

VMAT TBI autoplanning binary plug-in quick start guide

E. A. Simiele

(Revised August 11, 2021)

1 Binary plug-in script

1.1 Contouring/preparation

- Bring the patient CT scan into Aria and contour the relevant structures for this particular case (e.g., lungs, kidneys, etc.)
 - **NOTE: THIS SCRIPT IS LOOKING FOR COMBINED LEFT AND RIGHT STRUCTURES FOR GENERATING TUNING STRUCTURES!** For example, the script is looking for 'Kidneys' rather than the individual left and right kidney structures
 - **NOTE: you do NOT need to manually create substructures (e.g., Kidneys-1cm), as the script will determine if it is appropriate to create and add these structures to the structure set**
- Once contouring has been completed, open the STRUCTURE SET in the External Beam Planning workspace

1.2 Tuning structure generation (TS Generation)

- Run the script 'VMATTBIautoPlan_vXX.dll'
- By default, the structure set in the current context will populate the Structure Set ID drop-down menu
- Select a treatment regiment if you want to use one of the templates. If not, you can manually enter the dose per fraction (in cGy/fraction) and number of fractions

- If you want to add 'flash' to the optimization, check the 'Add flash' box. Select either Global (i.e., body is used to generate flash) or Local (i.e., user-defined structure is used to generate flash) and enter the uniform margin to create flash. If Local is selected, select a structure to generate flash
- Hit the 'Add Defaults' button
 - If structures listed in the template are missing from the selected structure set, the script will inform you which structures are missing/the structures it can't find
 - The default structures specified in the configuration file will always be added to the list, regardless of the selected treatment options
- For finer control, select the 'Add Structure' button to add a blank structure to the list. The user can then select a structure contained within the selected structure set, select the sparing type for this structure, and enter an added margin
 - NOTE: the added margins are uniform margins
 - **NOTE: both positive and negative floating point values are accepted in the margin box. A positive margin means an outer margin and a negative margin means an inner margin**
- NOTE: if the sparing type is set to "Dmax ~ Rx Dose" for a particular structure, the value entered in the 'Added Margin (cm)' box will be ignored
- You can hit the 'Clear List' button to clear the entire list
- Once you are satisfied with the structure sparing parameter list, hit the 'Generate Tuning Structures' button
 - Warning messages will pop up if there is a problem with the structure set that should be fixed
 - Certain checks can be overridden by the user. If a warning message pops up and asks if you want to continue, you can override this interlock
 - Other checks cannot be overridden, such as not setting the user origin, because other properties of the planning process depend on these items being set
- If tuning structure generation was successful, a message will pop up indicating that structure generation was successful and the user can proceed to the Beam Placement tab
- **DO NOT MESS WITH THE ADDED STRUCTURES USED TO CREATE FLASH! DOING SO MIGHT CAUSE THE SCRIPTS TO MALFUNCTION, WHICH MAY RESULT IN NO TARGET BEING DEFINED, ADDING FLASH MULTIPLE TIMES, ETC.**
- Don't close the script yet!

1.3 Beam Placement

- After successfully generating tuning structures, the Beam Placement tab will be populated by isocenter and field information
- The user can adjust the number of beams per isocenter for the VMAT isocenters (max number of fields per isocenter = 4)
 - The script automatically handles both the VMAT-only and VMAT-AP/PA legs TBI plans
- Select the machine and the beam energy for all VMAT fields from the drop-down lists
 - The beam energy for the AP/PA fields will always be set to 6X
- If you are satisfied with the proposed number of isocenters and beams per isocenter, hit the 'Place Beams' button
 - The script will add a plan named '_VMAT TBI' to the 'VMAT TBI' course. If this patient also requires AP/PA plans of the legs, an additional plan named '_Legs' will also be added to the same course
 - The isocenter separation will then be calculated depending on the height of the TS_PTV_VMAT structure. If the calculated isocenter separation is > 38.0 cm, the script will ask the user if they want to truncate the isocenter separation to 38.0 cm.
 - **A separation of 38.0 cm ensures there is at least 2.0 cm overlap between fields in adjacent isocenters**
 - If a patient requires an AP/PA plan(s) of the legs, the isocenter separation between the isocenters adjacent to the matchline will automatically be set to 38.0 cm
- If beam placement is successful, a warning message will appear telling the user beam placement was successful and they can proceed to the Optimization Setup tab
- At this point, you can exit this script or proceed to the Optimization Setup tab

1.4 Optimization Setup

- After successfully generating the plans and placing the beams, the Optimization Setup tab will be populated with suggested optimization objectives for this particular treatment
- The determined optimization objectives are displayed to the user in the Optimization Setup tab following the successful generation of the tuning structures. The intent here, is for the user to review all of the optimization objectives and adjust the constraints as they see fit

