
AnatQC

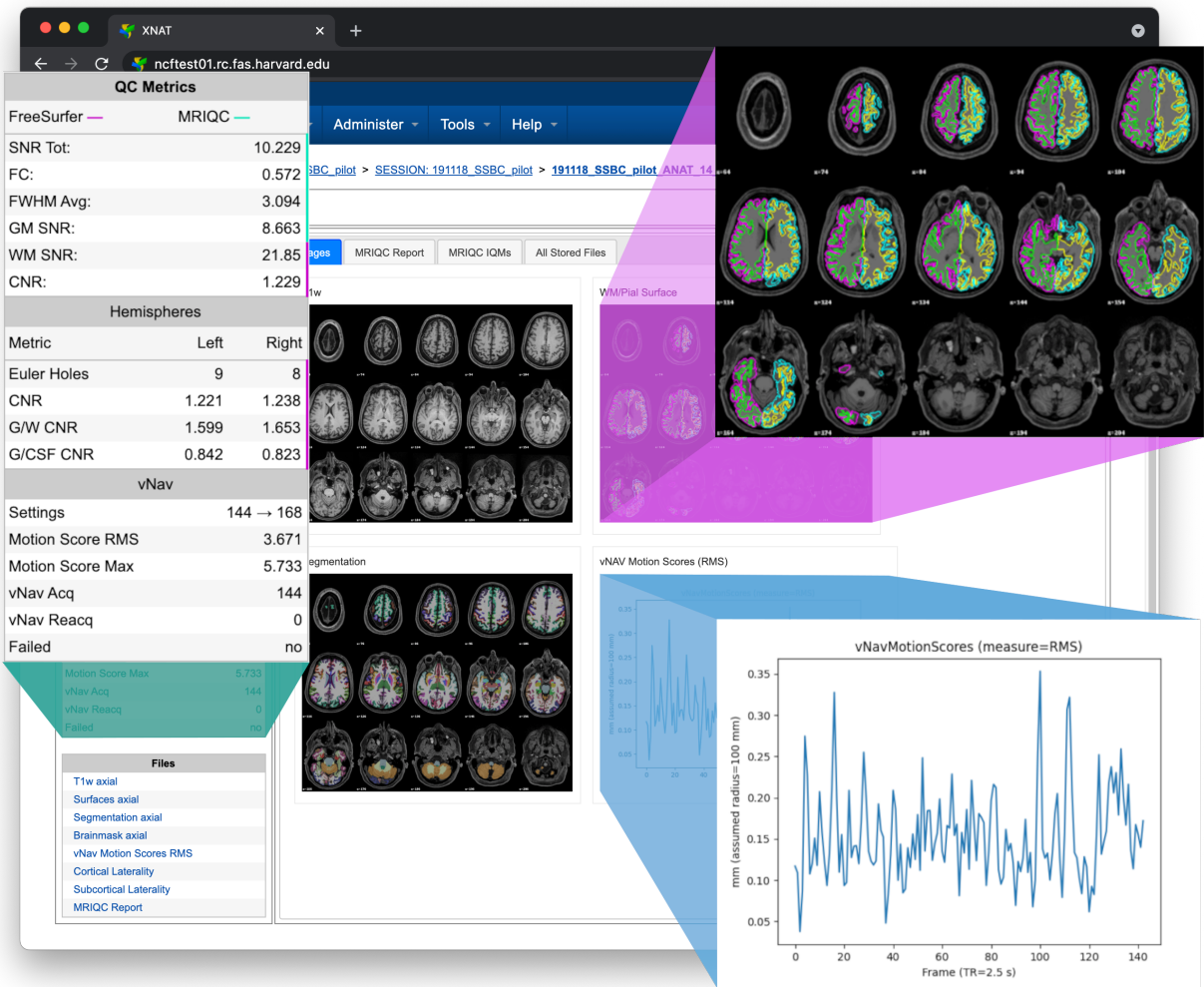
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AnatQC is a high-resolution “anatomical” MRI quality control pipeline built on the [FreeSurfer](#), [MRIQC](#), and [volumetric navigators](#) software packages. Working closely with neuroimaging experts, we designed an ergonomic user interface for the [XNAT](#) informatics and data management platform that allows users to quickly assess image quality and use those insights to get ahead of issues within the data acquisition workflow.



XNAT USER DOCUMENTATION

1.1 Tagging your scans

For AnatQC to discover **T1w** and **vNav** scans to process, you need to add notes to those scans in **XNAT**. You can add notes using the **Edit** button located within the **Actions** box on the MR Session report page

Type	Example series	Note
T1w	ABCD_T1w_MPR_vNav	#T1w_001, #T1w_002, ..., #T1w_N
vNav	ABCD_T1w_MPR_vNav_setter	#T1w_move_001, #T1w_move_002, ..., #T1w_move_N

The image below displays an MR Session report page with populated notes

Note: Note that if a T1w scan has a corresponding vNav scan, they should be assigned matching numbers. For example, #T1w_move_001 would correspond to #T1w_001.

MR Session: 191118_SSBC_pilot

Details | Projects

Accession #: XNAT_E00004 Subject: 191118_SSBC_pilot
 Date Added: 2021-06-22 14:28:57 (admin) Gender:
 Date: 2019-11-18 Handedness:
 Time: 15:34:09 Age: --
 Operator: Mair
 Scanner Name: AWP67056
 Scanner Type: SIEMENS Prisma_fit
 Acquisition Site: CBS Neuroimaging

Actions

- Edit
- View
- Download
- Email
- Manage Files
- Delete
- Run Containers

Scans

Bulk Actions: Download

Scan	Type	Series Desc	Usability	Files	Note
<input type="checkbox"/> 12	ABCD_T1w_MPR_vNav_setter	ABCD_T1w_MPR_vNav_setter	usable	27.9 MB in 144 files	#T1w_MOVE_001
<input type="checkbox"/> 14	ABCD_T1w_MPR_vNav	ABCD_T1w_MPR_vNav	usable	42.9 MB in 176 files	#T1w_001
<input type="checkbox"/> 17	BOLD	ABCD_fMRI_rest	usable	441.6 MB in 383 files	
<input type="checkbox"/> 19	ABCD_dMRI_Distortion Map_PA	ABCD_dMRI_Distortion Map_PA	usable	18.2 MB in 81 files	

Total: 530.6 MB in 784 files

1.2 Running the pipeline

To run the AnatQC pipeline, use the Run Containers > anatqc-session button located within the Actions box on the MR Session report page

Note: If you don't see the Run Containers menu, please refer to [Setting up the container](#).

