Weekly Update - Week of 29 April 2018

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1 Past Week

This **past week** I was primarily working on **three** things:

1. **Getting my workstation set up and running**
   - The following installations that are worth mentioning were made on the local machine:
     (a) Homebrew: package manager for Apple computers that allow one to access software necessary to do scientific computing
     (b) MacTex: distribution allowing macOS devices to compile LaTeXcode
     (c) Visual Studio Code and TeXstudio: Text editors that facilitate coding with shortcuts and fancy syntax highlighting and completions. For Python/C++ code and LaTeXcode, respectively.
     (d) iTerm2: a better terminal for macOS that is much more customizable and has better shortcuts and integration
     (e) Anaconda: scientific Python distribution that comes with its own package manager. Facilitates scientific computing by coming with the most commonly used packages for scientific computing in Python and also provides its own editor (Spyder) that is good for analysis of numerical outputs.
     (f) SourceTree: a GUI for git. Makes it easier to visually see what is going on when working to push changes
     (g) XQuartz and xmgrace: Allows for the X11 tunneling and functioning of egs_view and 3D Dose tools from the cluster on the local machine
   - Set up my own home area on the cluster and got it ready for computing
     – Installed EGSnrc with egs_brachy
     – Completed a working .cshrc file that allows for ease of navigation as well as has aliases, previously defined, that make using the cluster much easier
     – Compiled egs_view and got it to communicate with the local workstation
2. **Exploring the examples given in the egs_brachy user code**
   - Looked at the different examples to see how egs_brachy codes work
   - Performed an experiment to see what happens when the padding on the outside of the scoring phantom is removed
   - Intuitively would think that removing the outside padding would result in a lower dosage on the scoring phantom as backscatter events from the surrounding media would be lost if the surrounding media were to be removed.

- Worked with the example file "ex_prostate_permanent_implant.egsinp" and simply changed the final simulation geometry or the geometry of the surrounding box
- Figure 1 shows the dose volume histograms for 3 different configurations
  - As we can see for this histogram, removing the padding clearly results in the lowering of the average dose.
- Figure 2 shows the cumulative dose volume histogram for the 3 different configurations

3. **Reading on fundamentals of radiation dosimetry**
   - Finished Chapters 1-6 of Mayes, Nahum & Rosenwald's Handbook of Radiotherapy Physics
   - Of particular interest to me from this reading that I learned are the following:
     - Different interactions of charged particles with matter including elastic scattering and brehmmstrahlung
     - Concept of stopping power and its relation to the so-called "Continuous Slowing Down Approximation (CSDA)"
     - Learned about mass energy abosorption coefficients $\frac{\mu_{\text{en}}}{\rho}$ and their relation to mass attenuation coefficients
     - Different interactions of radiation (light) with matter including photoelectric effect, Compton effect, pair/triplet production, and coherent scattering
     - Relation of fluence (particle and energy) to kerma; relation of kerma to dose; relation of fluence to dose
     - Concept of "Charged Particle Equilibrium (CPE)" and how it is able to directly relate dose to collision kerma
4. **Read Lymperopoulou *et al.* (2004)**
   - Got a basic idea of what the geometry is of the applicator that they are using
   - Gives me a starting point for specifying the geometry on egs_brachy
   - Also gives good tests to subject the applicator to (eg. changing internal structure and materials of the applicator)
   - Gives results plots that I can work towards replicating using egs_brachy

2 Next Week

In the **next week** I plan on tackling the following **four** things:

1. **Read about fundamentals of brachytherapy**
   - I will primarily be reading Chapter 50 & 53 of the Handbook
2. **Read about the relevant statistics in use in dosimetry**
   - I currently know of dose volume histograms, and cumulative dose volume histograms
   - I will skim the Handbook for any more statistics that are useful
3. **Read the paper by Ma *et al.* (2017)**
   - Read this to try and learn more about the origin of the example of HDR therapy with applicator given in egs_brachy
   - Also read this to try and figure out what considerations need to be made when designing the applicator
4. **Start working on creating the geometry for the applicator in Lymper-**

opoulou *et al.* (2004)

- Use the geometry given in the TG186 folder of egs_brachy as a template to begin constructing the applicator

