

Welcome!

Thank you for taking the time to test my semantic implementation of the PreFreeSurfer workflow!

PreFreeSurfer is the first part of the Human Connectome Project Minimal Processing Pipeline designed to prepare brain MRI scans for analysis.

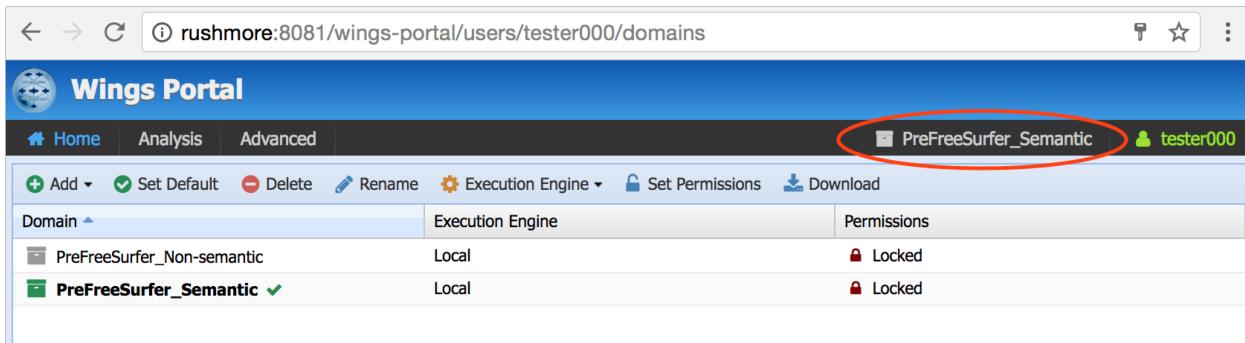
The semantics included in this implementation are an attempt to make running the workflow more user-friendly.

To access the workflow, open a web browser and navigate to:

<http://rushmore:8081/wings-portal/domains>

This will take you to our instance of the WINGS semantic workflow system. Log in using your testing credentials. An OHSU network connection is required.

At the top-right of the page, next to your username, is where you can switch between different domains, or environments. You should have a Semantic and Non-semantic domain available to you. If it does not already, set it so it says, "PreFreeSurfer_Semantic".



The screenshot shows a web browser window with the URL <http://rushmore:8081/wings-portal/users/tester000/domains>. The page title is "Wings Portal". The top navigation bar includes links for Home, Analysis, Advanced, and a user icon for "tester000". Below the navigation is a toolbar with buttons for Add, Set Default, Delete, Rename, Execution Engine, Set Permissions, and Download. A table lists domains with columns for Domain, Execution Engine, and Permissions. Two domains are listed: "PreFreeSurfer_Non-semantic" (Local, Locked) and "PreFreeSurfer_Semantic" (Local, Locked). The "PreFreeSurfer_Semantic" row is circled in red.

Domain	Execution Engine	Permissions
PreFreeSurfer_Non-semantic	Local	Locked
PreFreeSurfer_Semantic	Local	Locked

Click on "Analysis" at the top-left and choose "Run Workflows".

