

COMPARISON OF “CD” AND “ADJOINT-RATIO”

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April 4, 2008

Current-displacement (CD) has been implemented as a greedy criterion, and the results are compared with equivalent problems using a criterion based on the so-called *adjoint-ratio* (referred to as GDY throughout). The problem presented uses one two-dimensional slice from a patient prostate model that had been previously studied in the original work on Greedy methods. Here, the problem is run for four separate cases, namely problems employing:

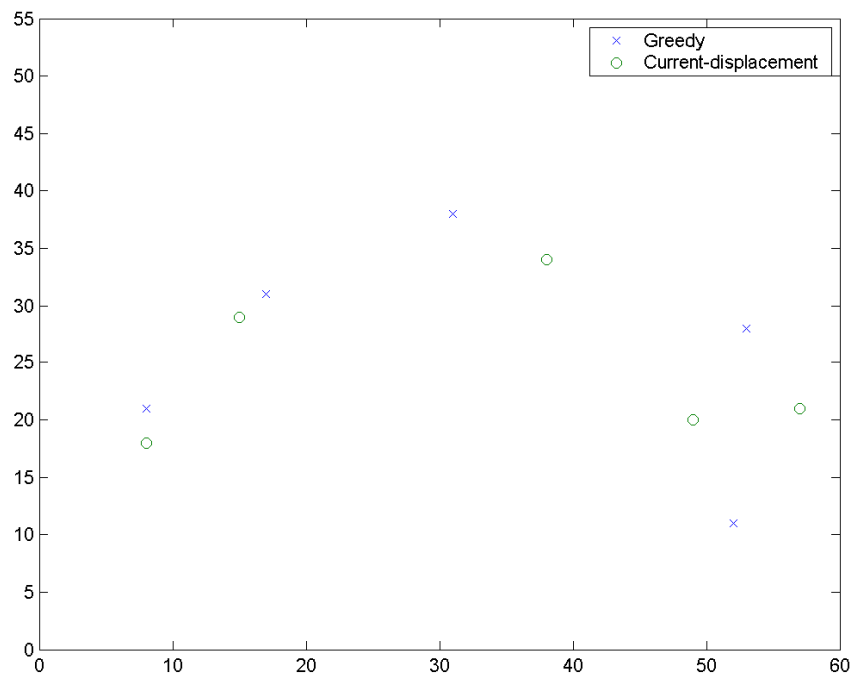
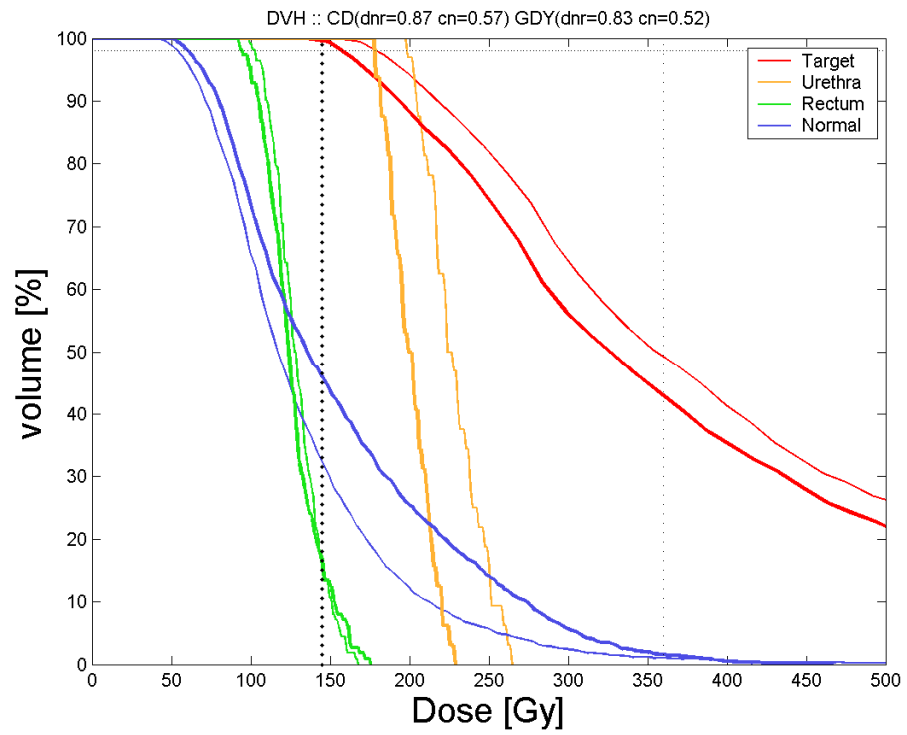
1. *seeds of strength 6U and no grid* (where U is the 0.4 mCi source strength seed; grid refers to 5mm by 5mm treatment grid)
2. *seeds of strength 6U with grid*
3. *seeds of strength 2U and no grid*
4. *seeds of strength 2U with grid*

