



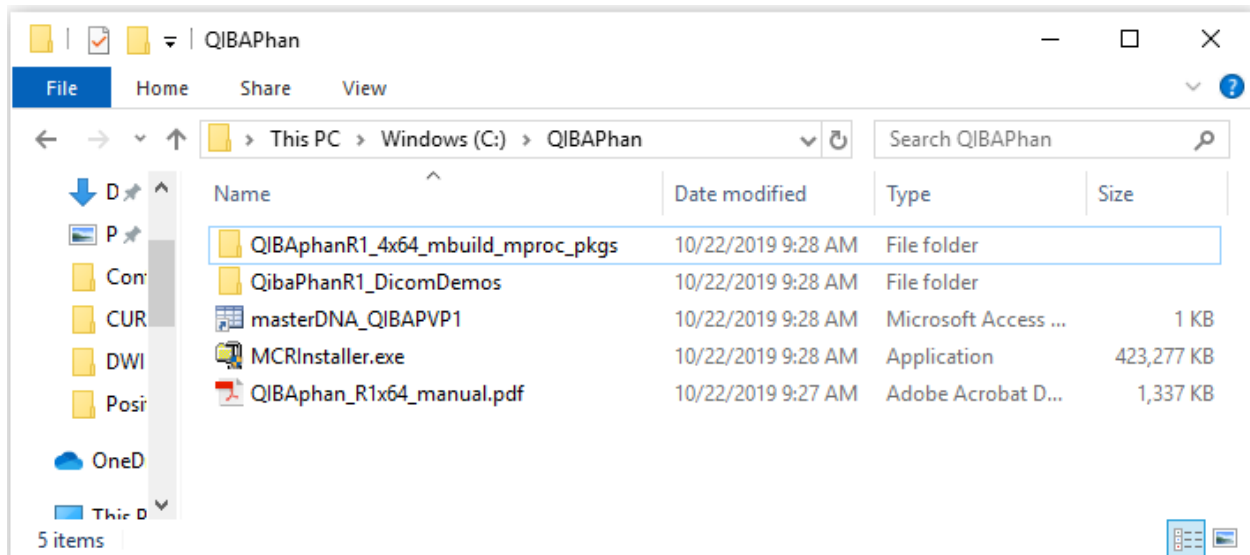
QIBA profile conformance testing

DWI MR

Supplement 2

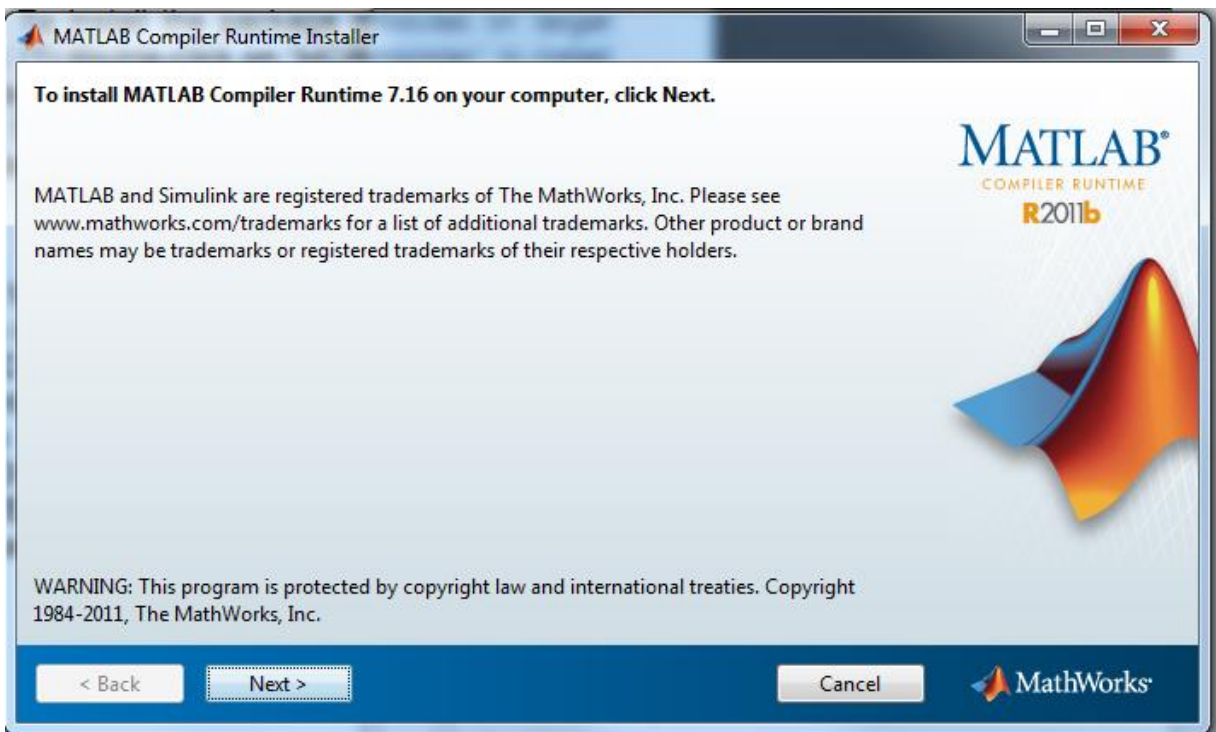
1. Get QIBAPhan

- a. Go to <http://qidw.rsna.org>
 - i. You will need permission to access the folders located below. Please check with Joe Koudelik to ensure you have access (jkoudelik@rsna.org)
 - ii. Click on “Collections” on the left-hand side of the screen
 - iii. Click on “MR Modality Datasets”
 - iv. Click on “Diffusion Weighted MR Imaging (DWI)”
 - v. Click on “DWI Profile Conformance”
