatic determination of seed and needle distributions resulting in an optimized dose distribution customized for each patient and independent of the dosimetrist experience. The algorithm has been fully implemented clinically and was used for the planning of 90 patients treated with prostate implants. The outcome is a better dose distribution and obtained much faster than what can be achieved without automation.