

This file provides information about the data set in the directory QIBA\_T1\_v03\_beta1.

Two sets of images are provided. DICOM part 10 format images are in the DICOM directory. XML files are in the XML directory. The XML images allow the values for the DICOM tags to be altered using a text editor, and new DICOM images can then be generated using dcm4che's tool called "xml2dcm," available at <http://www.dcm4che.org/confluence/display/d2/dcm4che2+DICOM+Toolkit>.

The parameter used to generate this data is:

Repetition Time = 5 msec

The test data is generated using several combinations of R1 and S0. R1 takes values of 0.0003536 through 0.0452548 ms<sup>-1</sup> using a  $\sqrt{2}$  progression. The values used in the set were: {0.0003536, 0.0005, 0.0007071, 0.001, 0.0014142, 0.002, 0.0028284, 0.004, 0.0056569, 0.008, 0.0113137, 0.016, 0.0226274, 0.032, 0.0452548} ms<sup>-1</sup>. S0 takes values of {500, 1000, 2000, 5000, 10000, 20000, 50000}. The test data contains 10\*10 pixels patches of each R1 and S0 combination. R1 values vary along the x direction. S0 varies along the y direction.

Simulated MR noise with a given noise level Sigma was added to all images. Noise was applied using the formula  $A = \sqrt{(R + r1)^2 + (r2)^2}$  where A is output "actual" signal intensity with noise, R is the input "noiseless" signal intensity, and r1 and r2 are gaussian noise with mean 0 and SD sigma. Sigma values of 2, 5, 10, 20, 50, and 100 were used.

The signal intensity images were generated for the following different flip angles: 3, 6, 9, 15, 24, 35 degrees. The files in the zip folder have the following names:

| filename | flip angle (in degrees) |
|----------|-------------------------|
| fa3      | 3                       |
| fa6      | 6                       |
| fa9      | 9                       |
| fa15     | 15                      |
| fa24     | 24                      |
| fa35     | 35                      |

The peak Signal Intensity for each flip angle is the top-left 75\*10 pixels strip of the image. This strip also contains a label with the flip angle and sigma value. No information is in the top-right 75\*10 pixels strip, so those pixels would have intensity values of 0 if no noise were added.

The following is a detailed list giving the specific R1, S0 combination used to generate each 10\*10 patch. The x,y location specifies the coordinates of the upper-left corner of each patch.

| x  | y  | R1        | S0    |
|----|----|-----------|-------|
| 0  | 10 | 0.0003536 | 500   |
| 0  | 20 | 0.0003536 | 1000  |
| 0  | 30 | 0.0003536 | 2000  |
| 0  | 40 | 0.0003536 | 5000  |
| 0  | 50 | 0.0003536 | 10000 |
| 0  | 60 | 0.0003536 | 20000 |
| 0  | 70 | 0.0003536 | 50000 |
| 10 | 10 | 0.0005    | 500   |
| 10 | 20 | 0.0005    | 1000  |
| 10 | 30 | 0.0005    | 2000  |
| 10 | 40 | 0.0005    | 5000  |
| 10 | 50 | 0.0005    | 10000 |
| 10 | 60 | 0.0005    | 20000 |
| 10 | 70 | 0.0005    | 50000 |
| 20 | 10 | 0.0007071 | 500   |