 - vi. Click on “QIBA_DWI_Phan_AnalysisSW”
- b. Download all four files for QIBAPhan (431 MB total)
 - i. MCRInstaller.zip
 - ii. QIBaphan_R1x64_manual.pdf
 - iii. QIBaphanR1_4x64_mbuild_mproc_pkgs.zip
 - iv. QIBAPhanR1_DicomDemos.zip
- c. Extract zip files to c:\QIBAPhan; move manual .pdf to this directory as well

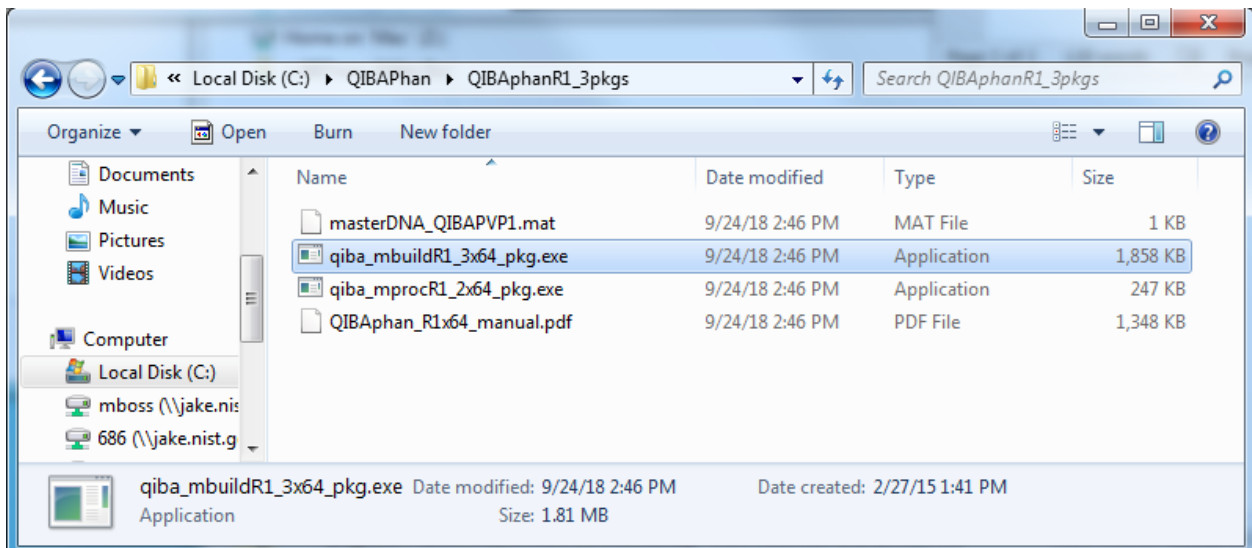


2. Install QIBAPhan *(directions located in QIBAphanR1_3pkgs\QIBAphan_R1x64_manual.pdf)*

- a. First, double-click on MCRIInstaller to install requisite MATLAB runtime libraries (~1 GB)



