

Statistics of Intrinsic fMRI Data

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August 10, 2023



Outline

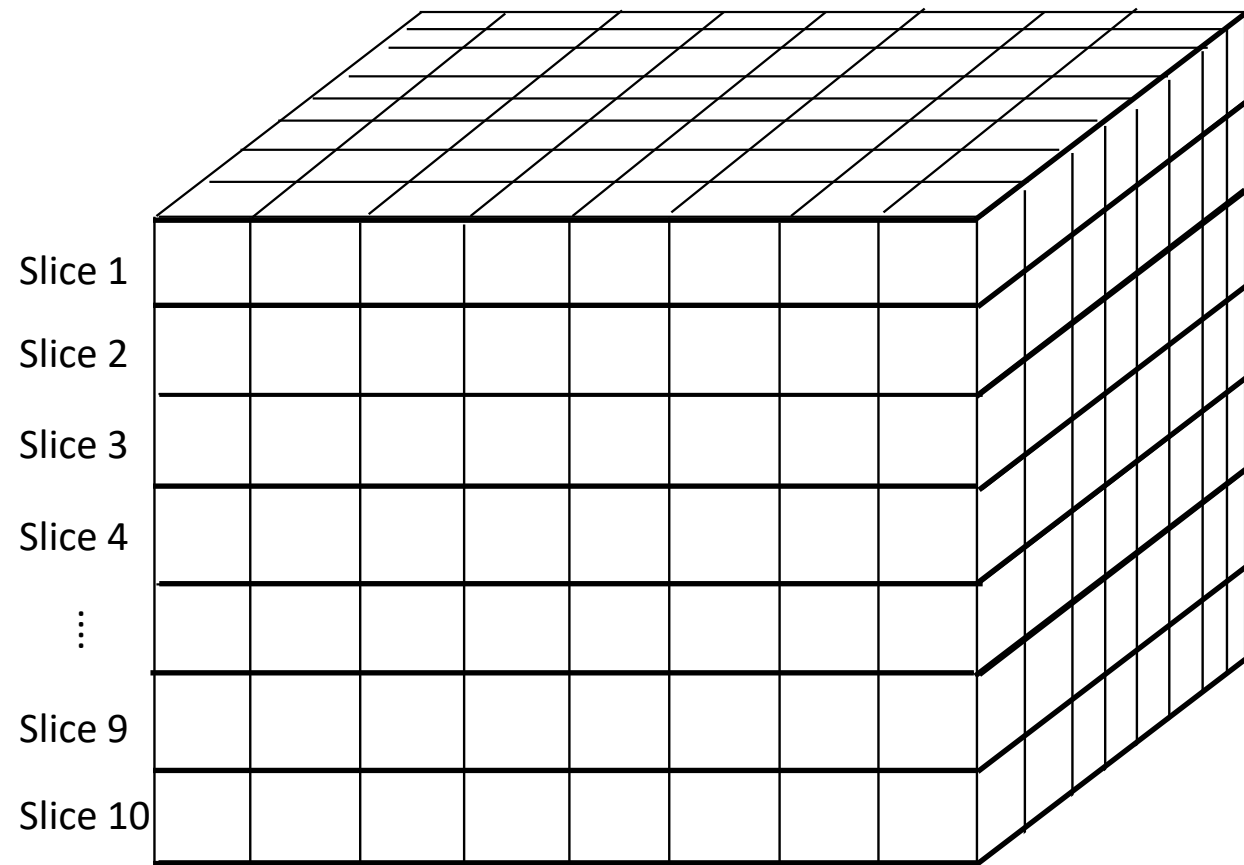
- 1. FMRI Data Acquisition**
- 2. FMRI RF Off No Signal Data**
- 3. FMRI RF Off No Signal Data + Simulated Signal**
- 4. FMRI RF On Signal Data + Noise**
- 5. FMRI Discussion**

1. fMRI Problem

In fMRI, a subject is placed in the MRI machine and slice-wise volume images of their brain measured