Special attention was given to seed strength because the two-dimension problem gives rise to difficulties not seen in three-dimensional problems. Because we are using two-dimensional physics, the flux and current profiles for the seed necessarily fall off less quickly than do those quantities on the midplane (perpendicular to the seed axis) for a true seed. This is due to the two-dimensional seed model being essentially an “infinitely long” seed. Additionally, being confined to a plane precludes many of the many better solutions found in a three-dimensional solution space. To account for these issues, the seed strength essentially was boosted such that the final result first needed no more than about 10 seeds (seeds of strength 6U) and then about 15 seeds (2U).

The CD algorithm uses “dose-update” as a means to spread out seeds; it is the same mechanism used in the GDY method. Subsequently, these results give a very clear idea of how much better the use of (adjoint) currents are as compared to (adjoint) fluxes.

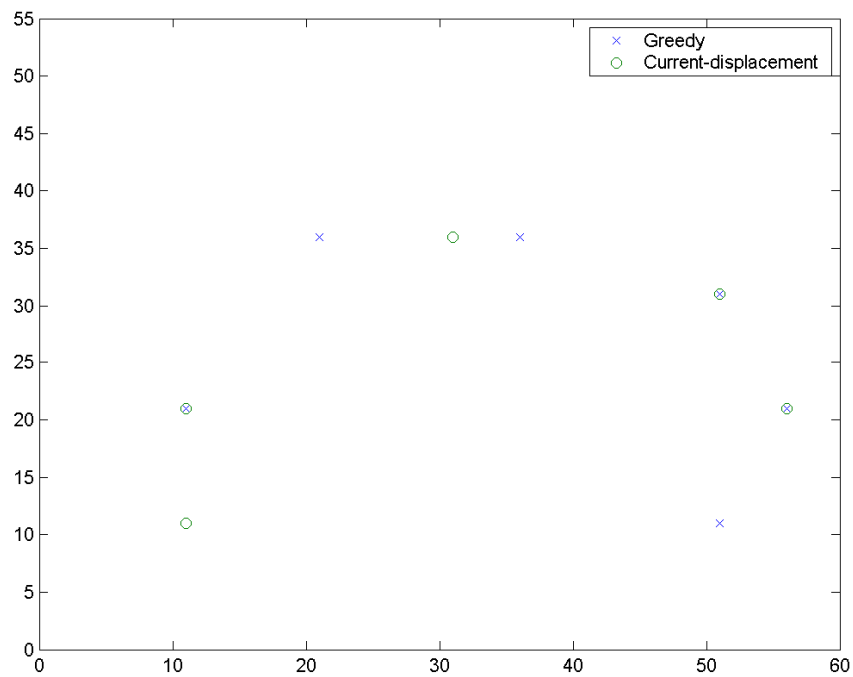
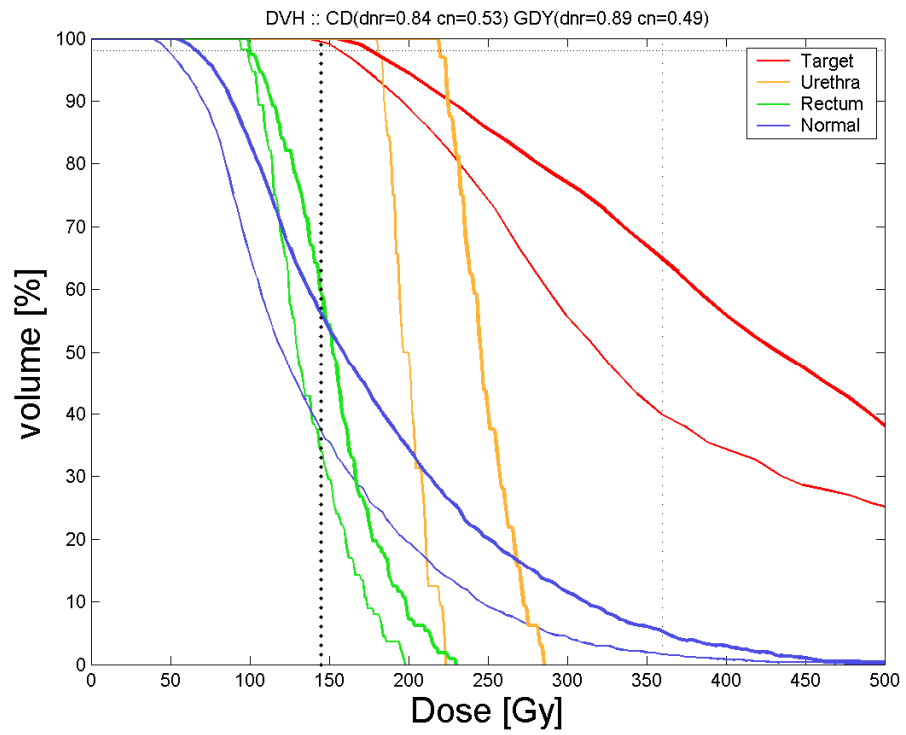
The following present only the pictures. The CD results are the thinner lines; the GDY the bolder lines. Moreover, the CN and DNR values are given in the title of the DVH plots. An additional set of plots is given for CD results using an modified dose-update scheme in which the *squared-dose* is applied.