|     |    |           |       |
|-----|----|-----------|-------|
| 20  | 20 | 0.0007071 | 1000  |
| 20  | 30 | 0.0007071 | 2000  |
| 20  | 40 | 0.0007071 | 5000  |
| 20  | 50 | 0.0007071 | 10000 |
| 20  | 60 | 0.0007071 | 20000 |
| 20  | 70 | 0.0007071 | 50000 |
| 30  | 10 | 0.001     | 500   |
| 30  | 20 | 0.001     | 1000  |
| 30  | 30 | 0.001     | 2000  |
| 30  | 40 | 0.001     | 5000  |
| 30  | 50 | 0.001     | 10000 |
| 30  | 60 | 0.001     | 20000 |
| 30  | 70 | 0.001     | 50000 |
| 40  | 10 | 0.0014142 | 500   |
| 40  | 20 | 0.0014142 | 1000  |
| 40  | 30 | 0.0014142 | 2000  |
| 40  | 40 | 0.0014142 | 5000  |
| 40  | 50 | 0.0014142 | 10000 |
| 40  | 60 | 0.0014142 | 20000 |
| 40  | 70 | 0.0014142 | 50000 |
| 50  | 10 | 0.002     | 500   |
| 50  | 20 | 0.002     | 1000  |
| 50  | 30 | 0.002     | 2000  |
| 50  | 40 | 0.002     | 5000  |
| 50  | 50 | 0.002     | 10000 |
| 50  | 60 | 0.002     | 20000 |
| 50  | 70 | 0.002     | 50000 |
| 60  | 10 | 0.0028284 | 500   |
| 60  | 20 | 0.0028284 | 1000  |
| 60  | 30 | 0.0028284 | 2000  |
| 60  | 40 | 0.0028284 | 5000  |
| 60  | 50 | 0.0028284 | 10000 |
| 60  | 60 | 0.0028284 | 20000 |
| 60  | 70 | 0.0028284 | 50000 |
| 70  | 10 | 0.004     | 500   |
| 70  | 20 | 0.004     | 1000  |
| 70  | 30 | 0.004     | 2000  |
| 70  | 40 | 0.004     | 5000  |
| 70  | 50 | 0.004     | 10000 |
| 70  | 60 | 0.004     | 20000 |
| 70  | 70 | 0.004     | 50000 |
| 80  | 10 | 0.0056569 | 500   |
| 80  | 20 | 0.0056569 | 1000  |
| 80  | 30 | 0.0056569 | 2000  |
| 80  | 40 | 0.0056569 | 5000  |
| 80  | 50 | 0.0056569 | 10000 |
| 80  | 60 | 0.0056569 | 20000 |
| 80  | 70 | 0.0056569 | 50000 |
| 90  | 10 | 0.008     | 500   |
| 90  | 20 | 0.008     | 1000  |
| 90  | 30 | 0.008     | 2000  |
| 90  | 40 | 0.008     | 5000  |
| 90  | 50 | 0.008     | 10000 |
| 90  | 60 | 0.008     | 20000 |
| 90  | 70 | 0.008     | 50000 |
| 100 | 10 | 0.0113137 | 500   |

|     |    |           |       |
|-----|----|-----------|-------|
| 100 | 20 | 0.0113137 | 1000  |
| 100 | 30 | 0.0113137 | 2000  |
| 100 | 40 | 0.0113137 | 5000  |
| 100 | 50 | 0.0113137 | 10000 |
| 100 | 60 | 0.0113137 | 20000 |
| 100 | 70 | 0.0113137 | 50000 |
| 110 | 10 | 0.016     | 500   |
| 110 | 20 | 0.016     | 1000  |
| 110 | 30 | 0.016     | 2000  |
| 110 | 40 | 0.016     | 5000  |
| 110 | 50 | 0.016     | 10000 |
| 110 | 60 | 0.016     | 20000 |
| 110 | 70 | 0.016     | 50000 |
| 120 | 10 | 0.0226274 | 500   |
| 120 | 20 | 0.0226274 | 1000  |
| 120 | 30 | 0.0226274 | 2000  |
| 120 | 40 | 0.0226274 | 5000  |
| 120 | 50 | 0.0226274 | 10000 |
| 120 | 60 | 0.0226274 | 20000 |
| 120 | 70 | 0.0226274 | 50000 |
| 130 | 10 | 0.032     | 500   |
| 130 | 20 | 0.032     | 1000  |
| 130 | 30 | 0.032     | 2000  |
| 130 | 40 | 0.032     | 5000  |
| 130 | 50 | 0.032     | 10000 |
| 130 | 60 | 0.032     | 20000 |
| 130 | 70 | 0.032     | 50000 |
| 140 | 10 | 0.0452548 | 500   |
| 140 | 20 | 0.0452548 | 1000  |
| 140 | 30 | 0.0452548 | 2000  |
| 140 | 40 | 0.0452548 | 5000  |
| 140 | 50 | 0.0452548 | 10000 |
| 140 | 60 | 0.0452548 | 20000 |
| 140 | 70 | 0.0452548 | 50000 |

The JSim model R1\_S0\_model\_20111012.proj was used to generate the signal intensity images. This model can be downloaded from a link provided on the QIBA page of our website. A link to download the JSim software is also provided.

The signal intensity for the T1 mapping images was calculated using the standard signal intensity equation,  $S = S_0 * (1 - E_0) * \sin(\theta) / [1 - (\cos(\theta) * E_0)]$  where S is the signal intensity, S0 is the equilibrium magnetization, theta is the flip angle, and  $E_0 = \exp(-TR/T_1)$ . This equation assumes that T2 effects are negligible.

Also included are three images in Analyze format: S0.img, R1.img, and T1.img. S0.img and R1.img are graphical representations of the S0 and R1 values given in the above table. The values in T1.img are the reciprocals of R1. R1 values have units of  $ms^{-1}$ . T1 values have units of ms. S0 values are unitless.