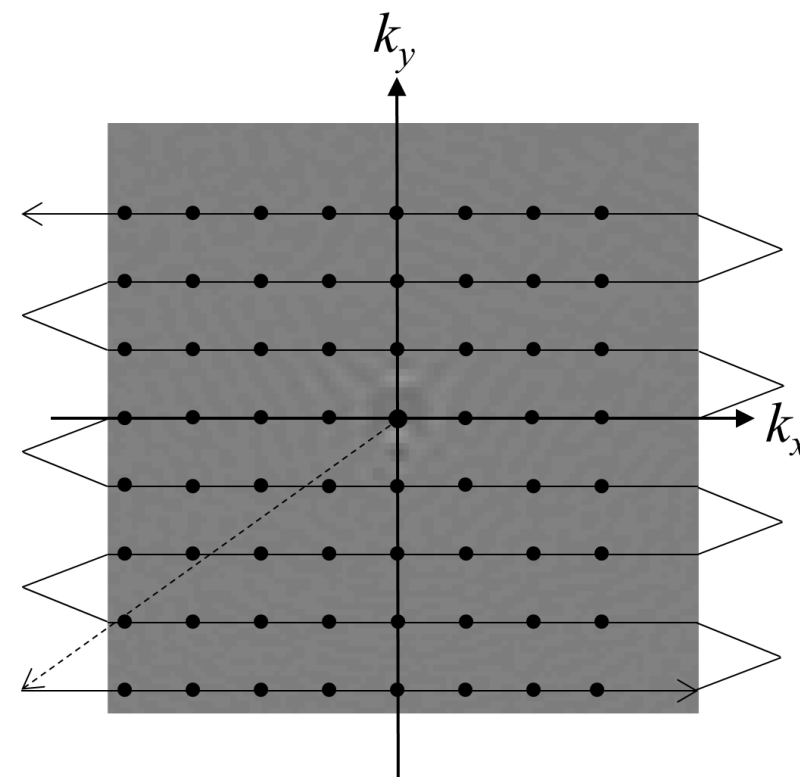
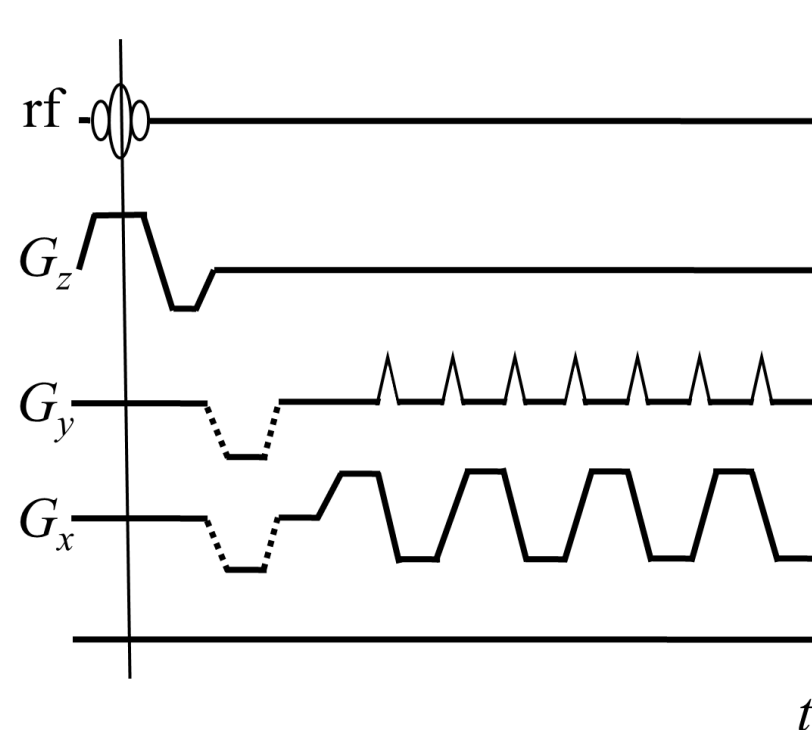
Volume Image



1. FMRI Data Acquisition

Magnetic field gradients are switched “left-right” to “travel” along different rows of k -space with in-between phase encodes to “increment” rows.