Problem 1: Seeds of strength 6U and no grid



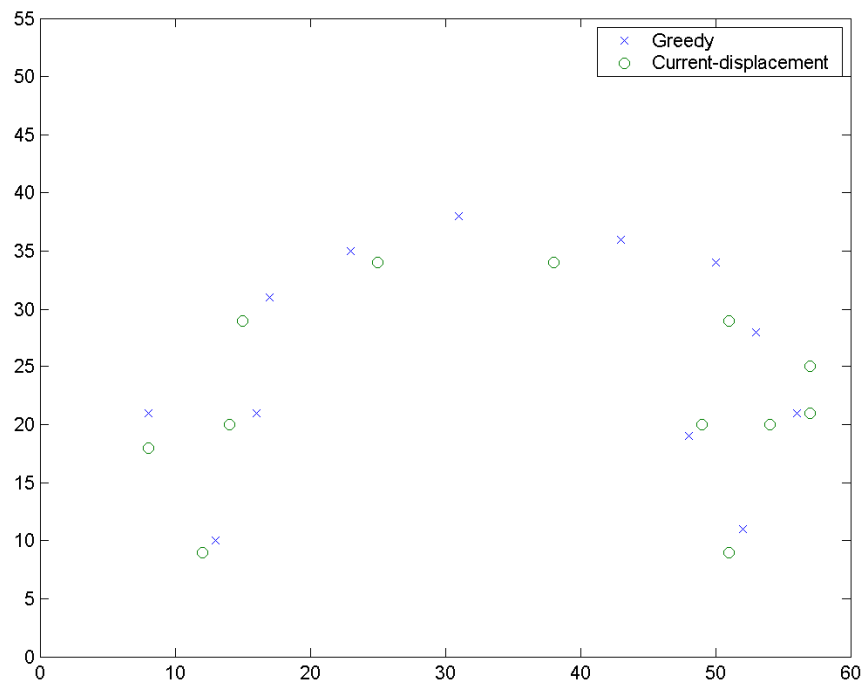
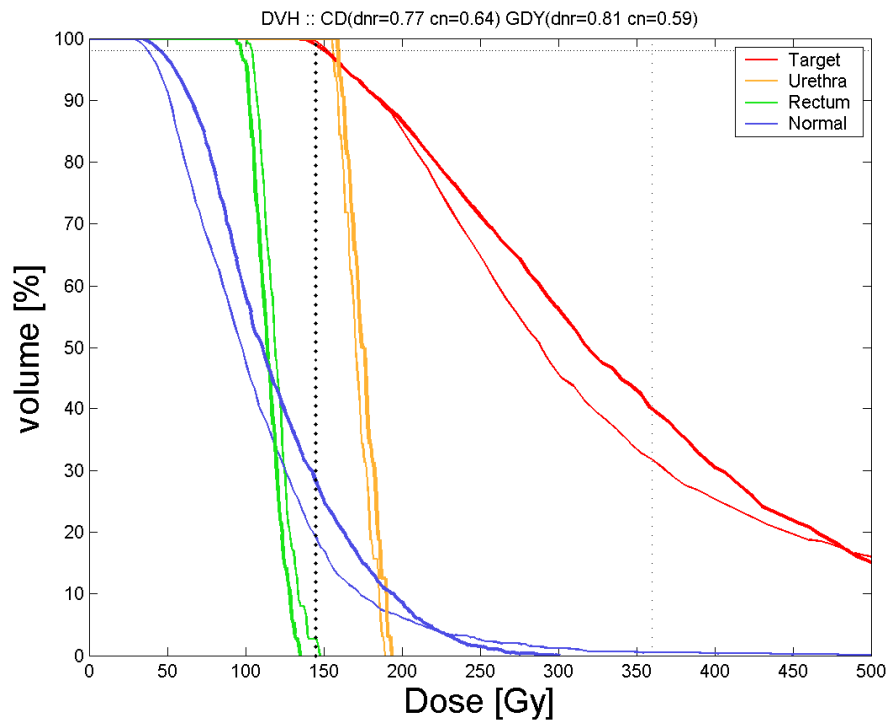
CD → 5 seeds, GDY → 6 seeds