MR Session: 191118_SSBC_pilot

Details | Projects

Accession #: XNAT_E00002 **Subject:** 191118_SSBC_pilot
Date Added: 05/04/2021 18:30:54 (admin) **Gender:**
Date: 11/18/2019 **Handedness:**
Time: 15:34:09 **Age:** --
Operator: Mair
Scanner Name: AWP67056
Scanner Type: SIEMENS Prisma_fit
Acquisition Site: CBS Neuroimaging

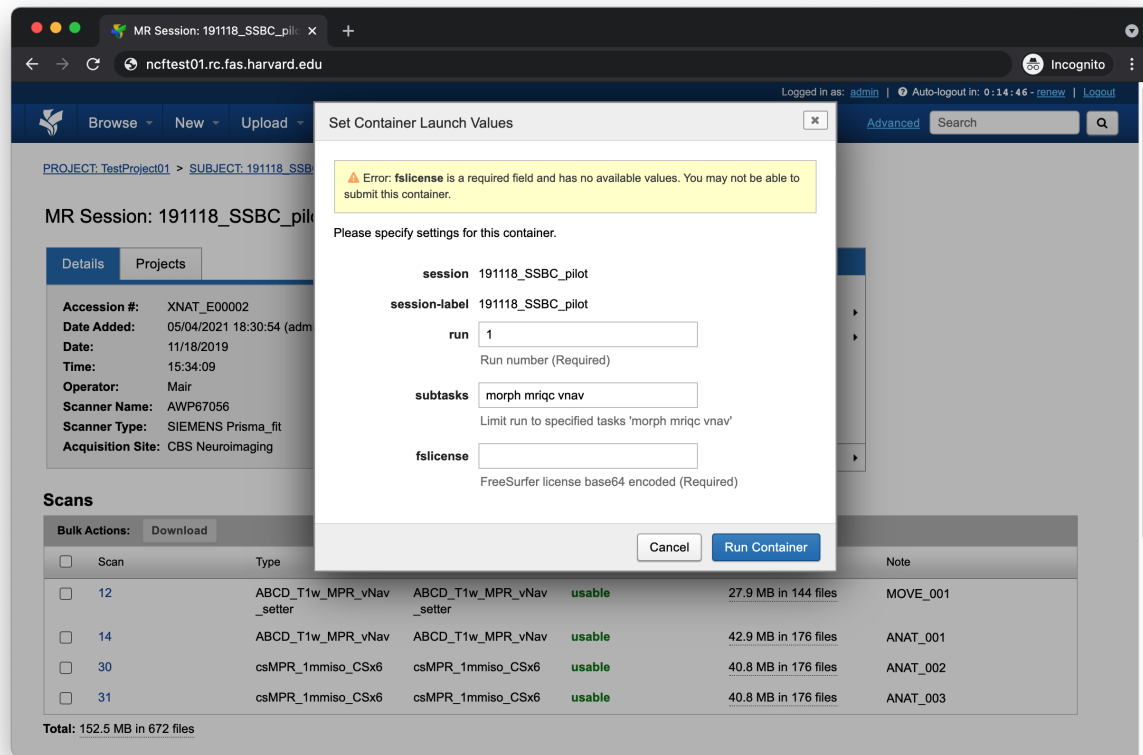
Actions
 Edit
 View
 Download
 Delete
 Run Containers

Scans

Bulk Actions:		Download				
<input type="checkbox"/>	Scan	Type	Series Desc	Usability	Files	Note
<input type="checkbox"/>	12	ABCD_T1w_MPR_vNav_setter	ABCD_T1w_MPR_vNav_setter	usable	27.9 MB in 144 files	MOVE_001
<input type="checkbox"/>	14	ABCD_T1w_MPR_vNav	ABCD_T1w_MPR_vNav	usable	42.9 MB in 176 files	ANAT_001
<input type="checkbox"/>	30	csMPR_1mmiso_CSx6	csMPR_1mmiso_CSx6	usable	40.8 MB in 176 files	ANAT_002
<input type="checkbox"/>	31	csMPR_1mmiso_CSx6	csMPR_1mmiso_CSx6	usable	40.8 MB in 176 files	ANAT_003

Total: 152.5 MB in 672 files

This should bring up a small form with several configurable settings. Continue reading for a description of each setting



1.2.1 run

This should be set to the integer value of the scan you want to process. If there's a corresponding move scan, that scan will also be processed

T1w scan	run
#T1w_001	1
#T1w_002	2
#T1w_999	999

1.2.2 subtasks

Under most circumstances you'll want to leave this field set to its default value

```
morph mriqc vnav
```

1.2.3 fslicense

This field should be set to a base64 encoded [FreeSurfer license](#). If you have a license file on a Linux or macOS machine, you can use the openssl command

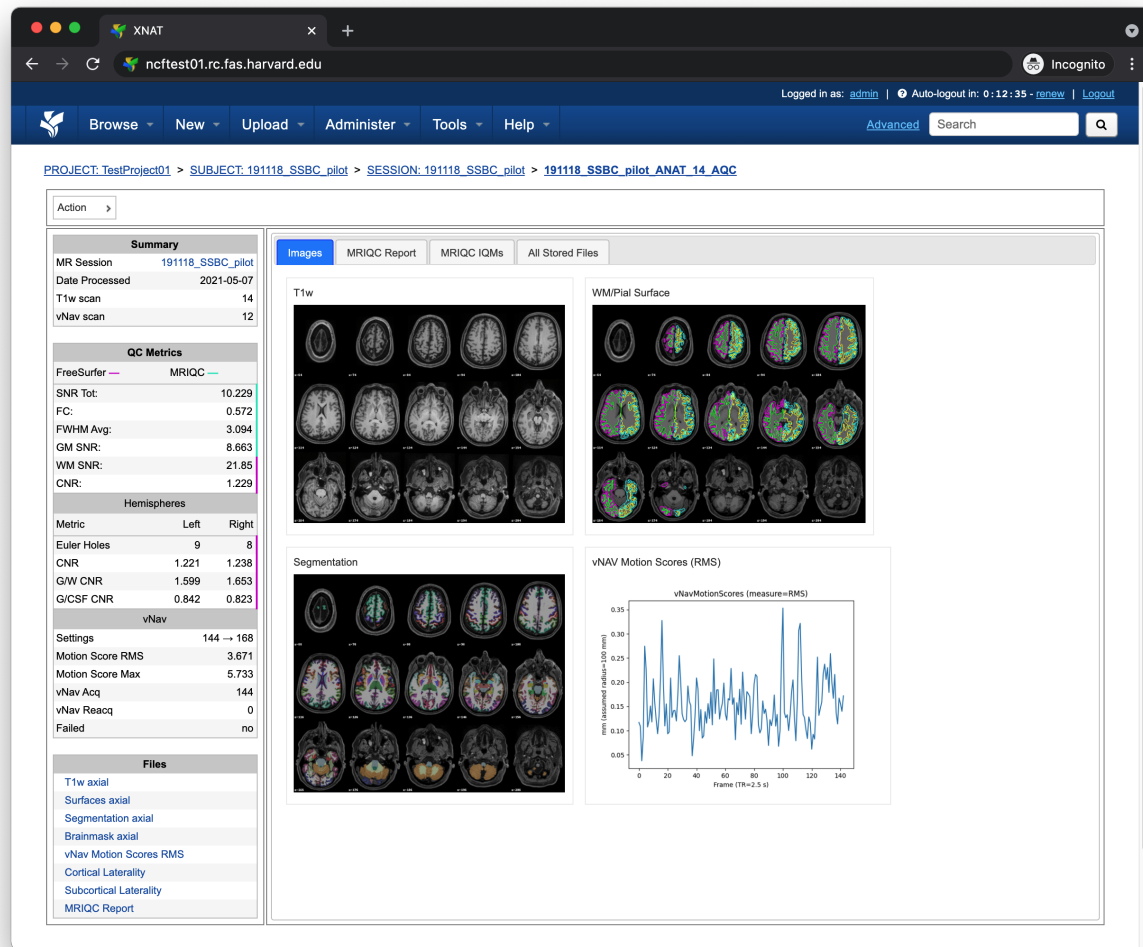
```
openssl base64 < license.txt
```

or you can use the base64 command, if that utility is installed

```
base64 license.txt
```

1.3 Understanding the report page

The following section will break down each section of the AnatQC report page.