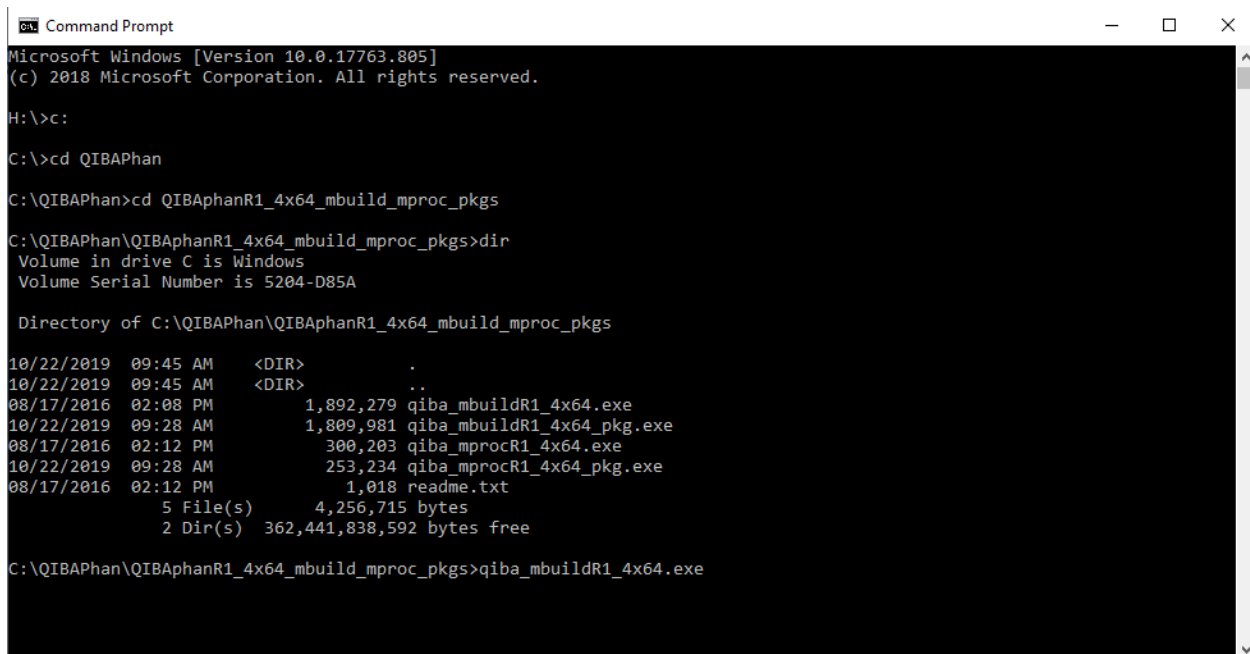
- b. Go into the QIBAPhanR1_4x64_mbuild_mproc_pkgs directory
 - i. Double-click the qiba_mbuildR1_4x64_pkg.exe file



- ii. Double-click the qiba_mprocR1_4x64_pkg.exe file
 1. You will be asked to overwrite or rename a readme.txt file. It is identical to the one created in the previous step, so just overwrite it.
- c. QIBAPhan is now installed and ready to process data