While gradients are switching, ADCs measure the current in a “wire” with normally distributed thermal noise, k -space amplitude coefficients.



Must travel along a trajectory like Pac-Man.
No jumping to other locations.

ROWE DB: Image Reconstruction in Functional MRI.
(205-232) In Handbook of Statistical Methods for
Brain Signals and Images, Chapman & Hall/CRC Press.
ISBN: 978-1-4822-20971

1. FMRI Data Acquisition

Data Set 1: No Signal

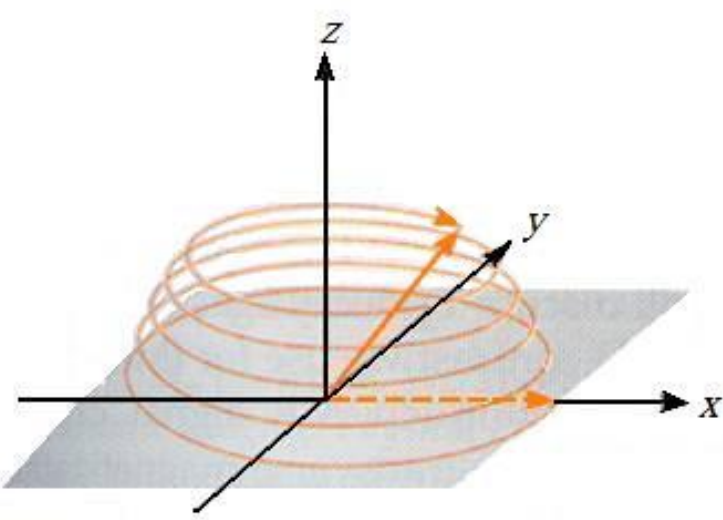
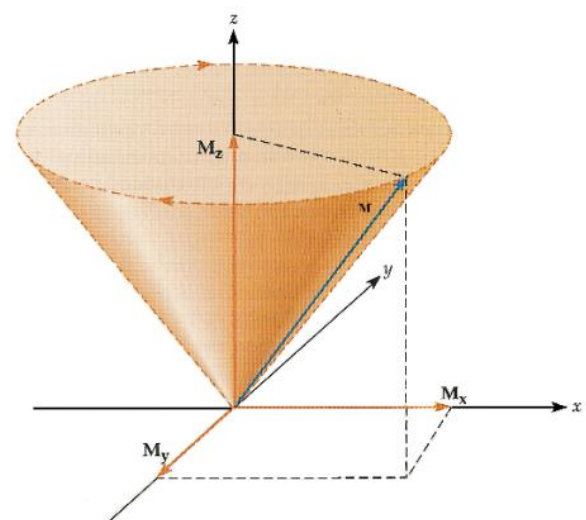
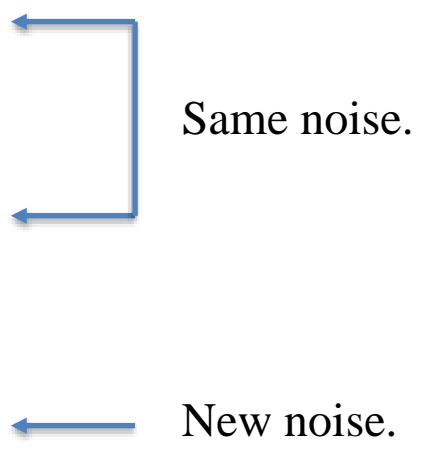
+ *Experimental Noise (RF Off)*