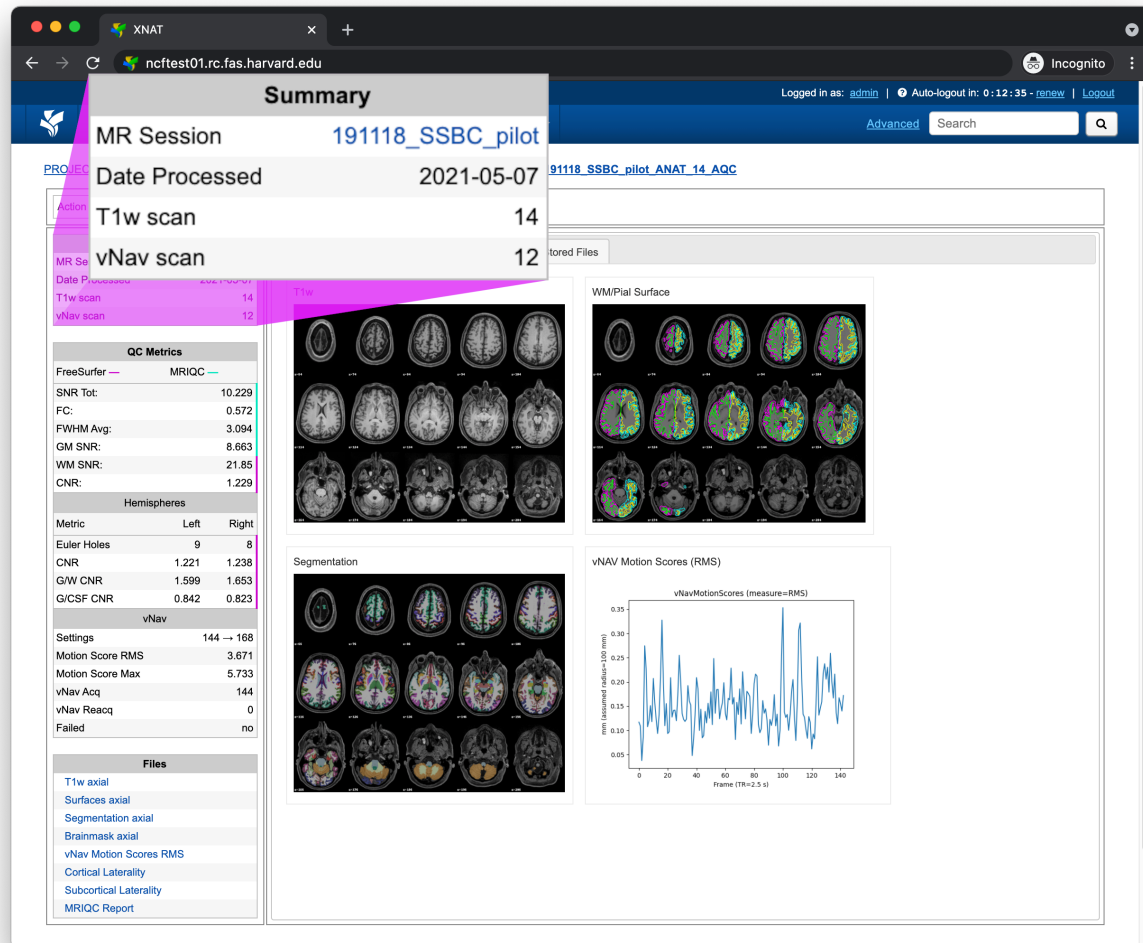


1.3.1 Left pane

The left pane is broken up into several distinct sections. Each section will be described below.

Summary

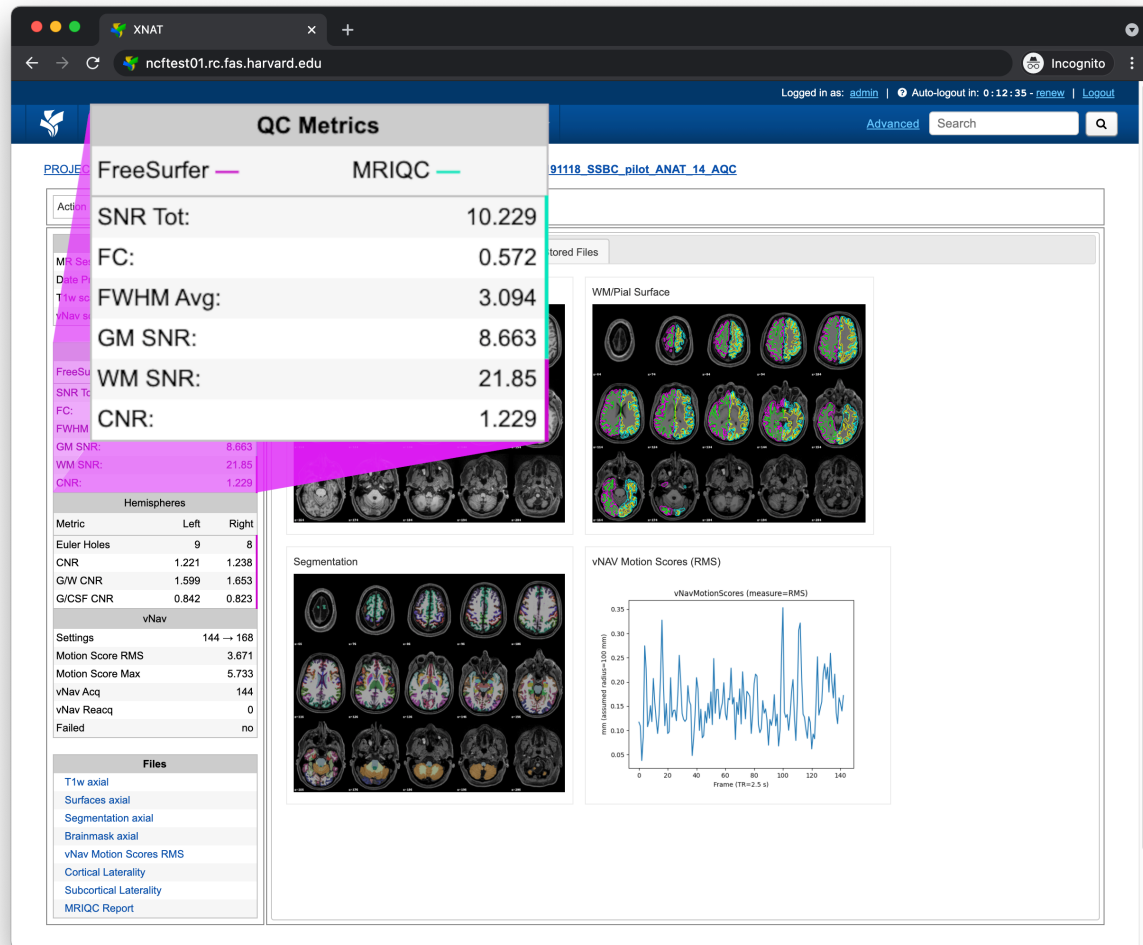
The Summary pane orients the user to what MR Session they're currently looking at and various processing details



Key	Description
MR Session	MR Session label
Date Processed	Processing date
T1w scan	T1-weighted scan used
vNav scan	vNav setter scan used (if present)