Problem 2: Seeds of strength 6U with grid



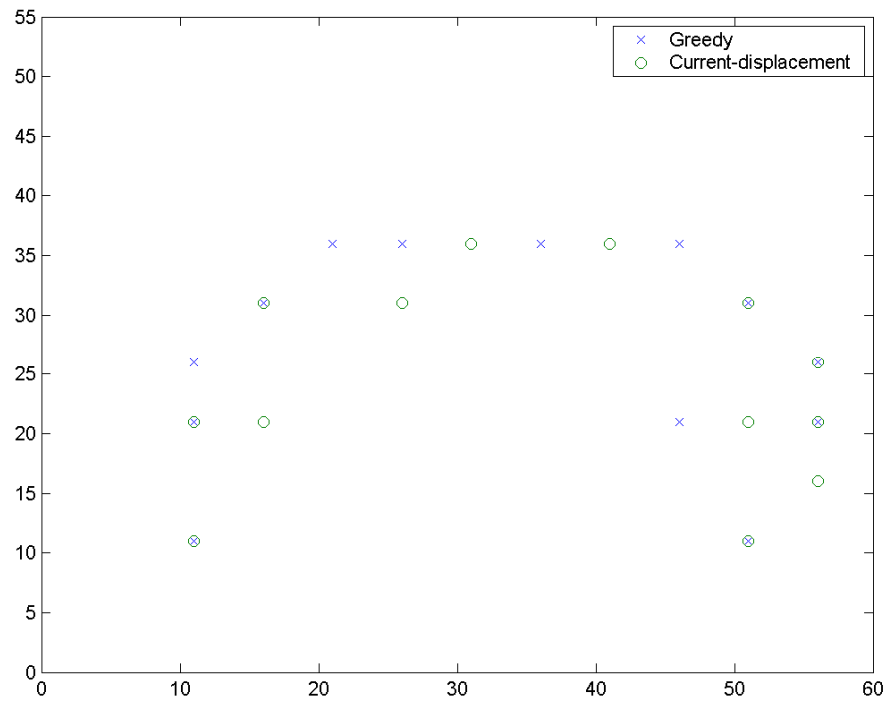
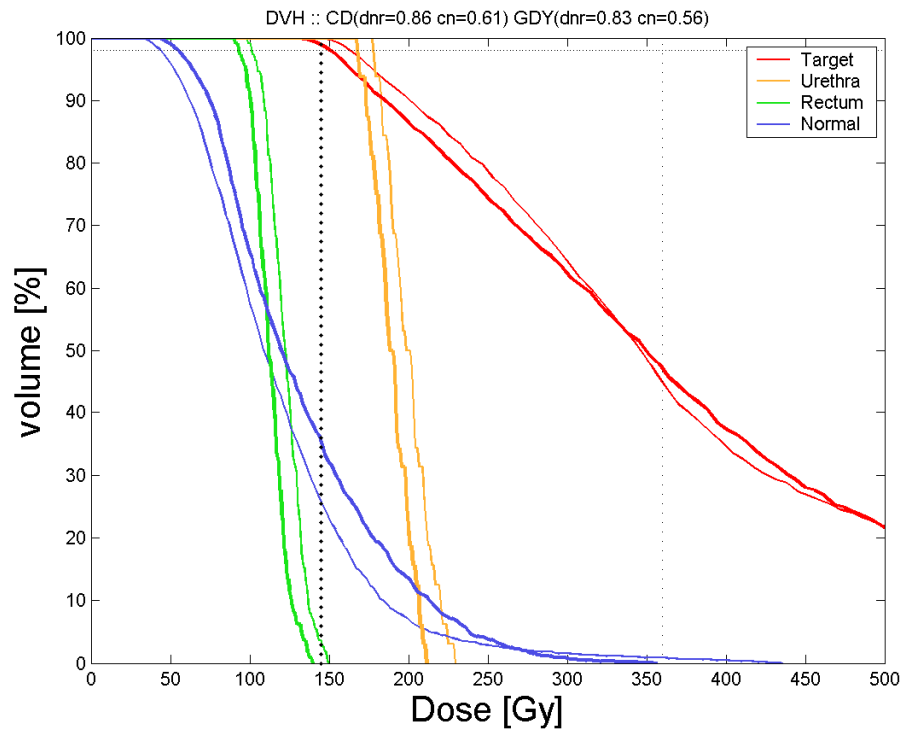
CD → 5 seeds, GDY → 6 seeds