Data Set 2: Simulated Signal

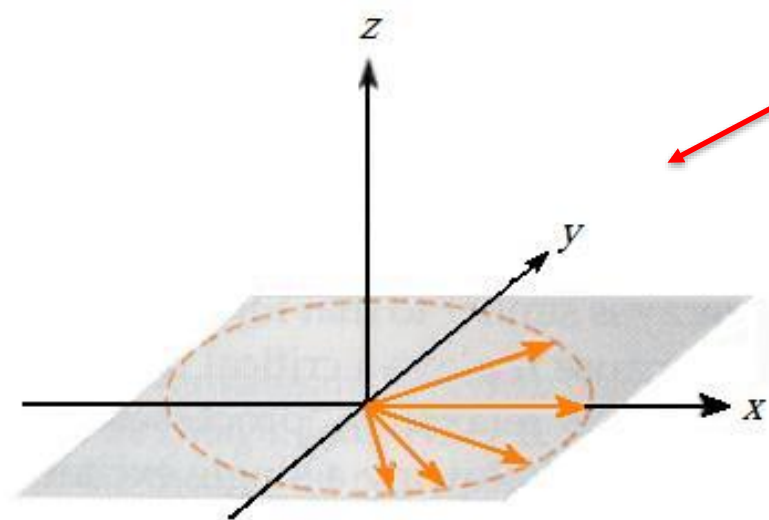
+ *Experimental Noise (RF Off)*

Data Set 3: Experimental Signal

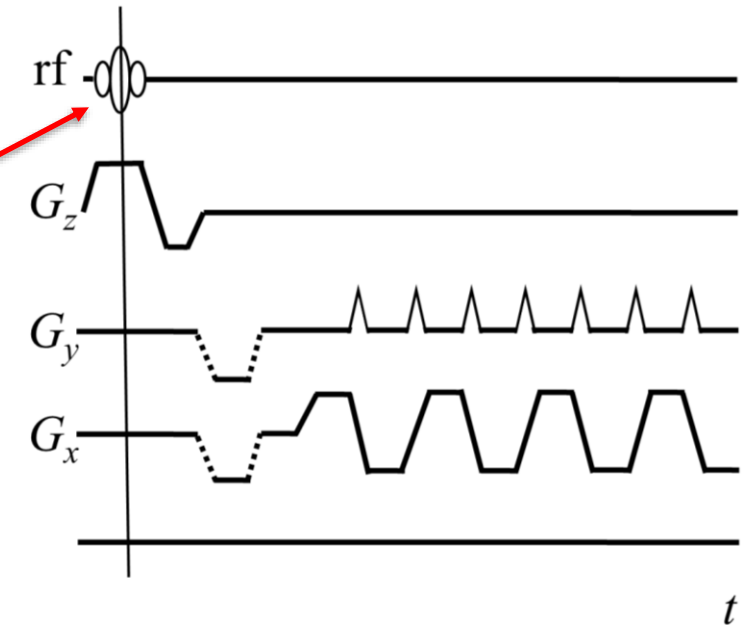
+ *Experimental Noise (RF On)*