3. Using QIBAPhan

- a. For the following steps, if a mistake is made, please close the terminal window, then bring up a new one to start over. Your data will not be harmed, but there is no going back if you mistype a “y” or “n” to a prompt in the terminal window.
 - i. This is very likely to happen the first few times you use the software. It pays to go slow and wait for prompts.
- b. **Building data structures:** Start a command prompt: click on the Start menu and type “cmd”. For the following commands, you may find it simplifies keystrokes to take advantage of hitting “tab” to autocomplete your entries, e.g., type “c:\Q” and then tab to get c:\QIBAPhan
 - i. Type “cd c:\QIBAPhan\QIBAphanR1_4x64_mbuild_mproc_pkgs”
 - ii. Type “qiba_mbuildr1_4x64”



```
Command Prompt
Microsoft Windows [Version 10.0.17763.805]
(c) 2018 Microsoft Corporation. All rights reserved.

H:\>c:

C:\>cd QIBAPhan

C:\QIBAPhan>cd QIBAphanR1_4x64_mbuild_mproc_pkgs

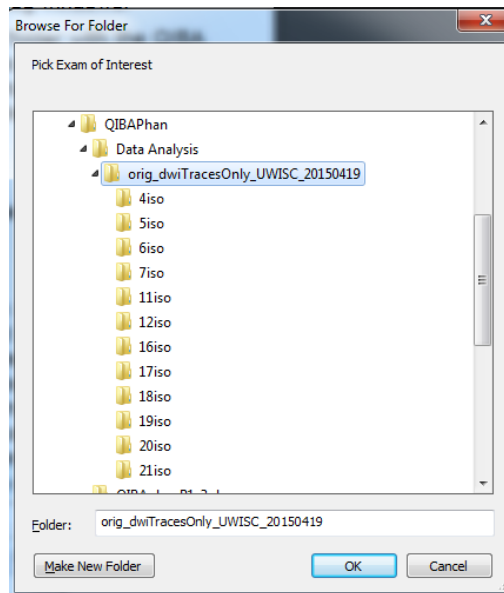
C:\QIBAPhan\QIBAphanR1_4x64_mbuild_mproc_pkgs>dir
Volume in drive C is Windows
Volume Serial Number is 5204-D85A

Directory of C:\QIBAPhan\QIBAphanR1_4x64_mbuild_mproc_pkgs
10/22/2019 09:45 AM <DIR>          .
10/22/2019 09:45 AM <DIR>          ..
08/17/2016 02:08 PM             1,892,279 qiba_mbuildR1_4x64.exe
10/22/2019 09:28 AM             1,809,981 qiba_mbuildR1_4x64_pkg.exe
08/17/2016 02:12 PM              300,203 qiba_mprocR1_4x64.exe
10/22/2019 09:28 AM             253,234 qiba_mprocR1_4x64_pkg.exe
08/17/2016 02:12 PM                1,018 readme.txt
                    5 File(s)      4,256,715 bytes
                    2 Dir(s)  362,441,838,592 bytes free

C:\QIBAPhan\QIBAphanR1_4x64_mbuild_mproc_pkgs>qiba_mbuildR1_4x64.exe
```

- iii. A dialogue will appear asking you to select an “exam folder”. Do not pick a series folder! Pick an exam folder which has been assembled from the prescribed QIBA DWI phantom protocol (described elsewhere).

- iv. Here an example is given, where I created a “Data Analysis” folder within c:\QIBAPhan, and within Data Analysis added a dataset from the University of Wisconsin. Note that I am choosing the top level UWISC directory.