Problem 3: Seeds of strength 2U and no grid



CD → 12 seeds, GDY → 12 seeds

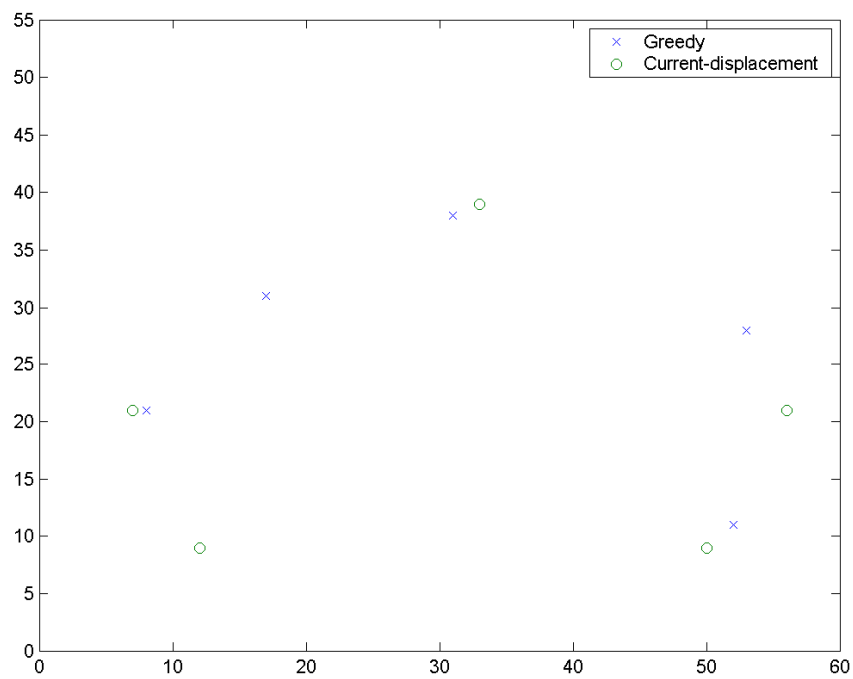
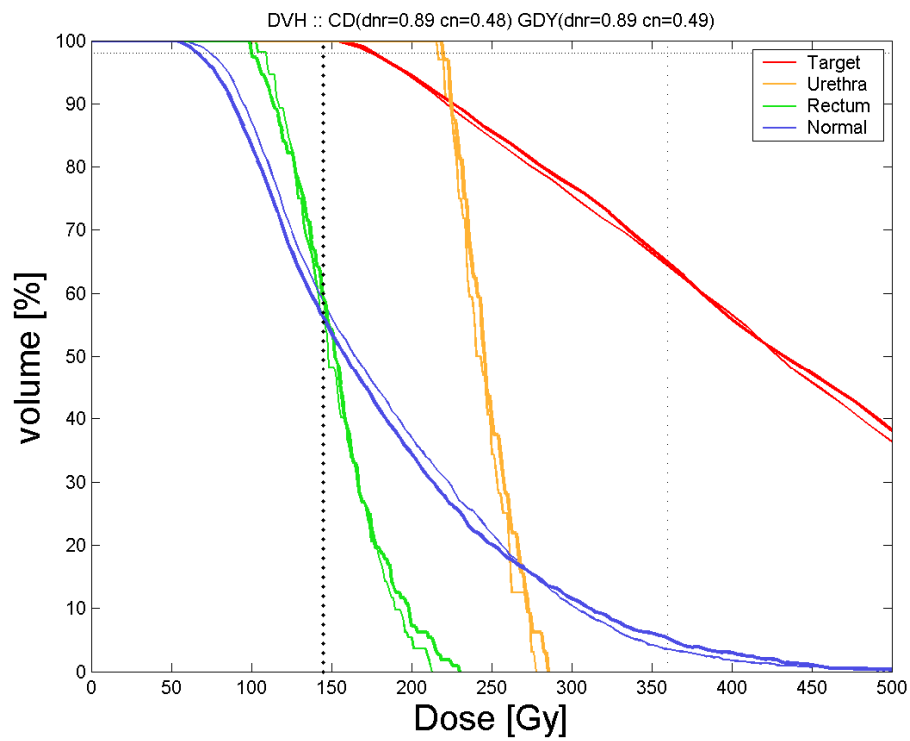
Problem 4: Seeds of strength 2U with grid



