Developments

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1 Algorithm

This is the implemented algorithm:

1. Read patient data
2. Raytrace each spot in CT to get endpoint coordinates
   (a) Lose energy voxel-by-voxel
   (b) Stop if outside of CT or no energy
3. Probe vector field at the endpoint positions
4. Apply VF at endpoints
5. Apply VF at starting points keeping the same treatment plane
6. Raytrace each spot in the CBCT to get endpoint coordinates
7. Compare with warped endpoint calculated at step 5 (already along the same line, only depth difference)
8. Assign 160MeV and move to the warped endpoint. Store the energy lost in it and its sign.
9. Export tramp file for MC simulation

The adaptation is then:

- XY inside the treatment plane as given by the VF for each spot
- Energy as given by the range difference at last steps

Problems so far? Sure:

Is the VF probing done at the appropriate position?

Warping the endpoint and entrance point should not be done in parallel. When going further from the tramp center, a bigger angle should be applied!

This effectively removes the layer organization in positions and energies.

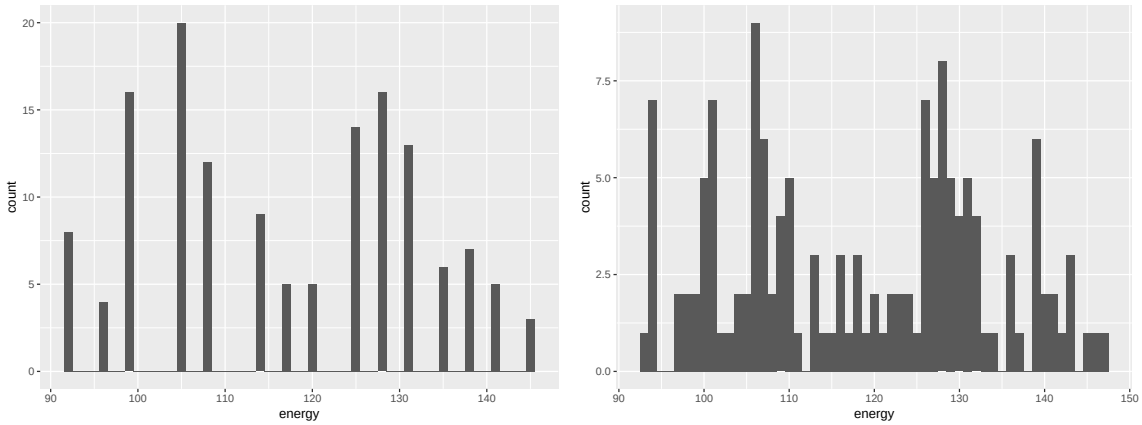

Figure 1: Histogram of the energy shifts.

2 Ray Tracing validation

The algorithm does a good job in predicting the range.

1. A single ray is initialized per spot.
2. The ray losses energy following the CSDA.
3. When the ray has zero energy the endpoint is scored.

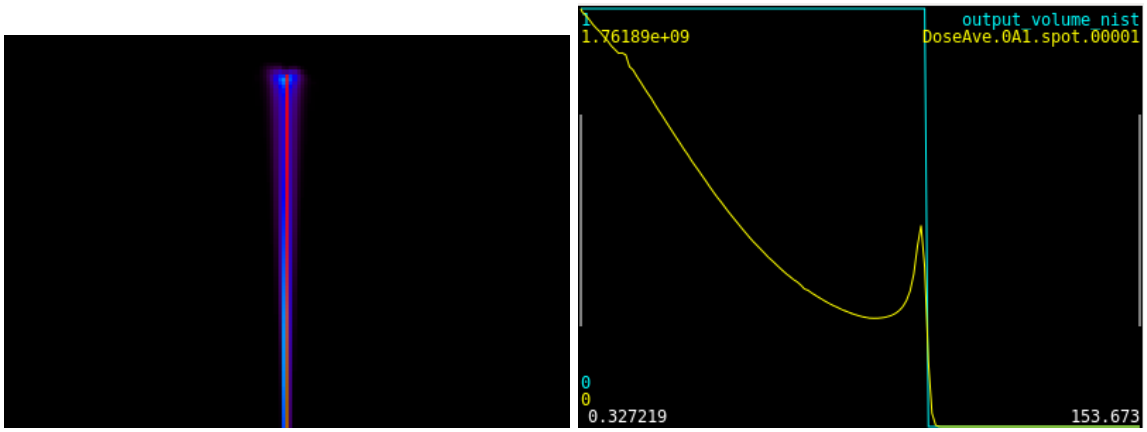

Figure 2: Beam with no σ and ϵ in a patient (P15) and ray traced trajectory.

3 Vector field probing

It is done through Plastimatch, growing concerns here.

4 Early results

Applying the first version of the code to patient 1:

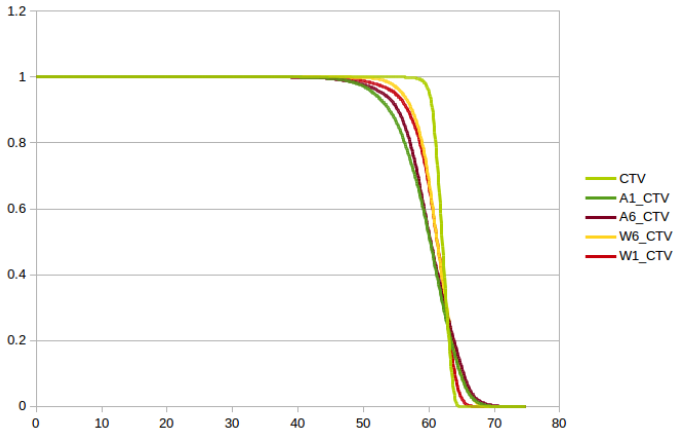

Figure 3: DVH of different stages during treatment.