QC Metrics

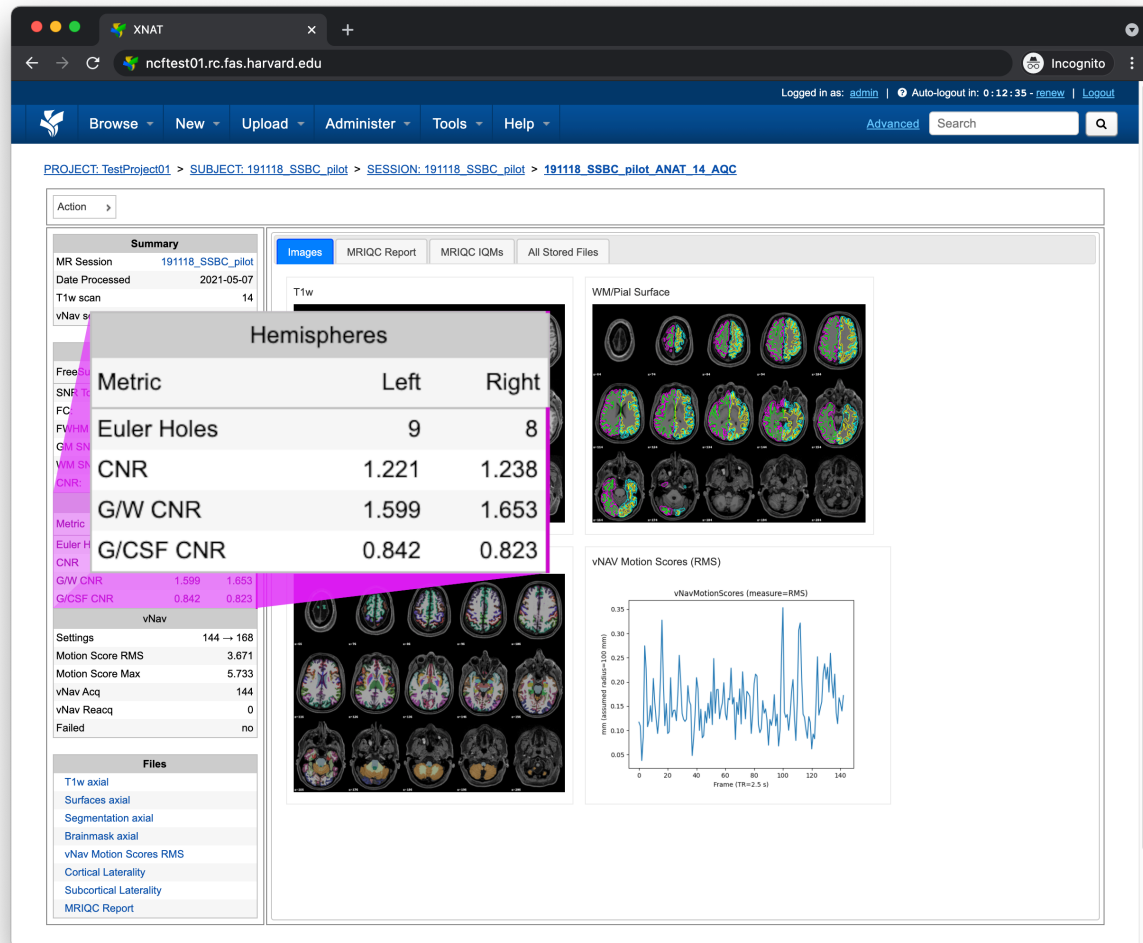
The QC Metrics pane displays quality control metrics computed *over the entire volume*



Metric	From	Description
SNR Tot	MRIQC	Signal-to-noise ratio
EFC	MRIQC	Entropy Focus Criterion
FWHM Avg	MRIQC	FWHM of spatial distribution of voxel intensities
GM SNR	MRIQC	Gray matter signal-to-noise ratio
WM SNR	FreeSurfer	White matter signal-to-noise ratio
CNR	FreeSurfer	Contrast-to-noise ratio

Hemispheres

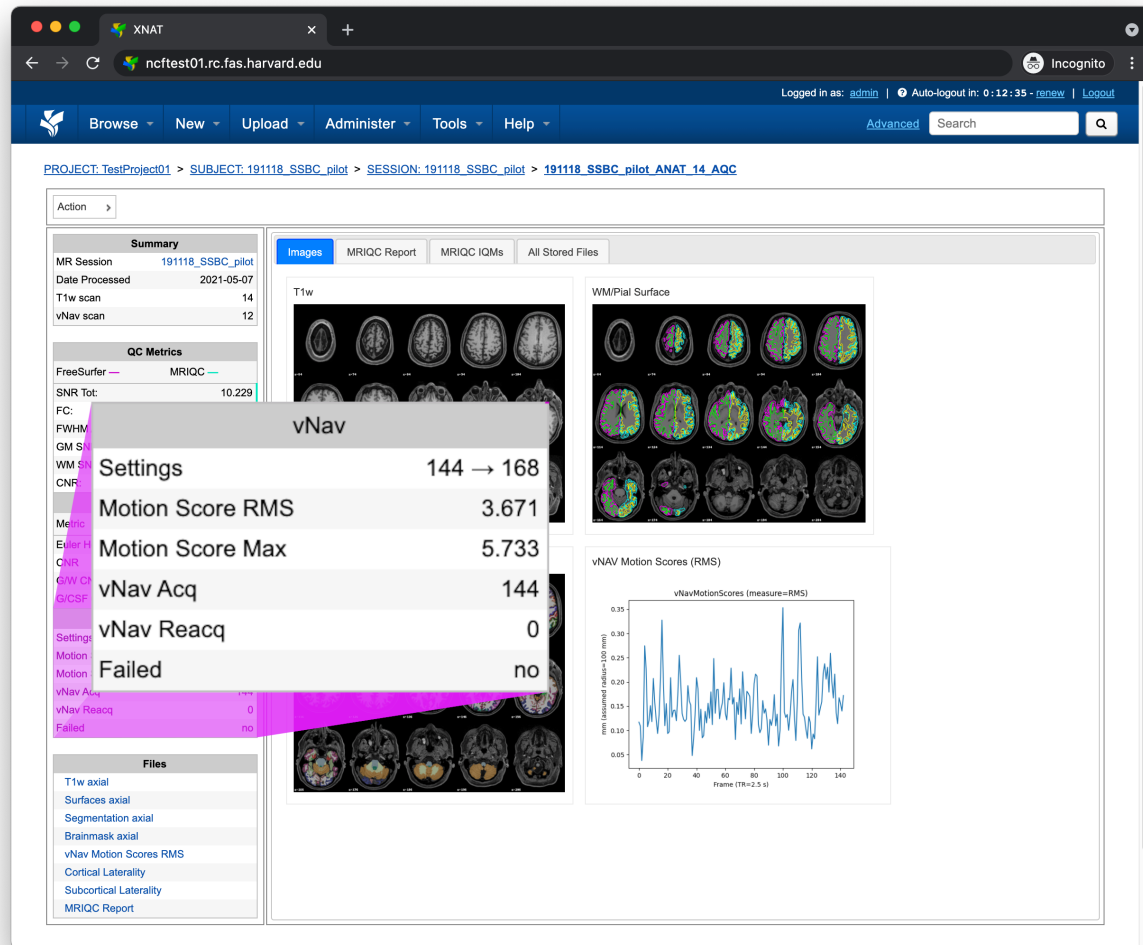
The Hemispheres pane displays quality control metrics computed *over each hemisphere*