CD → 13 seeds, GDY → 13 seeds

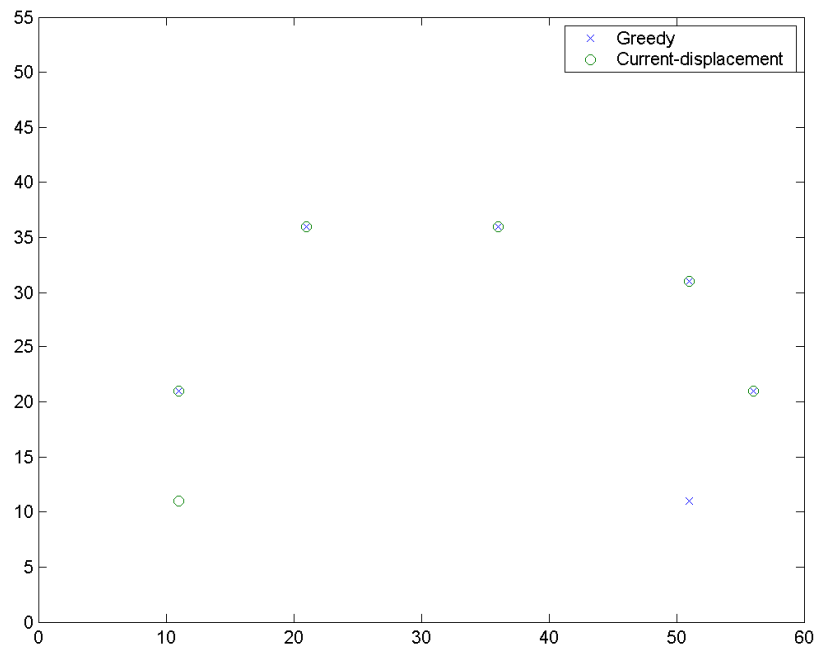
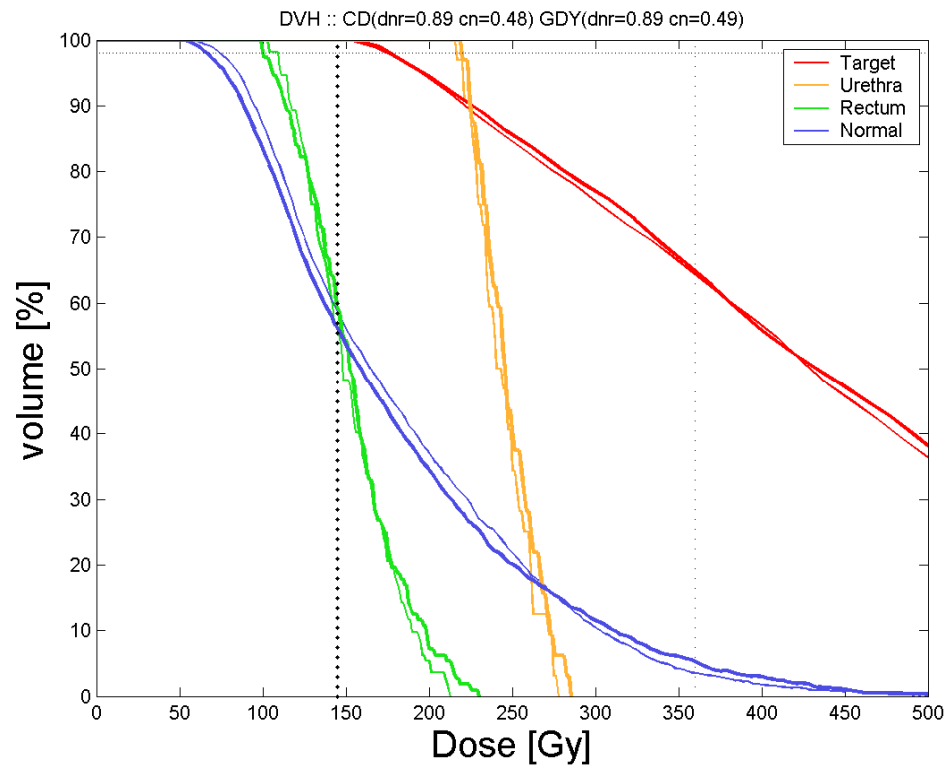
The CD as applied in the following uses a modified dose update in which the dose is squared.