- v. The scan series will be automatically cataloged by mbuild. Wait till it is finished.
- vi. When it is done, you will be asked if you want to build DWI data structures for this series. Answer “y” for each series. In this example, there are 12 series (4 repetitions for each of 3 phantom orientations, coronal, axial, and sagittal), and “y” must be individually typed for each one.

```

C:\Windows\system32\cmd.exe - qiba_mbuildr1_3x64
<FYI> Scan System Demographics:
SiteScanDemographics =
    Institution: 'WIMR'
    Manufacturer: 'GE MEDICAL SYSTEMS'
    Model: 'DISCOVERY MR750'
    FieldStrength: 3
    StationName: 'WIMRMR2'
    SerialNumber: '000000608WIMRMR2'
    SoftwareVersion: '24\LX\MR Software release:DU24.0_R01_1344.a'
    StudyDescription: 'Not Available'
    StudyDate: '20150419'
    StudyTime: '093513'
    PatientName: 'ZZNIST'

<FYI> Assigned "System ID" = "GE30T608WIMRMR2"

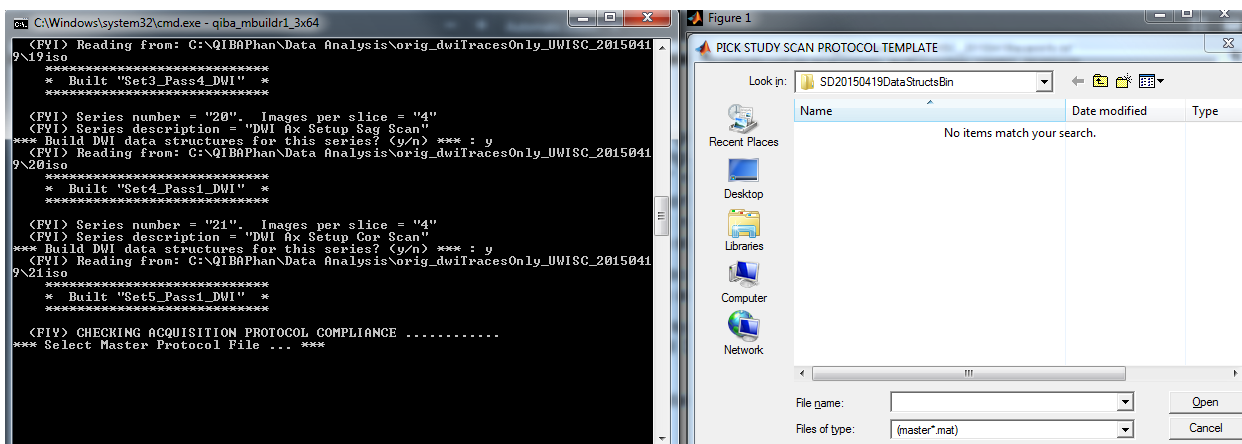
<FIY> BUILDING "DWI" DATA STRUCTURES FOR "orig_dwiTracesOnly_UWISC_20150419" S
CAN .....
*** Inspect scan catalogue to find candidate "DWI" series ***

<FYI> Series number = "4". Images per slice = "4"
<FYI> Series description = "DWI Cor 1"
*** Build DWI data structures for this series? (y/n) *** :

```

- vii. An informational window, “Figure 1” will also appear that can help you better identify the series in question.

viii. You will now be asked to select a “Master Protocol File”:



1. QIBAPhan has created a new directory (in this case, under C:\QIBAPhan\Data Analysis, at the same directory level as the Wisconsin data folder) called ****DataStructsBin. Use the Windows Explorer dialog (on the right in the above figure) to back out to the C:\QIBAPhan directory. Double-click on the QIBaphanR1_3pkgs directory.
 2. Here, you will see a file called masterDNA_QIBAPVP1.mat. Choose this file and click “Open”.
 3. This will build the ADC data structures
- ix. Next, you will be asked to include or exclude data for generation of data structures for multipass SNR analysis. In general, you will want to say yes to these dialogs in the terminal window so as to generate SNR statistics. You will also see another informational window, “Figure 2” that may show some non-compliance with the acquired data, but that does not necessarily mean that it cannot be properly analyzed.
- x. When these SNR data structures are done being generated, you may close the terminal window.

```

C:\Windows\system32\cmd.exe - qiba_mbuildR1_3x64.exe

*****
* Built "Set5_Pass1_DWI" *
*****

<FIY> CHECKING ACQUISITION PROTOCOL COMPLIANCE .....
*** Select Master Protocol File ... ***

<FIY> BUILDING "ADC" DATA STRUCTURES .....
<FYI> ADC data structure built for "GE30T608WIMRMR2_Set1_Pass1_ADC"
<FYI> ADC data structure built for "GE30T608WIMRMR2_Set1_Pass2_ADC"
<FYI> ADC data structure built for "GE30T608WIMRMR2_Set1_Pass3_ADC"
<FYI> ADC data structure built for "GE30T608WIMRMR2_Set1_Pass4_ADC"
<FYI> ADC data structure built for "GE30T608WIMRMR2_Set2_Pass1_ADC"
<FYI> ADC data structure built for "GE30T608WIMRMR2_Set2_Pass2_ADC"
<FYI> ADC data structure built for "GE30T608WIMRMR2_Set3_Pass1_ADC"
<FYI> ADC data structure built for "GE30T608WIMRMR2_Set3_Pass2_ADC"
<FYI> ADC data structure built for "GE30T608WIMRMR2_Set3_Pass3_ADC"
<FYI> ADC data structure built for "GE30T608WIMRMR2_Set3_Pass4_ADC"
<FYI> ADC data structure built for "GE30T608WIMRMR2_Set4_Pass1_ADC"
<FYI> ADC data structure built for "GE30T608WIMRMR2_Set5_Pass1_ADC"

<FIY> BUILDING MULTIPASS "SNR" DATA STRUCTURES .....
<FIY> Data contains *5* "Sets" for multipass analysis.
*** Include "Pass1" DWI (series "4") in "Set1" MULTIPASS SNR analysis (y/n) ? ***
* :