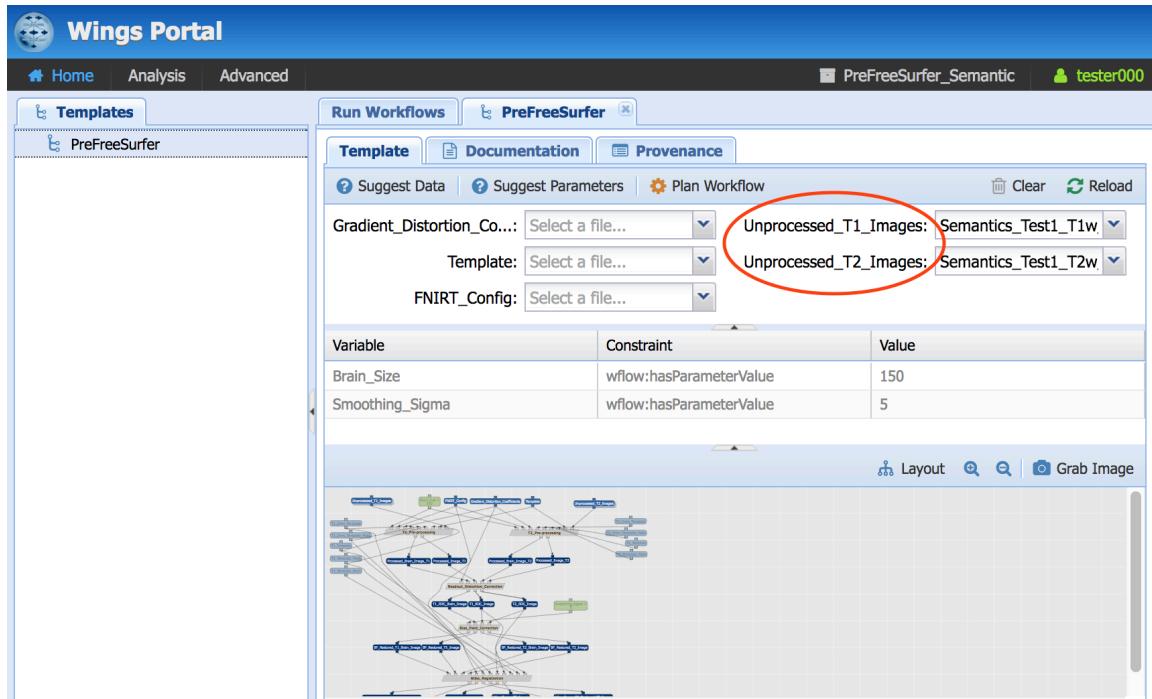
Select the PreFreeSurfer template. A map of the workflow is displayed at the bottom of the page. The grey boxes are the different processing steps used. You can see that we have broken up the workflow into 4 steps.

- 1) **Pre-processing** (separately for T1 and T2 images): This step carries out the ACPC alignment and brain extraction operations. If you have multiple replicates of T1 and/or T2 images, it will also average them together. It also performs gradient distortion correction, if applicable.
- 2) **Readout Distortion Correction**: This step corrects for readout distortion using whatever type of fieldmap is available for the subject. It also registers the T2 image to the T1.
- 3) **Bias Field Correction**: This step combines information from the T1 and T2 images to correct for the bias field, assuming both images are available.
- 4) **Atlas Registration**: This step registers the subject image to a universal template to allow for downstream cross-subject analysis.

This implementation of PreFreeSurfer is designed to use semantic reasoning to handle a variety of situations that can arise while processing your data. We will start with a relatively straightforward example to familiarize you with the WINGS platform.

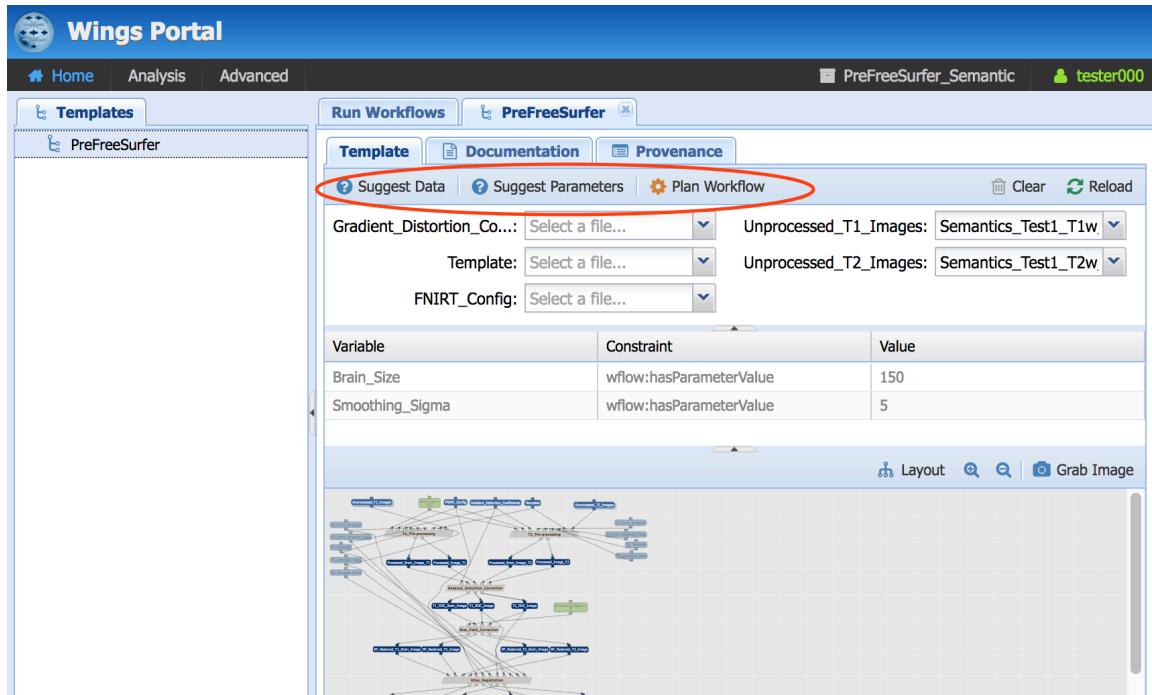
Scenario 1

First, we need to choose what images we want to process. Select the Test1 samples for both the unprocessed T1 and T2 inputs.