Problem 1b: Seeds of strength 6U and no grid



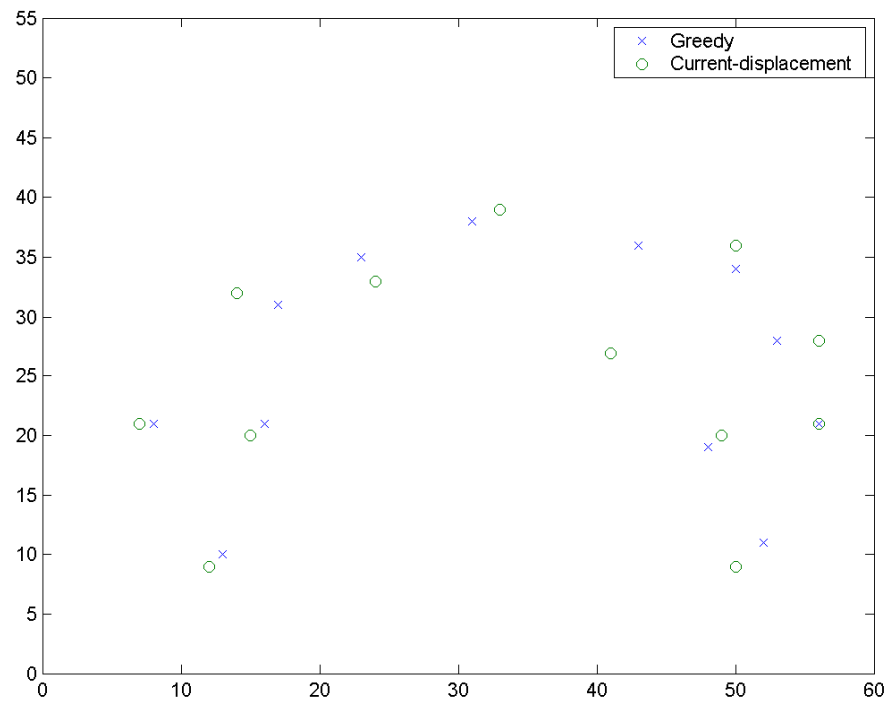
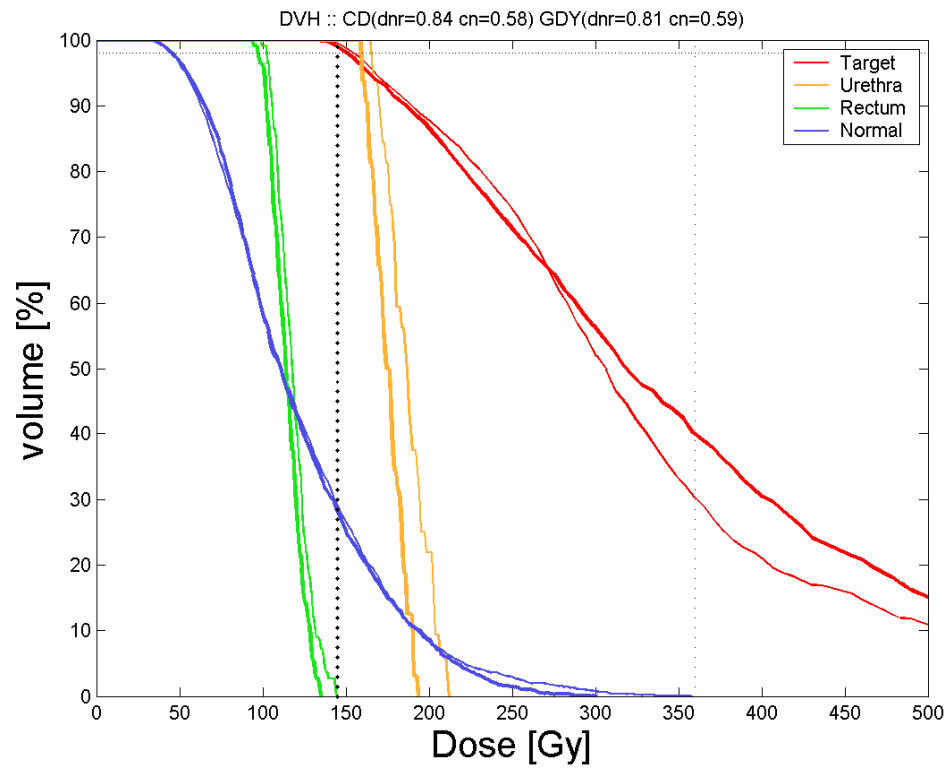
CD → 5 seeds, GDY → 6 seeds