```

- c. **Processing data structures:** Start a new terminal window, and go to
 - i. C:\QIBAPhan\QIBAPhanR1_4x64_mbuild_mproc_pkgs
 - ii. Run qiba_mprocR1_4x64.exe
 - iii. Choose the SD****DataStructsBin the previous build steps generated.
 - iv. You will be asked to define ROIs:

```

C:\Windows\system32\cmd.exe - qiba_mprocR1x64.exe

Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\mboss.NIST>cd c:\QIBAPhan\QIBAPhanR1_3pkgs
c:\QIBAPhan\QIBAPhanR1_3pkgs>qiba_mprocR1x64.exe

*** Select "*DataStructsBin" folder containing "DWI" and "ADC" data structures .
.. ***
<FYI> SELECTED "DWI"/"ADC" DATA STRUCTURE FOLDER = "C:\QIBAPhan\Data Analysis\SD20150419DataStructsBin"

*** Define (n)ew ROIs or use (o)ld (n/o)? *** :

```

- vi. Assuming you don't have previously-generated ROIs, enter "y" to generate new ones

- vi. You will be asked for label names. Below, I have generated labels that will apply to the PVP concentration and their location within the phantom:

```

C:\Windows\system32\cmd.exe - qiba_mprocR1x64.exe
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\mboss.NIST>cd c:\QIBAPhan\QIBaphanR1_3pkgs
c:\QIBAPhan\QIBaphanR1_3pkgs>qiba_mprocR1x64.exe

*** Select "*DataStructsBin" folder containing "DWI" and "ADC" data structures .
.. ***
(FYI) SELECTED "DWI"/"ADC" DATA STRUCTURE FOLDER = "C:\QIBAPhan\Data Analysis\SD20150419DataStructsBin"

*** Define (n)ew ROIs or use (o)ld (n/o)? *** : n
*** Provide unique label for ROI group (eg, A, B1, CC12,...) *** : 0c, 0i, 0o, 10i, 10o, 20i, 20o, 30i, 30o, 40i, 40o, 50i, 50o
  