Longitudinal relaxation



Transverse relaxation

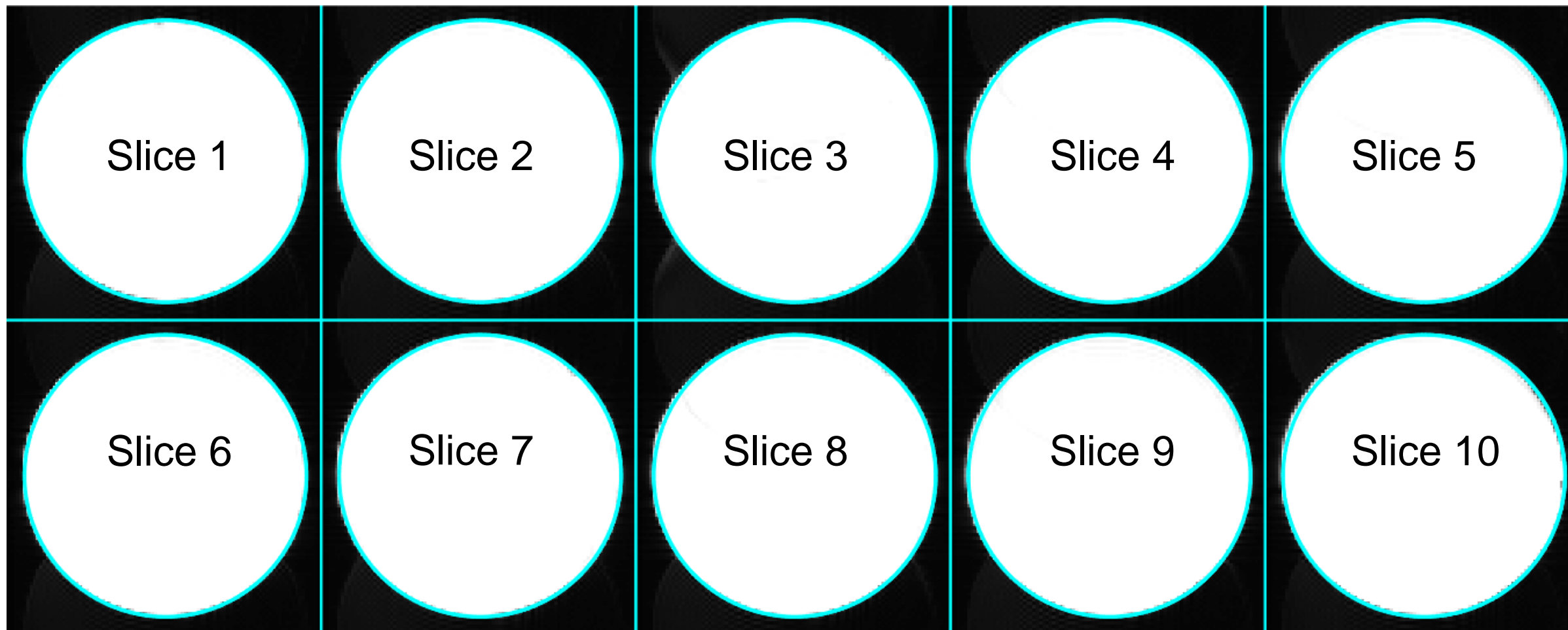


Huttel, Song, McCarthy: Functional Magnetic Resonance Imaging (2004). Sinauer Publishers. ISBN 0-87893-288-7

