Wednesday, 19 May 2021 HITRIplus Heavy Ion Therapy Masterclass School
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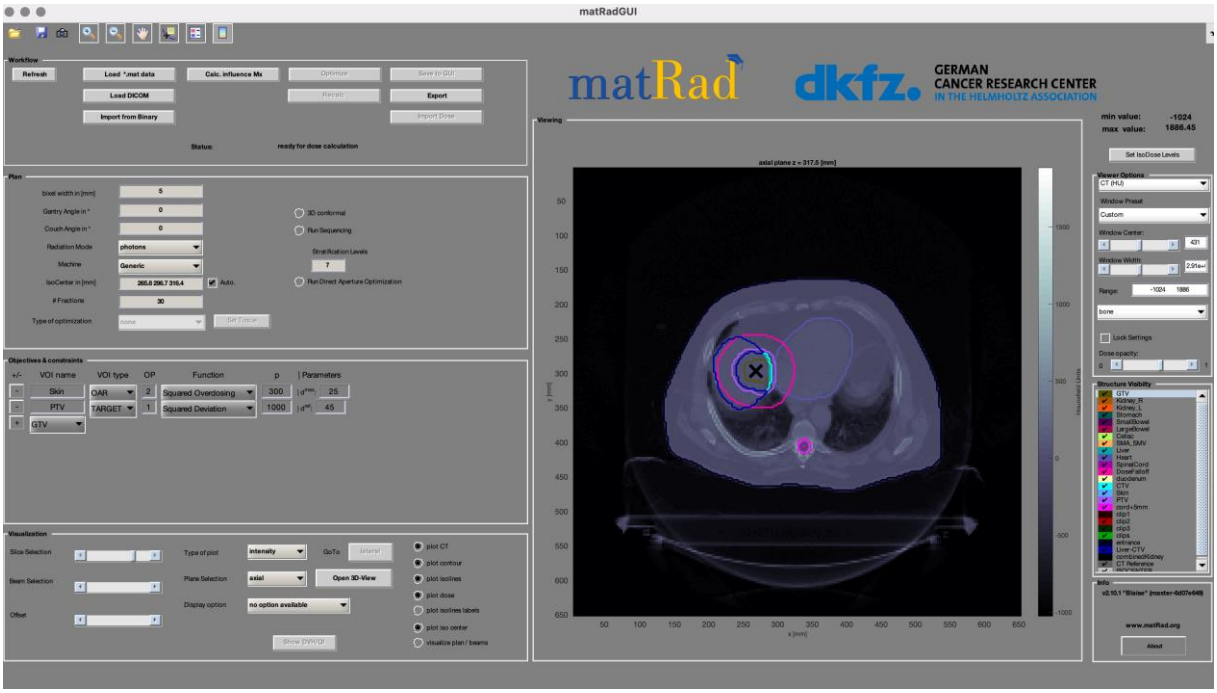
Hands-on treatment planning with matRad

Session 2: A glimpse at uncertainties

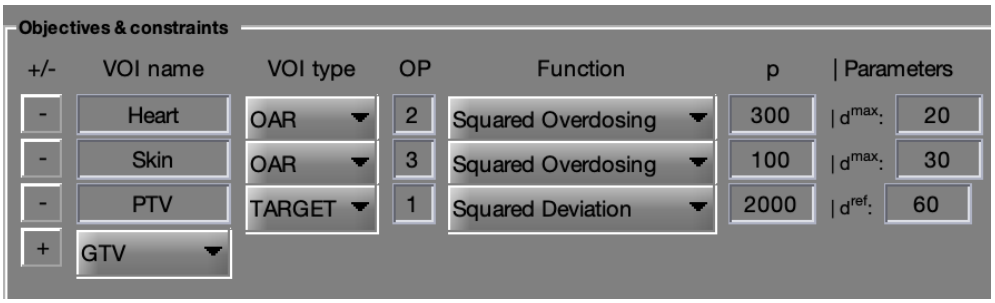
Task 1: Introduction to uncertainties on the LIVER case

Open Matrad User Interface

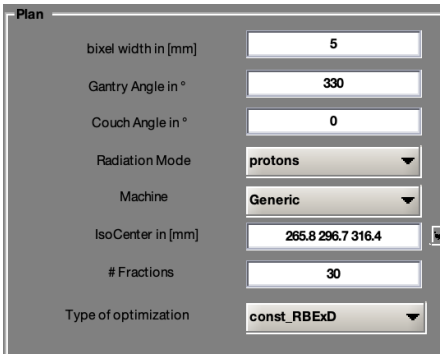


Load *.mat data and choose LIVER.mat

Choose the following objectives



Choose the following plan parameters



Enable the visualization of the beam angles.