```

- vii. You will be asked to choose the default ROI shape and size, a circle 10 mm in diameter. Type "y" to accept, or "n" to enter a different ROI configuration.
- viii. Next, you will be asked to choose a DWI data structure (previously generated with the build sequence above) to define the ROIs, which will then be propagated to the other datasets. **This step is why it is important to properly position the phantom from one orientation to another, or even from scan session to scan session: it allows reuse of the ROIs you are about to define.**

```

C:\Windows\system32\cmd.exe - qiba_mprocR1x64.exe
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\mboss.NIST>cd c:\QIBAPhan\QIBaphanR1_3pkgs
c:\QIBAPhan\QIBaphanR1_3pkgs>qiba_mprocR1x64.exe

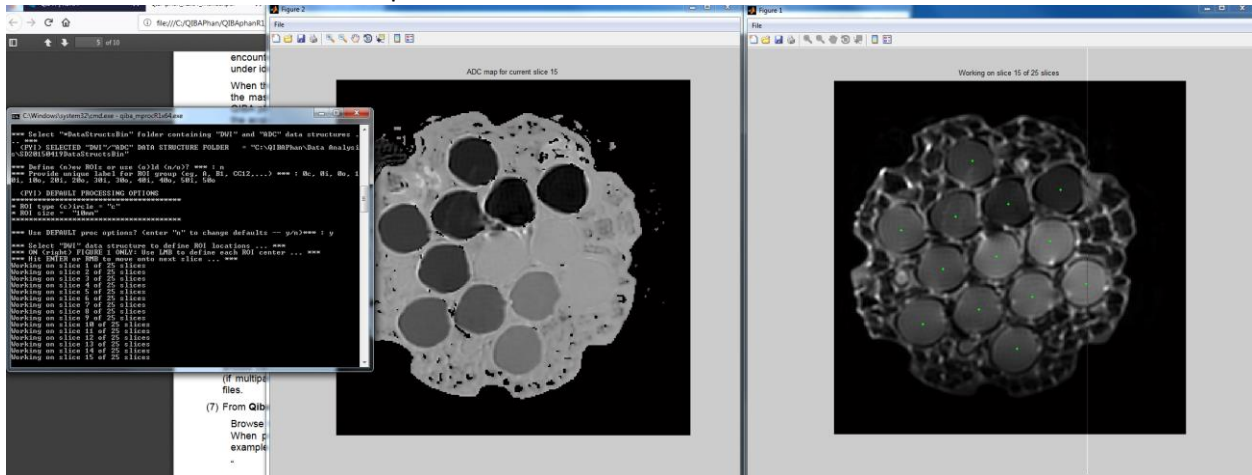
*** Select "*DataStructsBin" folder containing "DWI" and "ADC" data structures .
.. ***
(FYI) SELECTED "DWI"/"ADC" DATA STRUCTURE FOLDER = "C:\QIBAPhan\Data Analysis\SD20150419DataStructsBin"

*** Define (n)ew ROIs or use (o)ld (n/o)? *** : n
*** Provide unique label for ROI group (eg, A, B1, CC12,...) *** : 0c, 0i, 0o, 10i, 10o, 20i, 20o, 30i, 30o, 40i, 40o, 50i, 50o

(FYI) DEFAULT PROCESSING OPTIONS
*****
* ROI type (c)ircle = "c"
* ROI size = "10mm"
*****
*** Use DEFAULT proc options? (enter "n" to change defaults -- y/n)*** : y
*** Select "DWI" data structure to define ROI locations ... ***
  
```

Name	Date modified	Type
GE30T608WIMRMR2_Set1_Pass1_DWL.mat	9/24/18 3:32 PM	MAT File
GE30T608WIMRMR2_Set1_Pass2_DWL.mat	9/24/18 3:32 PM	MAT File
GE30T608WIMRMR2_Set1_Pass3_DWL.mat	9/24/18 3:32 PM	MAT File
GE30T608WIMRMR2_Set1_Pass4_DWL.mat	9/24/18 3:32 PM	MAT File
GE30T608WIMRMR2_Set2_Pass1_DWL.mat	9/24/18 3:33 PM	MAT File
GE30T608WIMRMR2_Set2_Pass2_DWL.mat	9/24/18 3:33 PM	MAT File
GE30T608WIMRMR2_Set2_Pass3_DWL.mat	9/24/18 3:33 PM	MAT File
GE30T608WIMRMR2_Set2_Pass4_DWL.mat	9/24/18 3:33 PM	MAT File
GE30T608WIMRMR2_Set3_Pass1_DWL.mat	9/24/18 3:33 PM	MAT File
GE30T608WIMRMR2_Set3_Pass2_DWL.mat	9/24/18 3:33 PM	MAT File
GE30T608WIMRMR2_Set3_Pass3_DWL.mat	9/24/18 3:33 PM	MAT File
GE30T608WIMRMR2_Set3_Pass4_DWL.mat	9/24/18 3:33 PM	MAT File
GE30T608WIMRMR2_Set4_Pass1_DWL.mat	9/24/18 3:33 PM	MAT File
GE30T608WIMRMR2_Set5_Pass1_DWL.mat	9/24/18 3:33 PM	MAT File