The screenshot shows the WINGS Portal interface for the PreFreeSurfer workflow. The top navigation bar includes 'Home', 'Analysis', 'Advanced', 'PreFreeSurfer Semantic', and a user 'tester000'. The main area has tabs for 'Run Workflows' and 'PreFreeSurfer'. Below these are 'Template', 'Documentation', and 'Provenance' tabs. The 'Template' tab is active. On the left, there's a sidebar with 'Templates' and 'PreFreeSurfer'. The main workspace shows a workflow graph with various nodes and connections. At the top of the workspace, there are input fields for 'Gradient_Distortion_Co...', 'Template', and 'FNIRT_Config', each with a 'Select a file...' dropdown. To the right of these are dropdowns for 'Unprocessed_T1_Images' (set to 'Semantics_Test1_T1w') and 'Unprocessed_T2_Images' (set to 'Semantics_Test1_T2w'). A red circle highlights these two dropdowns. Below the input fields is a table with columns 'Variable', 'Constraint', and 'Value', containing entries for 'Brain_Size' and 'Smoothing_Sigma'. At the bottom of the workspace are buttons for 'Layout', 'Search', and 'Grab Image'.

You can click on the other input fields to see what data is available, but since we don't know anything about these samples, let's have WINGS search for appropriate inputs for us. Click on "Suggest Data" on the workflow menu bar.



This screenshot is identical to the one above, showing the WINGS Portal interface for the PreFreeSurfer workflow. The 'Suggest Data' button in the workflow menu bar is highlighted with a red circle. The rest of the interface, including the input fields, table, and workflow graph, is the same as the previous screenshot.

Note: if you have an invalid input combination, such as choosing different test subjects for the unprocessed T1 and T2 images, you will get an error message. Red text is a specific problem you need to address. Blue text is general usage guidelines, and everything else is technical stuff that you can ignore. If you need to clear selected options, click on "Clear" or "Reload" on the workflow menu bar, then try selecting only the unprocessed T1 and T2 images.

WINGS will now show you all combinations of valid input files in its data library. In this case, there is only one valid combination of input files. Select it and click "Use Selected Data".

	Gradient_Distortion_Coefficients_Template	FNIRT_Config	Unprocessed_T1_Images	Unprocessed_T2_Images	
1	HCP_Skyra_Coefficients_FAKE	MNI152	T1_2_MNI152_2mm.cnf	Semantics_Test1_T1v	Semantics_Test1_T2v

The "Suggest Parameters" button does something similar, but in this case, the workflow parameters have all been pre-set, or will be automatically determined from the input files we have selected.

Clicking on "Plan Workflow" generates all valid versions of the workflow we can run with the available data. In this case you will see two options, which differ only in the Readout Distortion Correction module that is being used. We can always choose to skip readout distortion correction, but for this individual, WINGS was able to find the necessary data files to run the Siemens RDC algorithm.

Run Selected Workflow	Variable	Constraint	Value
Template	FNIRT_Config	rdf:type	dccom:Config-FNIRT_Configuration
PreFreeSurfer-98-0bc90b0f-2b44-48e2-b543-621d8e5cddeb	FNIRT_Config	dccom:Resolution	2
	FNIRT_Config	dccom:Version	MNI152
	FNIRT_Config	dccom:Modality	T1
	Gradient_Distortion_Coefficients	rdf:type	dccom:Config-Gradient_Distortion_Coefficients...

With the readout distortion correction method of your choice selected, click on "Run Selected Workflow" to submit your results. we are only focusing on setting up the workflow, so you can just close the pop-up window and not worry about monitoring the execution. Processing the data takes a while and wont actually succeed for our testing scenarios. (The gradient distortion coefficients file from Siemens is considered proprietary information, so we are using a dummy input file.) All you would see is a list of inputs, including everything the semantics handled in the background.