Problem 2b: Seeds of strength 6U with grid



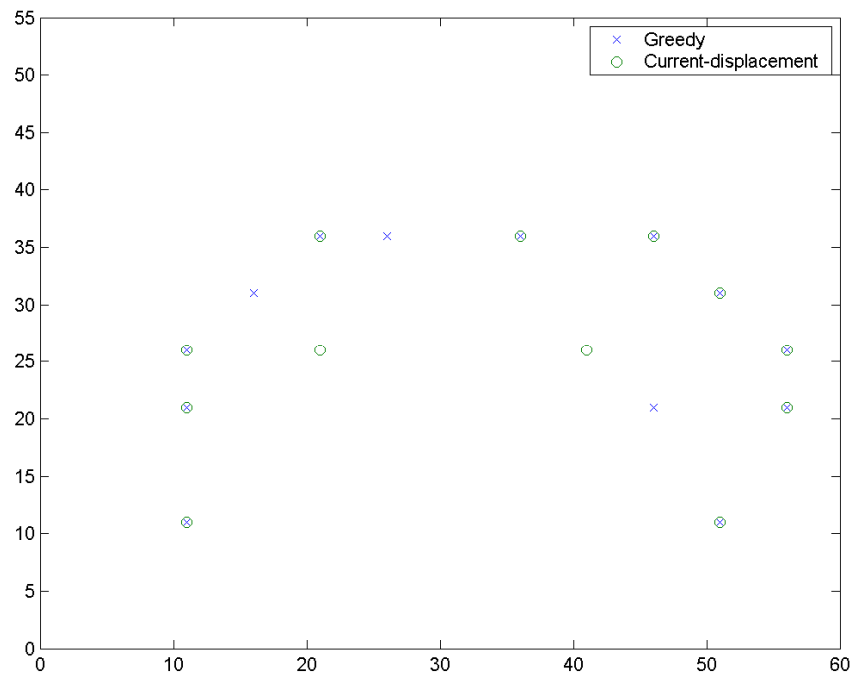
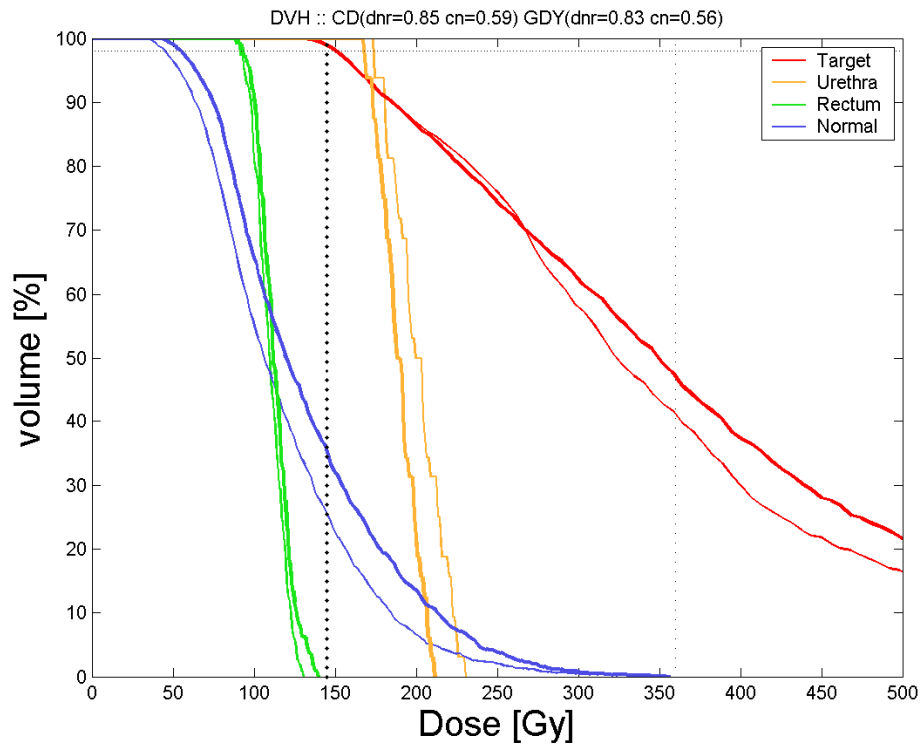
CD → 6 seeds, GDY → 6 seeds

Problem 3b: Seeds of strength 2U and no grid



CD → 12 seeds, GDY → 12 seeds

Problem 4b: Seeds of strength 2U with grid



CD → 12 seeds, GDY → 13 seeds