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7/2/2021

The NTCP calculator is a relatively small program that calculates the Normal Tissue Complication Probability (NTCP) of the Liver. Normal Tissue Complication Probability is an empirical model used to estimate the probability of a patient developing some kind of “complication” from a radiation treatment plan. In the context of Liver plans, this means Radiation Induced Liver Disease (RILD), which is a serious problem. Due to the risk of RILD, the department has limits set for Liver NTCP that SRS Liver plans need to meet. The dosimetrists use this program to quickly calculate the NTCP when they are working on SRS Liver plans so the physicists don’t need to do a manual calculation, which is time consuming. Eclipse has a biological evaluation module which can do this, but it does not work well and it does not explicitly display the effective volume, which the department also has limits set for. So, I made this program to make it easier. Currently it only works for the Liver, but it could be expanded for any organ, given the necessary parameters of the LKB model.

The theory behind NTCP is fairly complicated, so I’m not going to attempt to explain it here. If you want to familiarize yourself with the theory, I have saved the two journal papers that the program is based off of, and which form the basis of the Lyman-Kutcher-Burman (LKB) NTCP model, in this folder.

The NTCP calculator is a plug-in script. It starts in a cs file called NTCPcalc. This just calls the execute method and gets the scriptcontext to start the script, and then starts a WinForms GUI that is passes the plan list to, which is where the rest of the program takes place. The user uses the GUI to select the plan they would like to evaluate and if it is a Hepatocellular Carcinoma patient (HCC) or a Metastatic liver cancer patient (METS). This selection determines the TD50 parameter used in the NTCP calculation, 39.8 for HCC and 45.8 for METS. The rest of the parameters required by the LKB model are hardcoded into the program, and are specifically for the Liver. Lahey’s Liver protocol uses an n value of 1 (the volume effect parameter of the LKB model), an m value of 0.12 (the slope parameter of the LKB model), and a value of 3 for the α/β (alpha/beta radiation sensitivity ratio). When the user clicks the execute button, the NTCP calculation is performed and the NTCP value and the effective volume are displayed in the GUI.

The in-code comments explain the details of how the program works. The Math.Net Numerics package used to perform a numerical approximation of the Error function found within the NTCP formula. That is essentially the core of the program. It doesn’t make extensive use of ESAPI, so it’s pretty simple.