Metric	From	Description
Euler Holes	FreeSurfer	Estimate of the number of surface defects
CNR	FreeSurfer	Global contrast-to-noise ratio
G/W CNR	FreeSurfer	Gray and white matter contrast-to-noise ratio
G/CSF CNR	FreeSurfer	Gray matter and cerebrospinal fluid contrast-to-noise ratio

vNav

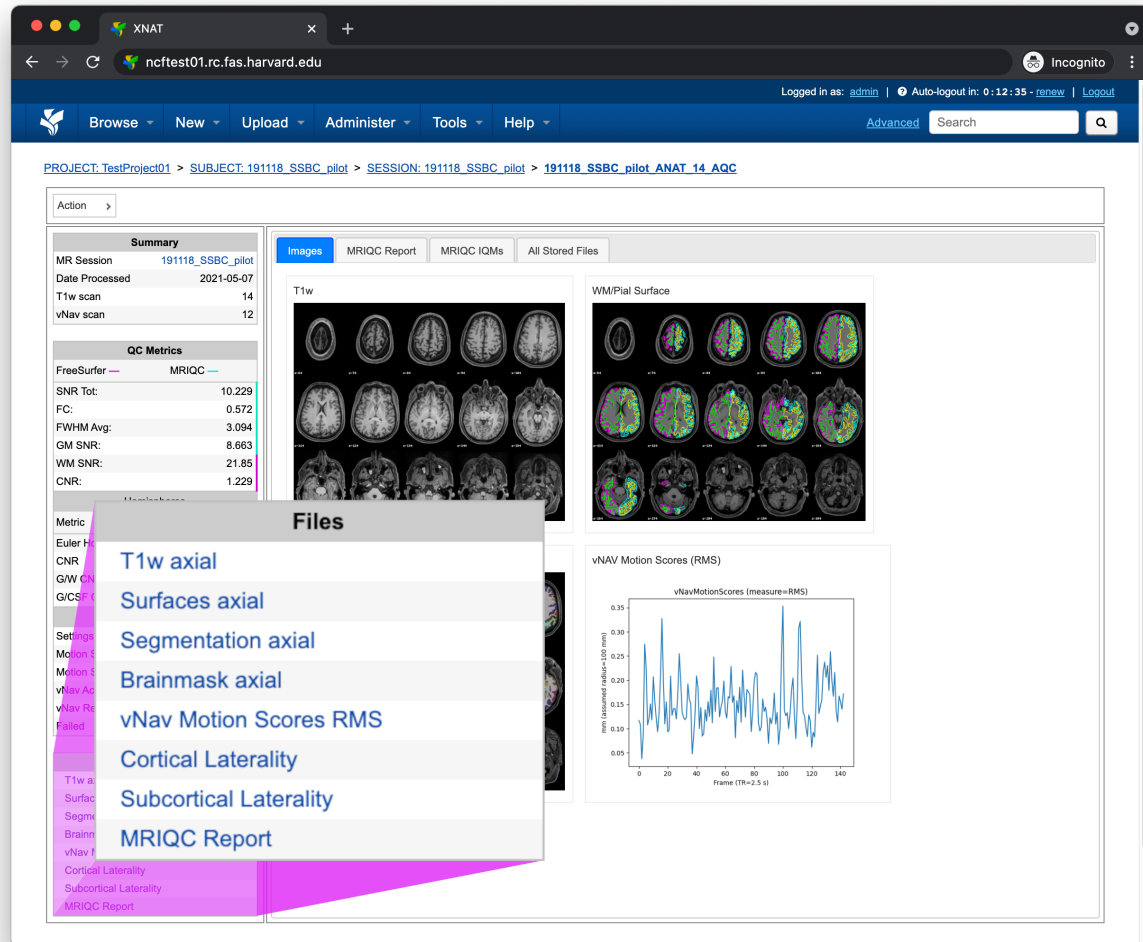
The vNav pane displays vNav specific quality control metrics, but *only* if a vNav scan was processed



Metric	Description
Settings	Minimum and maximum number of navigators allowed
Motion Score RMS	Root mean square of motion scores
Motion Score Max	Maximum motion score
vNav Acq	Total number of navigators collected
Failed	vNav failure detected

Files

The Files pane contains the most commonly requested files. Clicking on any of these files will display that file in the browser



File	Description
T1w axial	T1-weighted image, axial plane
Surfaces axial	FreeSurfer surface boundaries, axial plane
Segmentation axial	FreeSurfer segmentations, axial plane
Brainmask axial	FreeSurfer brain mask, axial plane
vNav Motion Scores RMS	vNav motion scores RMS plot
Cortical Laterality	Cortical region volume laterality plot
Subcortical Laterality	Subcortical region volume laterality plot
MRIQC Report	MRIQC HTML report

1.3.2 Tabs

To the right of the *left pane* you'll find a tab container. The following section explains the contents of each tab.

Images

The Images tab displays a zoomed out view of the T1-weighted image, FreeSurfer surface boundaries, FreeSurfer segmentations, and vNav RMS motion scores

The screenshot shows the XNAT web interface in a browser window. The URL is ncf0101.rc.fas.harvard.edu. The user is logged in as 'admin'. The interface has a top navigation bar with links: Browse, New, Upload, Administer, Tools, Help. A search bar is also present.

The main content area is titled 'PROJECT: TestProject01 > SUBJECT: 191118_SSBC_pilot > SESSION: 191118_SSBC_pilot > 191118_SSBC_pilot_ANAT_14_AQC'. The 'Images' tab is selected, indicated by a blue highlight and a red arrow.

The 'Images' tab displays four panels:

- T1w**: A grid of 12 axial T1-weighted brain slices.
- WM/Pial Surface**: A grid of 12 axial brain slices showing FreeSurfer surface boundaries in various colors.
- Segmentation**: A grid of 12 axial brain slices showing FreeSurfer segmentations in various colors.
- vNAV Motion Scores (RMS)**: A line graph showing motion scores over time. The y-axis is 'mm (assumed radius=100 mm)' ranging from 0.05 to 0.35. The x-axis is 'Frame (TR=2.5 s)' ranging from 0 to 140. The graph shows a fluctuating blue line representing motion scores.

The left sidebar contains a 'Summary' section with the following information:

- MR Session: 191118_SSBC_pilot
- Date Processed: 2021-05-07
- T1w scan: 14
- vNav scan: 12

Below the summary is a 'QC Metrics' section with a table:

Metric	Left	Right
Euler Holes	9	8
CNR	1.221	1.238
G/W CNR	1.599	1.653
G/CSF CNR	0.842	0.823

Below the QC Metrics is a 'vNav' section with the following information:

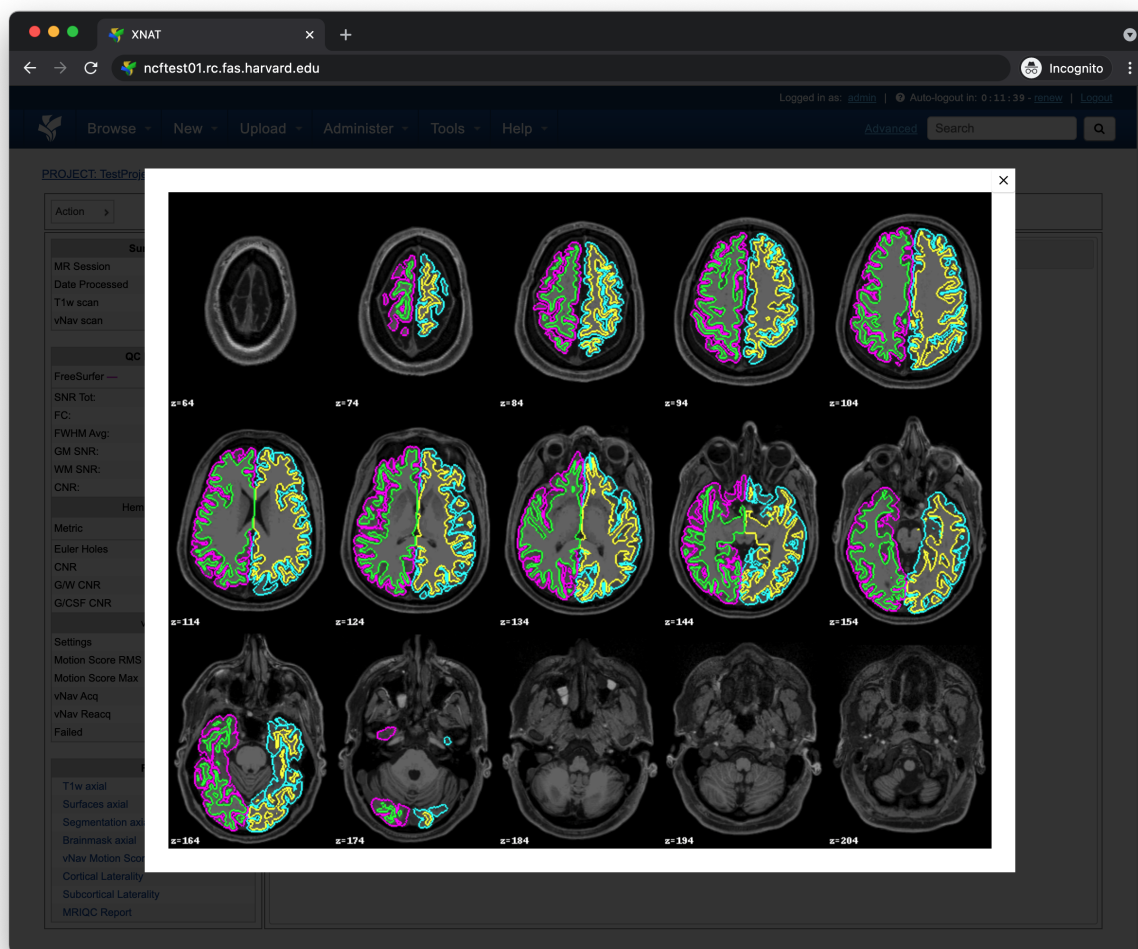
- Settings: 144 → 168
- Motion Score RMS: 3.671
- Motion Score Max: 5.733
- vNav Acq: 144
- vNav Reacq: 0
- Failed: no

At the bottom of the sidebar is a 'Files' section with a list of files:

- T1w axial
- Surfaces axial
- Segmentation axial
- Brainmask axial
- vNav Motion Scores RMS
- Cortical Laterality
- Subcortical Laterality
- MRIQC Report

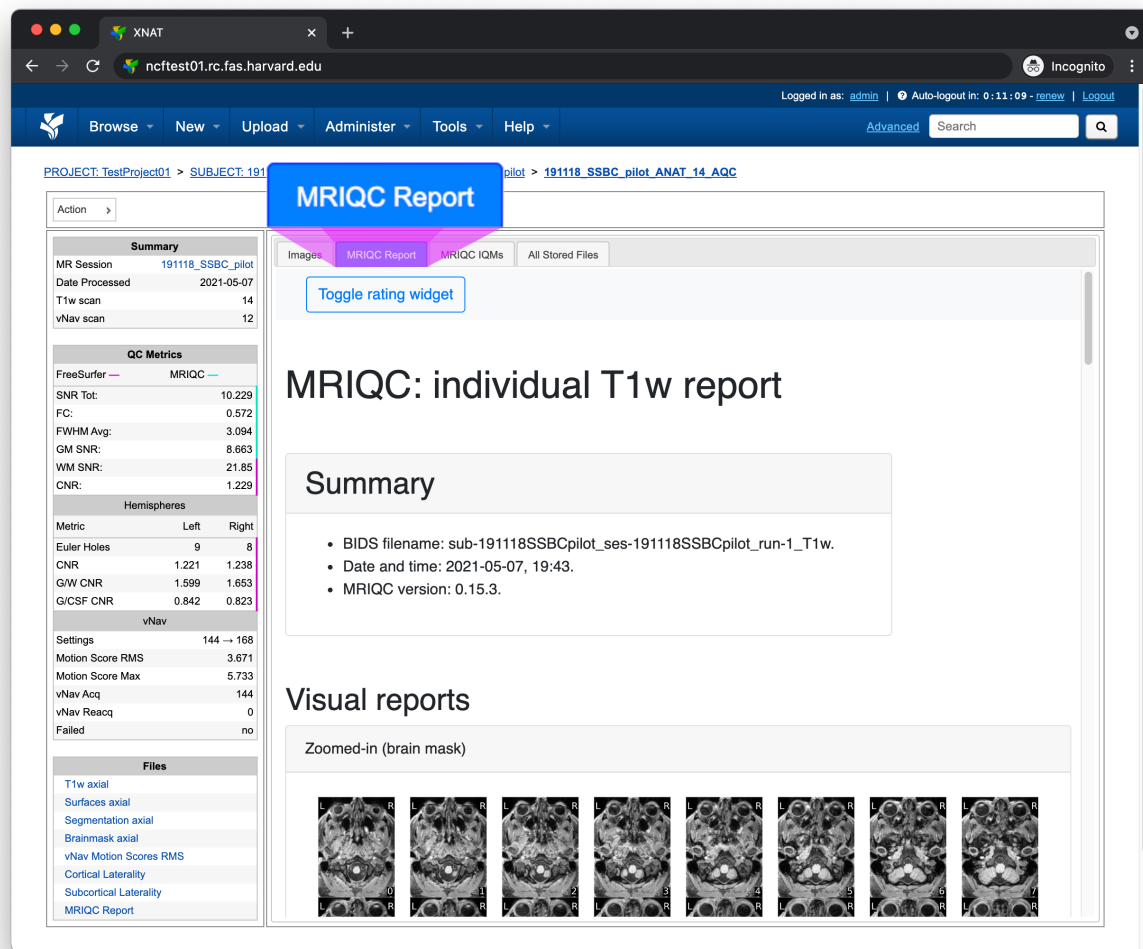
Clicking on an image within the Images tab will display a larger version of that image in the browser

Note: AnatQC automatically crops and centers each brain slice for improved visibility. For this reason, slices will often appear larger than their native size.



MRIQC Report tab

The MRIQC Report tab displays the complete MRIQC HTML report



The screenshot shows the XNAT web interface with the MRIQC Report page. The browser address bar shows 'ncftest01.rc.fas.harvard.edu'. The user is logged in as 'admin' and the auto-logout time is 0:11:09. The page title is 'MRIQC Report'. The left sidebar contains a 'Summary' section with the following data:

Summary	
MR Session	191118_SSBC_pilot
Date Processed	2021-05-07
T1w scan	14
vNav scan	12

Below the summary is the 'QC Metrics' section, which includes a table of metrics for the Left and Right hemispheres:

Metric	Left	Right
SNR Tot:	10.229	
FC:	0.572	
FWHM Avg:	3.094	
GM SNR:	8.663	
WM SNR:	21.85	
CNR:	1.229	

The 'Visual reports' section shows a 'Zoomed-in (brain mask)' view with a grid of 8 axial brain slices. The 'MRIQC Report' tab is highlighted in blue, and the 'Toggle rating widget' button is visible.