5. **(Extra Credit) Run initial simulation on prototype geometry**

3 Figures

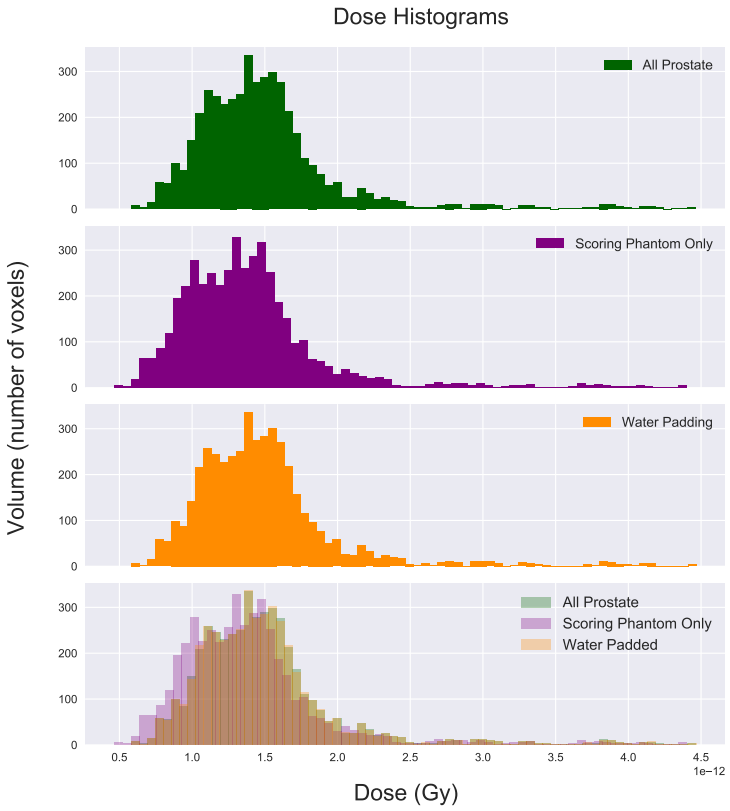

Figure 1: Volumetric Dose Histogram (VDH) for various simulation configurations. Top most subplot is for a simulation where both the scoring phantom and the padding surrounding it are made of prostate. The second subplot is for a simulation with no padding and only considering the scoring phantom as the simulation geometry. The third subplot is if scoring phantom is still made of prostate but now padded with water instead. The last subplot is the three subplots above superimposed on one another. Between the results, only the configuration of the geometries were changed. Other parameters were left the same across the different simulations.

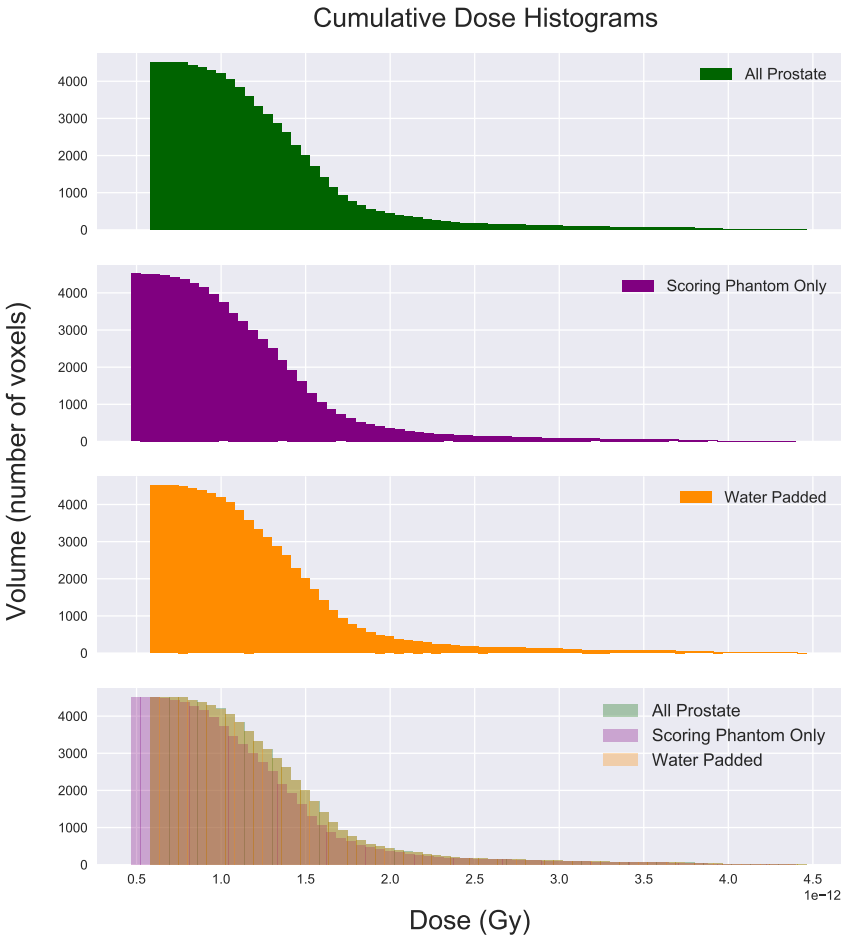

Figure 2: Cumulative Volumetric Dose Histogram (VDH) for various simulation configurations. Same configuration for subplots as Fig. 1