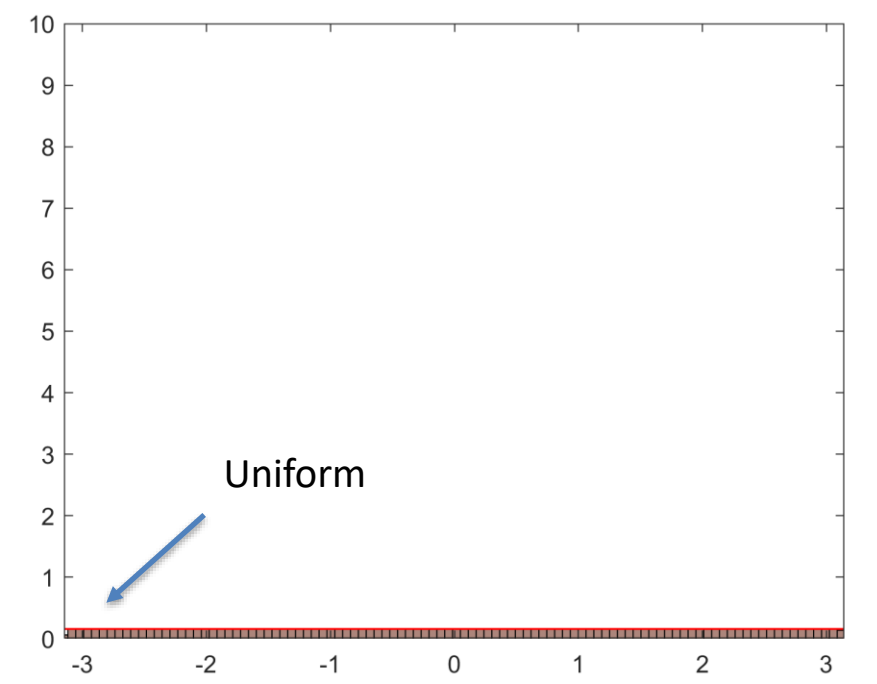
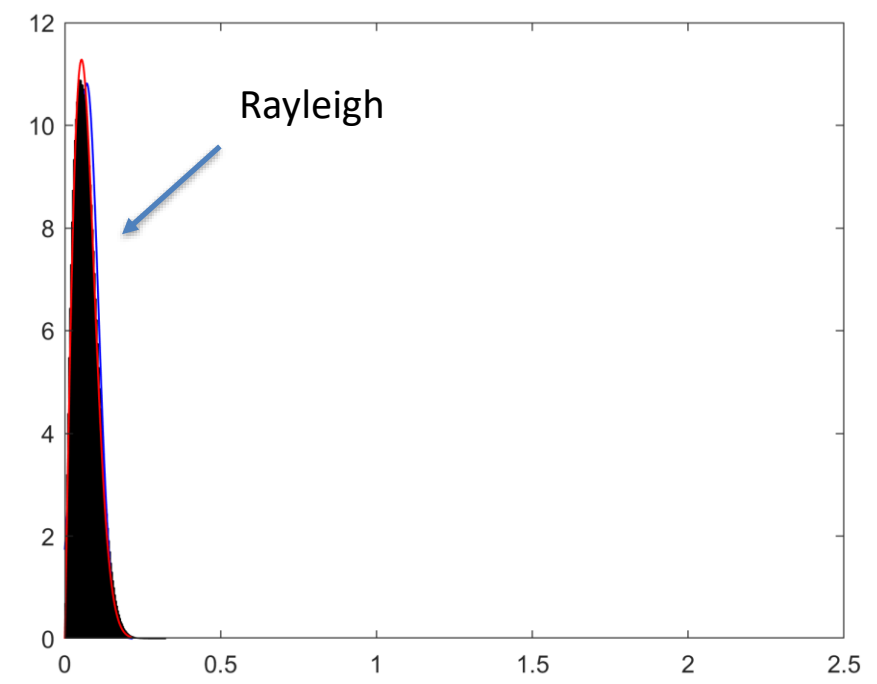