MRIQC IQMs

The MRIQC IQMs tab displays all of the MRIQC Image Quality Metrics. These metrics can also be found within the MRIQC HTML Report

PROJECT: TestProject01 > SUBJECT: 191118_SSBC_pilot > SSBC_pilot_ANAT_14_AQC

Action >

MRIQC IQMs

Images | MRIQC Report | **MRIQC IQMs** | All Stored Files

#	Metric	Value
1	cjv	0.53
2	cnr	2.31
3	efc	0.572
4	fber	3671.582
5	fwhm_avg	3.094
6	fwhm_x	3.143
7	fwhm_y	3.169
8	fwhm_z	2.969
9	icvs_csf	0.179
10	icvs_gm	0.422
11	icvs_wm	0.399
12	inu_med	1.706
13	inu_range	0.607
14	ql_1	0
15	ql_2	0.002
16	rpve_csf	30.803
17	rpve_gm	14.311
18	rpve_wm	18.364
19	size_x	176
20	size_y	256
21	size_z	256
22	snr_csf	3.341
23	snr_gm	8.663
24	snr_total	10.229
25	snr_wm	18.684

Summary

MR Session: 191118_SSBC_pilot
 Date Processed: 2021-05-07
 T1w scan: 14
 vNav scan: 12

QC Metrics

FreeSurfer: 10.229
 MRIQC: 0.572
 SNR Tot: 10.229
 FC: 0.572
 FWHM Avg: 3.094
 GM SNR: 8.663
 WM SNR: 21.85
 CNR: 1.229

Hemispheres

Metric	Left	Right
Euler Holes	9	8
CNR	1.221	1.238
G/W CNR	1.599	1.653
G/CSF CNR	0.842	0.823

vNav

Settings: 144 → 168
 Motion Score RMS: 3.671
 Motion Score Max: 5.733
 vNav Acq: 144
 vNav Reacq: 0
 Failed: no

Files

- T1w axial
- Surfaces axial
- Segmentation axial
- Brainmask axial
- vNav Motion Scores RMS
- Cortical Laterality
- Subcortical Laterality
- MRIQC Report

All Stored Files

The All Stored Files tab contains a list of *every file* stored by AnatQC

The screenshot shows the XNAT web interface. The browser address bar displays 'ncftest01.rc.fas.harvard.edu'. The user is logged in as 'admin'. The main content area is titled 'All Stored Files' and shows a list of 11 files. A blue callout box highlights the 'All Stored Files' tab.

#	File	Description	Type
1	191118_SSBC_pilot_ANAT_14_AQC_T1w_axial.png	T1w axial image	image/png
2	191118_SSBC_pilot_ANAT_14_AQC_aseg_axial.png	Segmentation axial image	image/png
3	191118_SSBC_pilot_ANAT_14_AQC_brainmask_axial.png	Brainmask axial image	image/png
4	191118_SSBC_pilot_ANAT_14_AQC_surface_axial.png	Surfaces axial image	image/png
5	191118_SSBC_pilot_ANAT_14_AQC_aparc_laterality.png	Cortical laterality plot	image/png
6	191118_SSBC_pilot_ANAT_14_AQC_aseg_laterality.png	Subcortical laterality plot	image/png
7	191118_SSBC_pilot_ANAT_14_AQC_mriqc.html	MRIQC Report	text/html
8	191118_SSBC_pilot_ANAT_14_AQC_freesurfer.tar.gz	FreeSurfer results	application/gzip
9	191118_SSBC_pilot_ANAT_14_AQC_vNav_Motion.json	vNav Report	text/json
10	191118_SSBC_pilot_ANAT_14_AQC_vNavMotionScoresMax.png	vNav Motion Scores Max	text/png
11	191118_SSBC_pilot_ANAT_14_AQC_vNavMotionScoresRMS.png	vNav Motion Scores RMS	text/png

Note: Clicking on a file within the All Stored Files tab will download that file.

File	Description
*_AQC_T1w_axial.png	T1-weighted image, axial plane
*_AQC_aseg_axial.png	FreeSurfer segmentations, axial plane
*_AQC_brainmask_axial.png	FreeSurfer brain mask image, axial plane
*_AQC_surface_axial.png	FreeSurfer surface boundaries, axial plane
*_AQC_aparc_laterality.png	FreeSurfer parcellation laterality plot
*_AQC_aseg_laterality.png	FreeSurfer segmentation laterality plot
*_AQC_mriqc.html	MRIQC HTML report
*_AQC_freesurfer.tar.gz	FreeSurfer results
*_AQC_vNav_Motion.json	vNav processing output
*_AQC_vNavMotionScoresMax.png	vNav motion max plot
*_AQC_vNavMotionScoresRMS.png	vNav motion RMS plot

DEVELOPER DOCUMENTATION

2.1 Installation

At the moment, the only supported way to install AnatQC is *within a container*.

2.1.1 downloading a container

There are prebuilt versions of AnatQC on [Docker Hub](#). You can pull the latest version by running

```
docker pull neuroinformatics/anatqc
```

or you can pull a specific version e.g., `0.4.0` by running

```
docker pull neuroinformatics/anatqc:0.4.0
```

2.1.2 building a container

To build AnatQC as a container, grab the latest [Dockerfile](#) from the repository and run

```
docker build -t anatqc:latest - < Dockerfile
```

Now you can run `anatQC.py` using `docker run`

```
docker run anatqc:latest --help
```

2.2 XNAT Installation

The following section will describe how to build and configure AnatQC as a [XNAT](#) plugin.

2.2.1 building the plugin

Clone the `xnat-1.7.6` branch from the `github.com/harvard-nrg/anatqc` repository

```
git clone -b xnat-1.7.6 --single-branch https://github.com/harvard-nrg/anatqc
```

Change into the repository directory and compile the plugin using [Gradle](#)

```
./gradlew jar
```

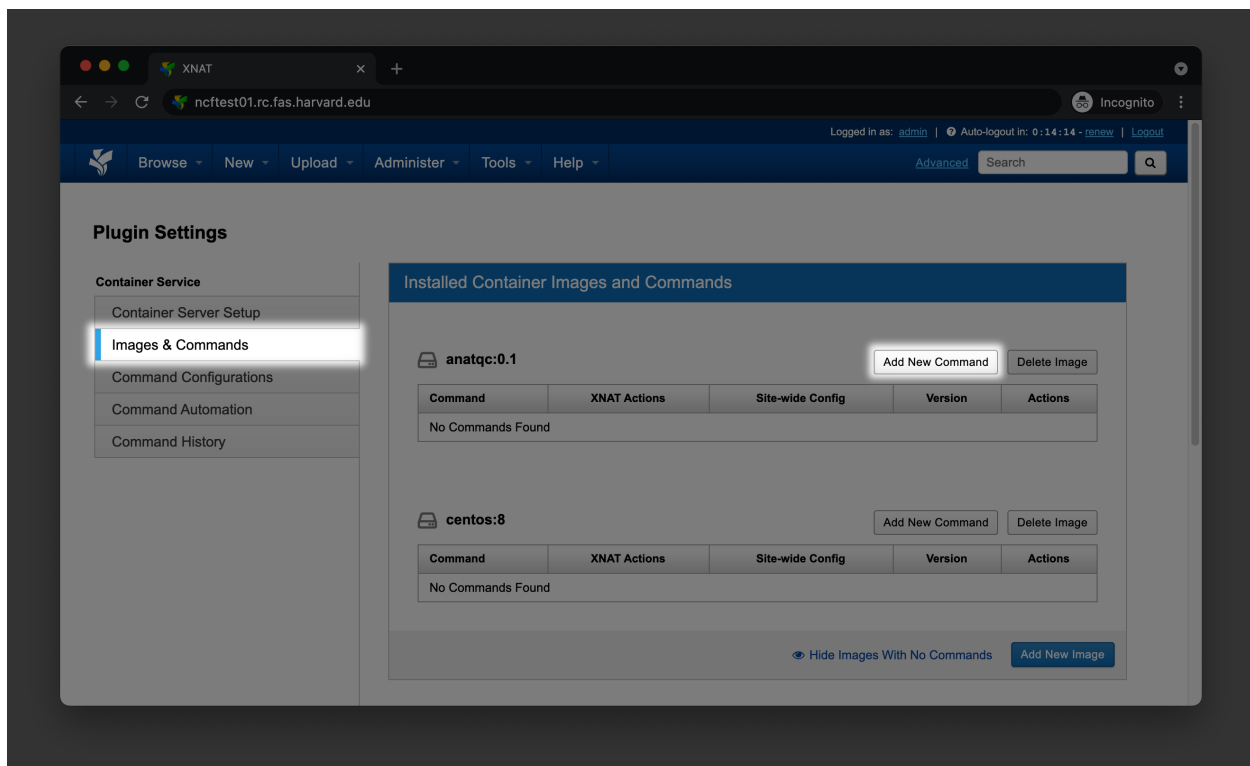
Once the plugin has been compiled, move the resulting `.jar` into your XNAT plugins directory

```
mv ./build/libs/anatqc-plugin-1.0.0.jar ${XNAT_HOME}/plugins/
```