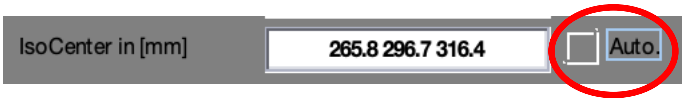
Calculate the dose influence matrix by clicking Calc influence Matrix

Then click Optimize

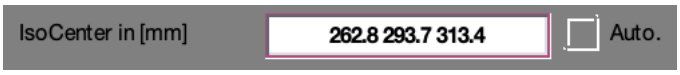
Save your dose to the list with Save to GUI and choose a name (e.g. **proton1beamNOshift**). You can export an image using the screenshot button:

Use Show DVH to see the DVH and dose metrics for all OARs and target (you can also export an image for your report)

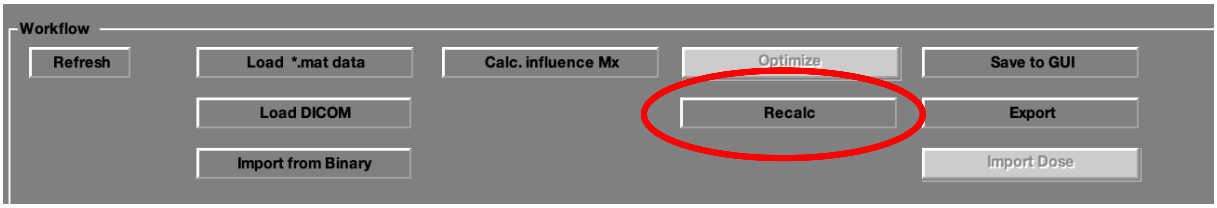
Uncheck the box right next to the iso center in the Plan parameter settings



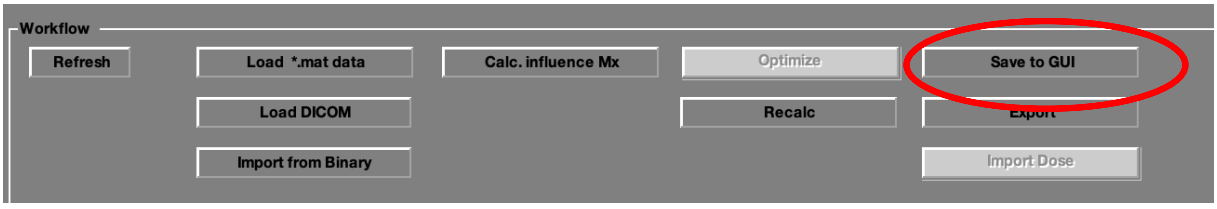
Enter a new iso-center position e.g. subtract 3mm in x, y, z dimension



Recalculate the dose with Recalc for the shifted patient geometry.

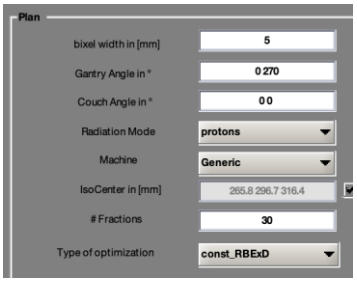


Save the re-calculated treatment plan for the shifted patient geometry using Save to GUI and choose a name (e.g. **proton1beam3mmshift**)



Compare the D95 dose and the DVH for the PTV and CTV for these two dose distributions

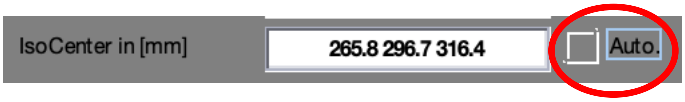
Choose now two proton beam angle (e.g. 0 and 270) and redo everything and look at individual beam doses.



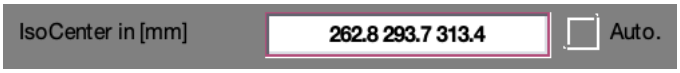
Switch the radiation modality to photons and find a satisfying treatment plan with multiple photon beams. Alternatively also a single beam direction can be used.