Template	Progress	Start Time	End Time
PreFreeSurfer	Completed	9:21:47 pm, Mar 09, 2017	9:22:16 pm, Mar 09, 2017

Variable	Binding	Save
1 Brain_Size	150	
2 Echo_Difference	5.3E-4	
3 FNIRT_Config	T1_2_MNI152_2mm.cnf (2 KB)	
4 Fieldmap_Magnitude	Semantics_Test1_FieldMap_Magnitude.nii.gz (1 MB)	
5 Fieldmap_Phase	Semantics_Test1_FieldMap_Phase.nii.gz (1 MB)	
6 Gradient_Distortion_Coefficients	Not available	
7 Smoothing_Sigma	5	
8 T1_2mm_Template	MNI152_T1_2mm.nii.gz (1 MB)	
9 T1_Sample_Spacing	1.0E-5	

Comparison to a Non-semantic Workflow

Next, we want to see how the setup experience would be different without utilizing semantic constraints. Set the domain at the top-right of the page to “PreFreeSurfer_Non-semantic” and again, go to “Analysis” -> “Run Workflows”.

Without the semantics reasoning out what processing steps are appropriate for our data, we will have to decide what workflow to use on our own. If you remember, in this case, we have everything we need to run Siemens readout distortion correction, and to run a gradient distortion correction as well. Select the correct version of the workflow and try to set up the processing run. Start by specifying the Unprocessed T1 and T2 images, then try to set up the rest.

The screenshot shows the Wings Portal interface with the 'Run Workflows' tab selected. The left sidebar contains a list of available templates. The main workspace is titled 'PreFreeSurfer_SiemensRDC_WithGDC'. It features several input fields for specifying processing parameters. Two specific fields, 'Unprocessed_T2_Images' and 'Unprocessed_T1_Images', are circled in red to highlight them.

Some of the inputs and parameters are not immediately obvious. You will need to investigate the data to get the correct values. I would suggest opening another tab and going to “Advanced” -> “Manage Data”. From here you should be able to locate the images you are trying to process and find some of the parameters saved as metadata.

The screenshot shows the 'Data Manager' interface with the 'Metadata' tab selected. On the left, there's a tree view of processed images under the 'Unprocessed_Image' and 'Unprocessed_Image_T2' folders. The main area displays a table of metadata for a specific file ('Semantics_Test1_T1w_MPR1.nii.gz'). Several metadata entries are circled in red: 'Sample_Spacing' (value: 0.00001) and 'Unwarp_Direction' (value: z).

If you get to a point where this seems too difficult, you can cheat by using the “Suggest Data” and “Suggest Parameters” buttons on the workflow menu bar. Just remember, that having WINGS make these suggestions is utilizing semantics that a truly non-semantic workflow would not have.

Once you have specified all the inputs and parameters, click on “Plan Workflow” on the workflow menu bar. If you don’t get any error messages, that is pretty good. But even then, remember that if the wrong file is selected for any of the templates, or any parameters are set incorrectly, nothing will stop it from running, which could lead to inaccurate results.

Unguided Scenarios

Now that you know how to use WINGS, please run through the other 3 scenarios. For each scenario, try setting up the workflow run in the **non-semantic domain first**, before trying it in the semantic domain.

Setting up a non-semantic workflow run should take less than 5 minutes. If it takes longer than that, or you feel stuck, don’t hesitate to move on to the semantic version. Working with the semantic version should reveal what was giving you trouble.

If you were successful with the non-semantic workflow, try to pay attention to whether the semantic workflow sets things up the same way.

Scenario 2

This scenario is intended to simulate running PreFreeSurfer with alternate processing steps. The Test2 images were acquired using a different type of MRI scanner than the first, so the processing steps may be a little different.

When selecting the Unprocessed T1 and T2 inputs, you will notice that Test2 has multiple input images available. You can select one, then shift+click the other to select them both. These are multiple replicates that will be averaged together.

Scenario 3

This scenario is intended to simulate running PreFreeSurfer with different types of data. The Test3 images were acquired from a non-human primate.

Scenario 4

This scenario is intended to simulate running PreFreeSurfer when there may be an issue with the data, or all of the necessary files may not be available. Try to set up a valid workflow run for the Test4 images despite any issues you encounter. Deciding that you are unable to run the workflow with the available data is certainly a legitimate answer.

Thank you!

When you are done, please take a few minutes to fill out the feedback form, and email it back to keibler@ohsu.edu.

Your involvement has been greatly appreciated!