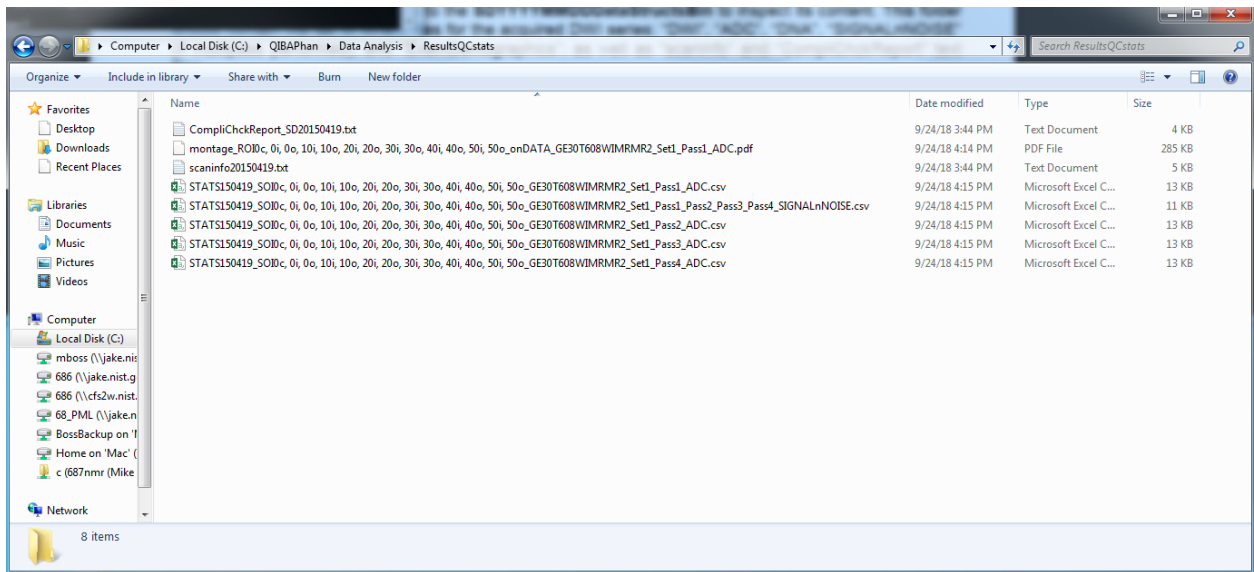
- ix. You will now find two more dialog windows have opened: Figure 2 contains an ADC map, and Figure 1 contains the “raw” DWI.
 1. You will select ROI centers in the DWI window, but can use the ADC map as a guide.
 2. Use any arrow key to advance to the next slice.
 3. It is a good idea to try to sample near the center slices of the phantom, assuming this corresponds with magnet isocenter. It is easy to identify the phantom center by the plate which contains the letters “HPD” (the phantom manufacturer).
 4. Assuming you have looked at the images in another viewer and know you have good centering, you will begin placing ROIs in slice 11, and stop in slice 15.
 5. Click on the center of the vials where you would like your ROIs to be placed



6. Here, I have shown the final image in my five slices of interest. The green dots are the center of the ROIs.
 - a. It is very important to click on the ROIs in the same order, matching your labels from the previous steps above! Use the ADC map to properly identify the vials.
 - b. Because I am generating VOI statistics from 5 slices, each with 13 ROIs (corresponding to the 13 vials), I will have a total of 65 ROIs.
- x. Next, you will be asked to pick an ROI file. Click on the filename auto-generated for you.
- xii. If you have no other ROIs to generate, type “n” in the terminal window. You may want to generate additional ROI sets for the other orientations of the phantom if they do not match well with the first orientation’s data set due to misalignment.
- xii. You will then be asked to which datasets you wish to apply this ROI. In the example, this is the coronal dataset (Set 1), so I will only apply it to the coronal series.

d. Parsing analysis results

- i. At this point, QIBAPhan has completed its analysis. It has generated .csv file with summary statistics. These are located in C:\QIBAPhan\Data Analysis\ResultsQCstats for the example above:



- ii. You may parse the .csv file statistics for each pass for a given phantom orientation as you like. Alternatively, you may examine the summary .csv file which generates SNR statistics to get statistics on the ADC values across the VOIs for all passes (protocol dictates 4 passes for each orientation). This larger .csv file is often times the most useful for summary statistics.

GOOD LUCK! Feel free to ask questions, Michael.a.boss@gmail.com, more specific questions may require consulting the package authors.