Save the treatment plan Save to GUI (e.g. **photon_noShift**)

Uncheck the box right next to the iso center in the Plan parameter settings



Enter a new iso-center position e.g. subtract 3mm in x, y, z dimension

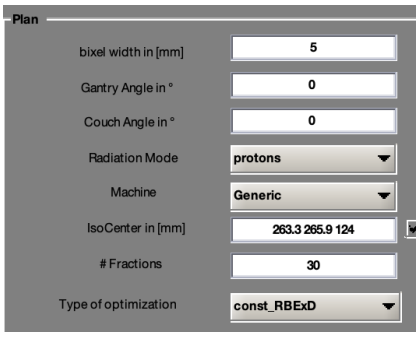


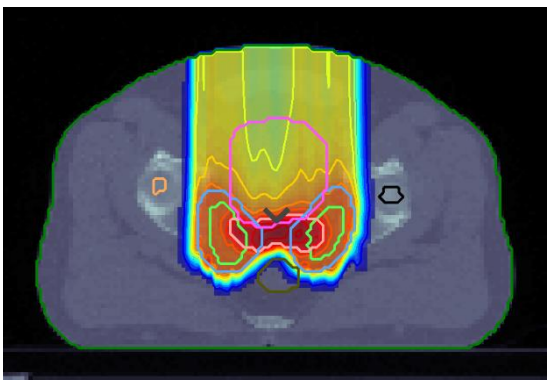
Then Recalc the dose distribution for the shifted geometry and click on Save to GUI and choose a name **photon_3mm shift.**

Analyse the plan – what differences to the proton (IMPT) treatment plan can be observed?

Task 2: Density Scaling – 1 beam on the prostate case

Click on Load *.mat data and load the prostate.mat case.





Create a treatment plan with a single proton beam coming from 0 degree gantry angle. Click on Calc.Influence and then on Optimze to derive the treatment plan.

Look at the DVH and save the plan (e.g., call it proton1_nominal)

For those with the code & Matlab (not working with standalone):

Go to the command window and execute the following commands simulate previously overestimating the rSP:

```
ct = matRad_calcWaterEqD(ct,pln);
pln.propDoseCalc.useGivenEqDensityCube = true;
ct.cube{1} = ct.cube{1}*0.965;
```

Then Recalc the dose distribution for the downscaled rSP values.

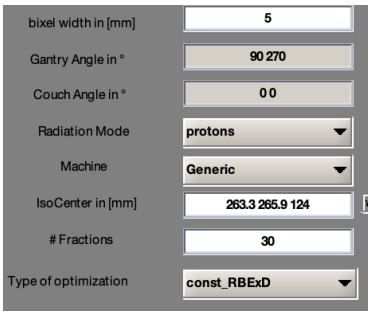
Look at the DVH and save the plan (e.g., call it proton1_overshoot). What happened?

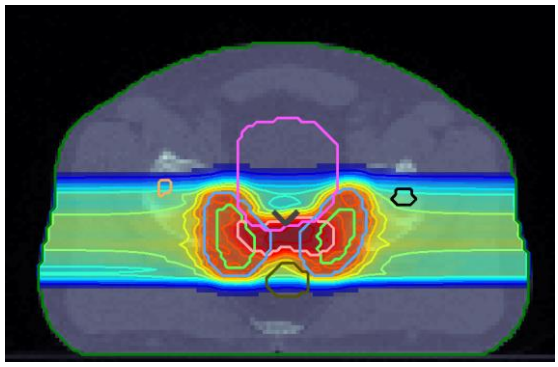
Finally, reset the following setting to false in the command window:

```
pln.propDoseCalc.useGivenEqDensityCube = false;
```

Task 3: Density Scaling and Shifting – 2 opposing proton beams on the prostate case

Create a treatment plan with opposing beams (i.e., 90 & 270 degree couch angle). Click on Calc.Influence and then on Optimze to derive the treatment plan.





Look at the DVH and save the plan (e.g., call it proton2_nominal)

For those with the code & Matlab (not working with standalone):

Go to the command window and execute the following commands to simulate previously underestimating the rSP:

```
ct = matRad_calcWaterEqD(ct,pln);
pln.propDoseCalc.useGivenEqDensityCube = true;
ct.cube{1} = ct.cube{1}*1.035;
```

For all of you:

Additionally, we want to assume a patient shift like in task 1:

Uncheck the box right next to the iso center in the Plan parameter settings

Enter a new iso-center position e.g. subtract 3mm in x, y, z dimension

Then Recalc the dose distribution for the shifted geometry and click on Save to GUI and choose a name (e.g., proton2_shiftscale).

Analyse the plan – what differences can be observed?