- Once the user is satisfied with the optimization objectives, they can hit the 'Set Optimization Constraints' button. This will assign the optimization objectives in the list to the '_VMAT TBI' plan.
- Upon successful assignment of the optimization objectives, a warning message will be displayed indicating the user needs to exit the script then review the generated tuning structures, placed isocenters and beams, and the assigned optimization objectives
- After reviewing the properties of the generated plans, hit the save button in Eclipse to save the changes to the patient. If you are unsatisfied with the produced plan, you can remove all changes by hitting the reload button in Eclipse

1.4.1 Alternative path to set optimization objectives

- If you generated the tuning structures and placed the isocenters and beams then exited the script to review your work, you DON'T have to repeat the entire process to get to the Optimization Setup tab
- If you have previously generated the tuning structures using this script, you can proceed directly to the Optimization Setup tab
- Select a treatment regiment or enter the treatment prescription information
- You can then hit the Scan RTSTRUCT and Add Constraint button
- When you hit the Set Optimization Constraints, the script will look for the '_VMAT TBI' plan in the 'VMAT TBI' course. If either of these items are missing, the script will throw an error message
- If you use this method and intended to include flash in the optimization, you must check the Add flash box! **OTHERWISE, THE TARGET WILL BE INCORRECTLY ASSIGNED!**

1.5 Plan preparation

- Open the _VMAT TBI plan in Eclipse and launch the plugin
- The shift note for this plan can be generated by hitting the 'generate shift note' button on the Plan preparation tab (no other information needs to be entered into the GUI). This can be completed before or after optimizing the plan
- NOTE: THE SCRIPT IS LOOKING FOR PLANS NAMED _VMAT TBI AND _LEGS! IF MULTIPLE PLANS ARE FOUND IN THE VMAT TBI COURSE, A POP-UP WINDOW WILL ASK YOU TO CHOOSE THE CORRECT VMAT TBI PLAN. THE AP/PA PLAN MUST BE NAMED _LEGS!

- Following shift not generation, you can separate the VMAT and AP/PA plans into separate plans (one for each isocenter)
 - The script will automatically check if flash was used during the optimization. If so, it will ask you if you want to remove those structures from the structure set. The body structure will be reset to its original contour before adding flash
 - NOTE: YOU WILL NEED TO MANUALLY ADD SETUP FIELDS, PRIMARY REFERENCE POINTS, AND TARGET STRUCTURES TO EACH OF THE CREATED PLANS!
 - Once the plans have been separated, you can choose to calculate dose to each of the separated plans. This will take some time since it has to be done sequentially, but it's a nice excuse for a coffee break :)
 - The rest of the plan preparation functionality will be added once the upgrade to v16.0 or greater has been completed
-

1.6 Some notes about the Scleroderma trial treatment regiment

- **NOTE: THE USER DOES NOT NEED TO MANUALLY CONTOUR THE KIDNEY AND LUNG SUBSTRUCTURES WITH AYSYMMETRIC MARGINS! THE SCRIPT WAS DESIGNED TO CREATE THESE STRUCTURES IF THE SCLERODERMA TRIAL TREATMENT REGIMENT WAS SELECTED AND THE LUNGS AND KIDNEYS WERE ADDED TO THE STRUCTURE SPARING LIST**
 - If the Scleroderma trial checkbox is selected, the script will ignore the values entered into the 'Added Margin (cm)' box for the lungs and kidneys volumes
 - Do to the unique nature of this treatment regiment, it is strongly recommended for all Scleroderma trial patients that the Scleroderma trial checkbox be selected to ensure the script properly generates the required tuning structures and optimization constraints

1.7 Known limitations in ESAPI v15.5 (limits the functionality of the script)

- It is not possible to set the target volume ID in a newly created plan in ESAPI v15.5 (fixed in v16.0)
- It is not possible to assign a primary reference point in a newly created plan in ESAPI v15.5. A primary reference point is automatically created and can't be changed (fixed in v16.0)

- It is not possible to assign a base dose plan for optimization in the script in ESAPI v15.5 (fixed in v16.0)
- It is not possible to create setup fields for plans in ESAPI v15.5 (fixed in v16.0)
- It is not possible to create or remove plan sums from the script in ESAPI v15.5 (fixed in v16.0)
- It is not possible to assign plan goals for plans in ESAPI v15.5
- It is not possible to remove the automatic normal tissue objective (NTO) in optimization in ESAPI v15.5. However, the script does not remove the NTO, but assigns the priority to 0
- It is not possible to set a MU objective for optimization in ESAPI v15.5
- It is not possible to set the patient orientation for a plan in ESAPI v15.5. This impacts the generation of the '_AP/PA Legs' plan as the patient will always be oriented head-first supine. To fix, the user will have to set the patient orientation manually.

– **DO NOT ADJUST THE JAW/FIELDS AS THEY ALREADY TAKE THIS ISSUE INTO ACCOUNT!**