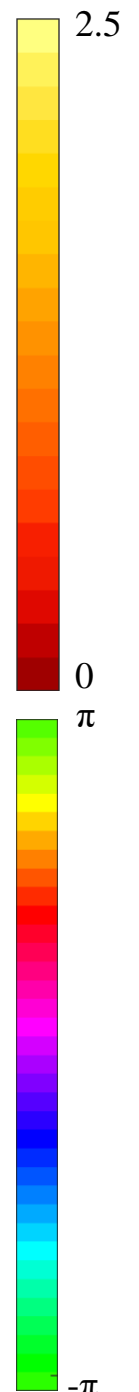
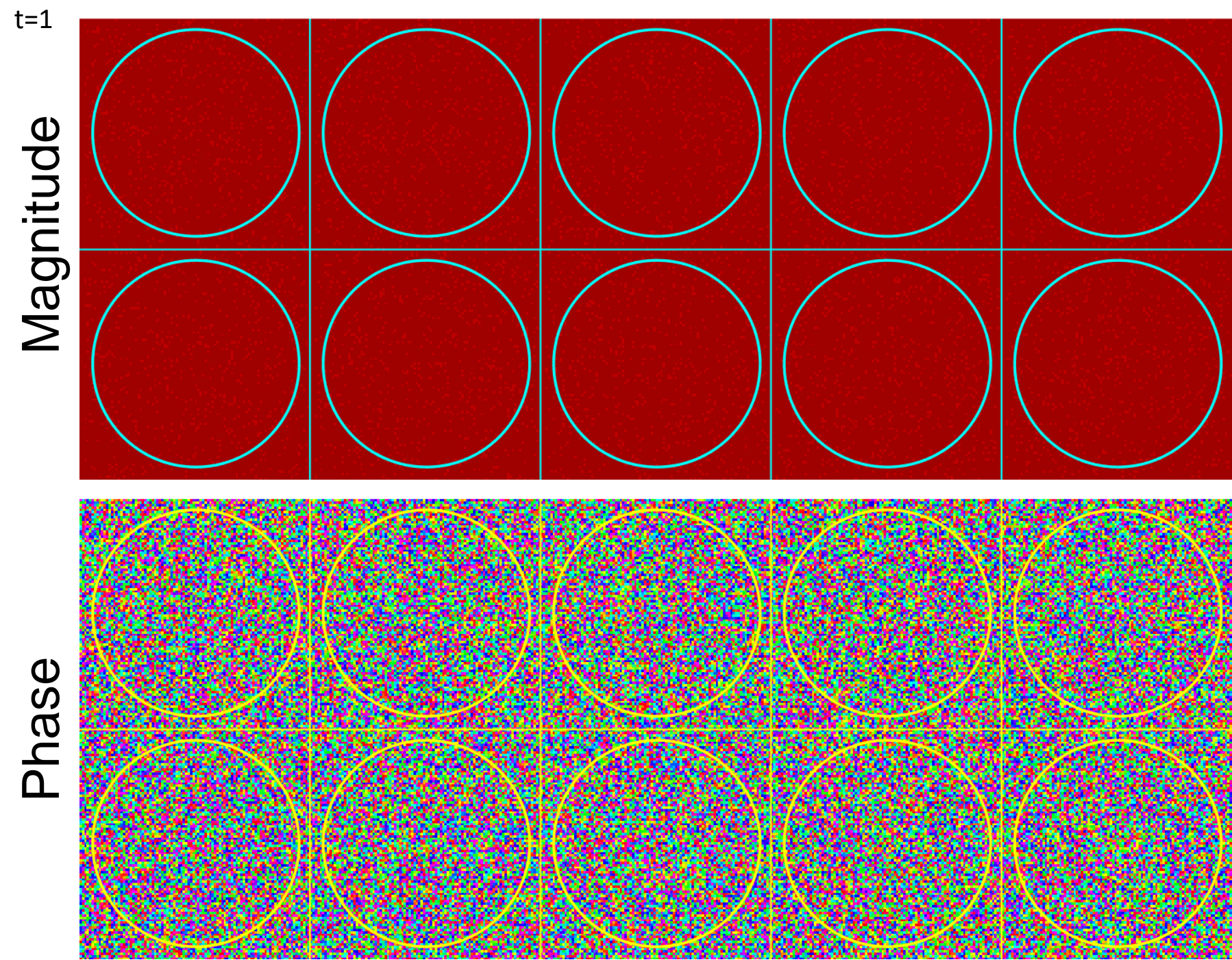
1. FMRI Data Acquisition