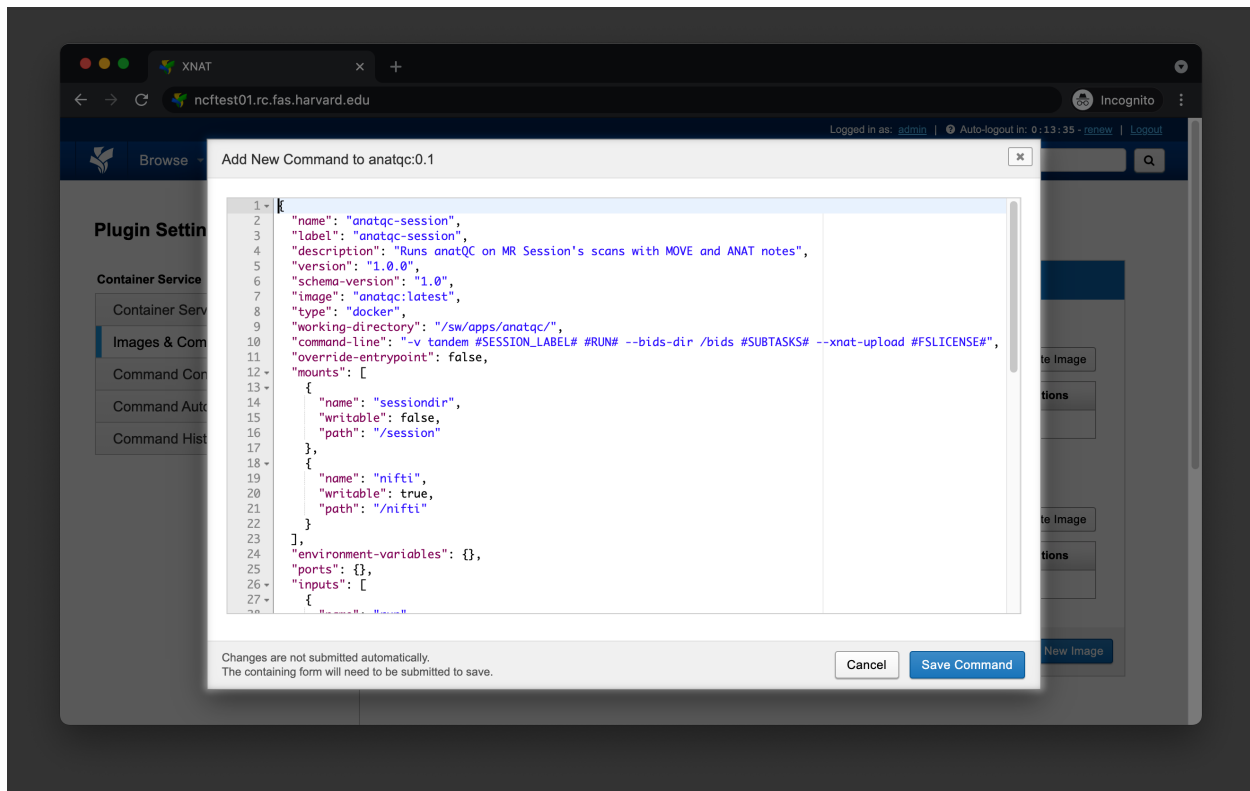
2.2.2 setting up the container

Note: This documentation assumes you have successfully *built the container* and that the container is being served from a local Docker daemon e.g., `unix:///var/run/docker.sock` on your XNAT server.

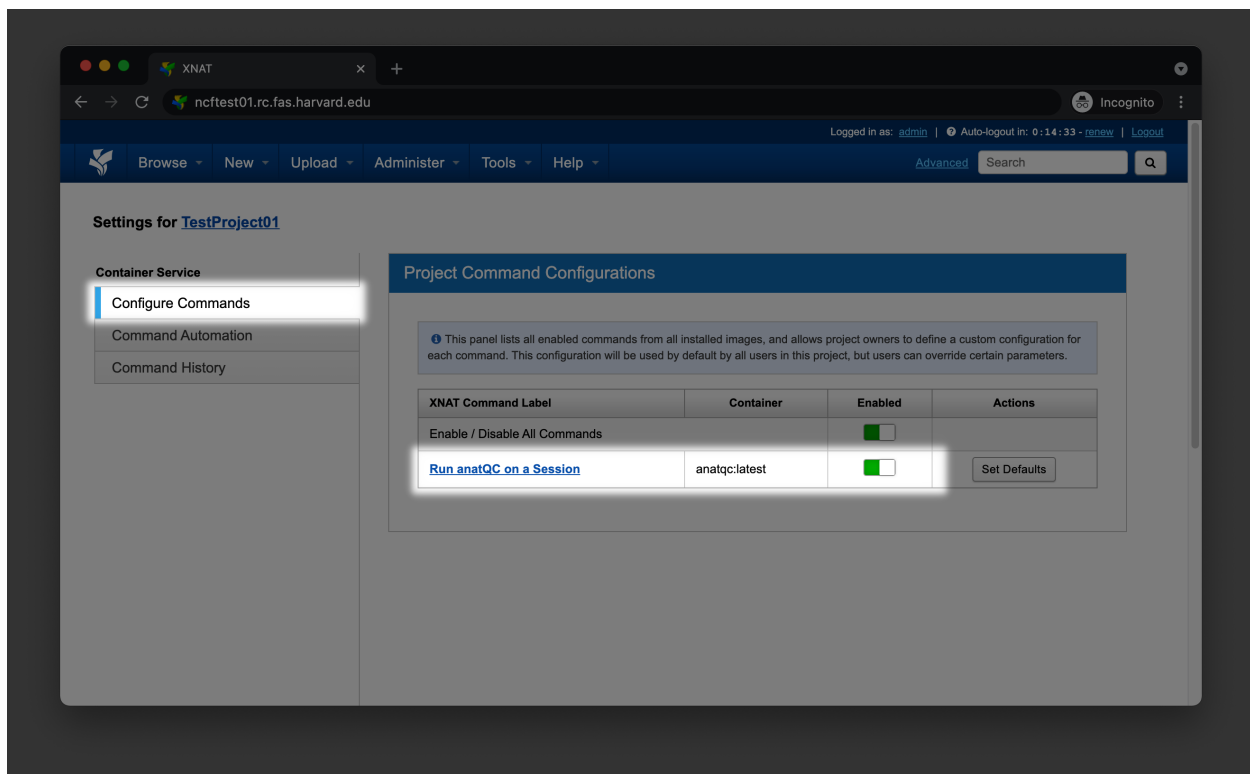
To setup the container within XNAT, go to **Administer > Plugin Settings > Images & Commands**, find the AnatQC container, and click **Add New Command**



You should see a small dialog box where you can configure your command. Paste the content from [command.json](#).



Navigate to your Project's home page and click on Project Settings in the Actions box. Select Configure Commands and enable the new command for your project



INDICES AND TABLES

- `genindex`
- `modindex`
- `search`