Scanner=GE 3.0T Signa LX. $n_y=96$, $n_x=96$ $n_z=96$, $n_t=138$, $n_c=1$ coil
 $TE=84.1$ ms, $FOV=192$ mm, $EESP=0.864$ ms, $RF=0^\circ$ or 90° .

Fiducial Circles

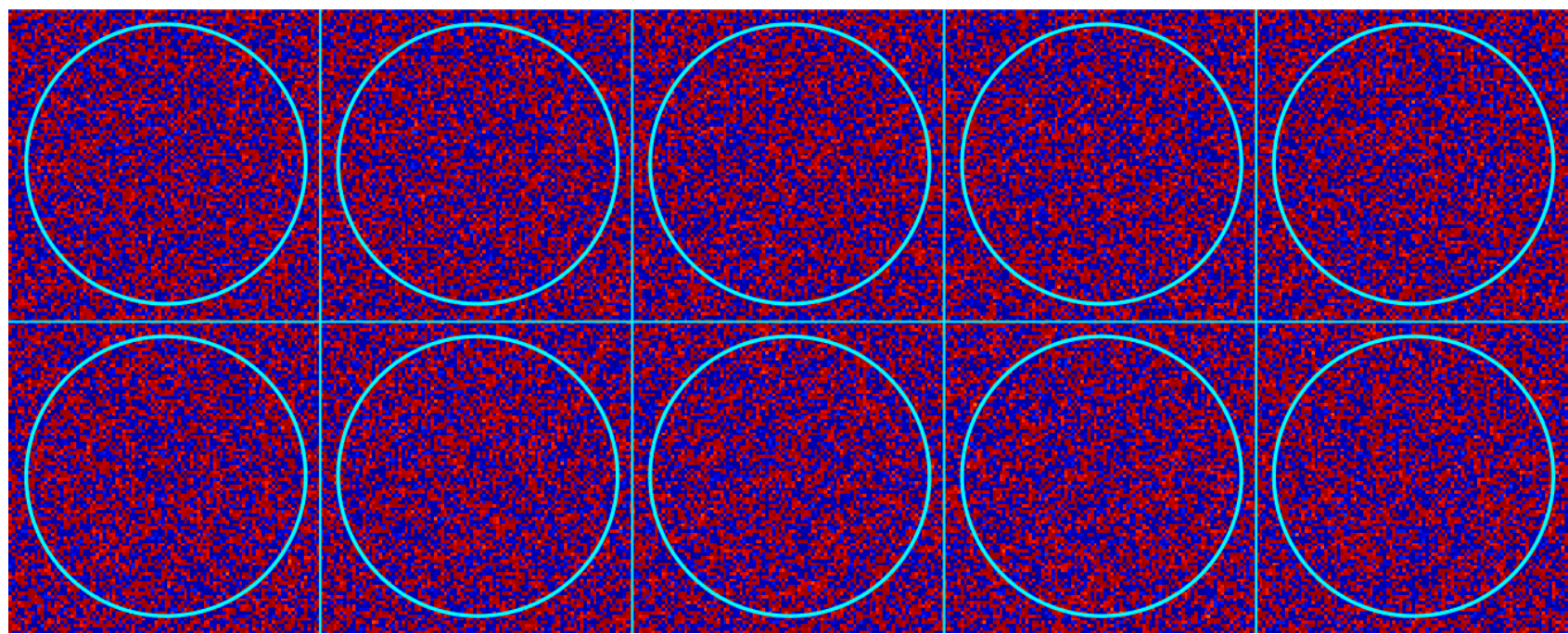


2. FMRI RF Off No Signal Data

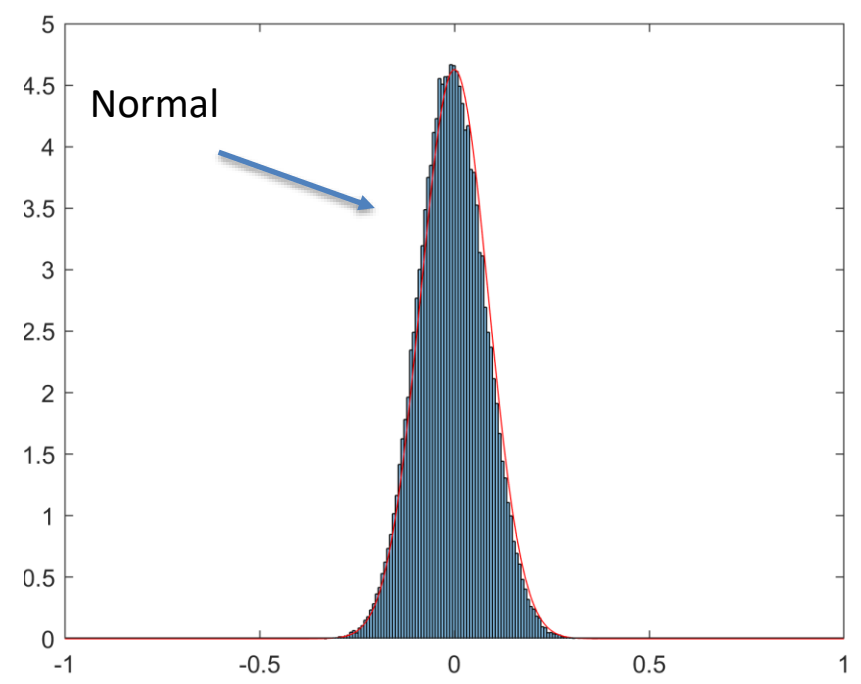
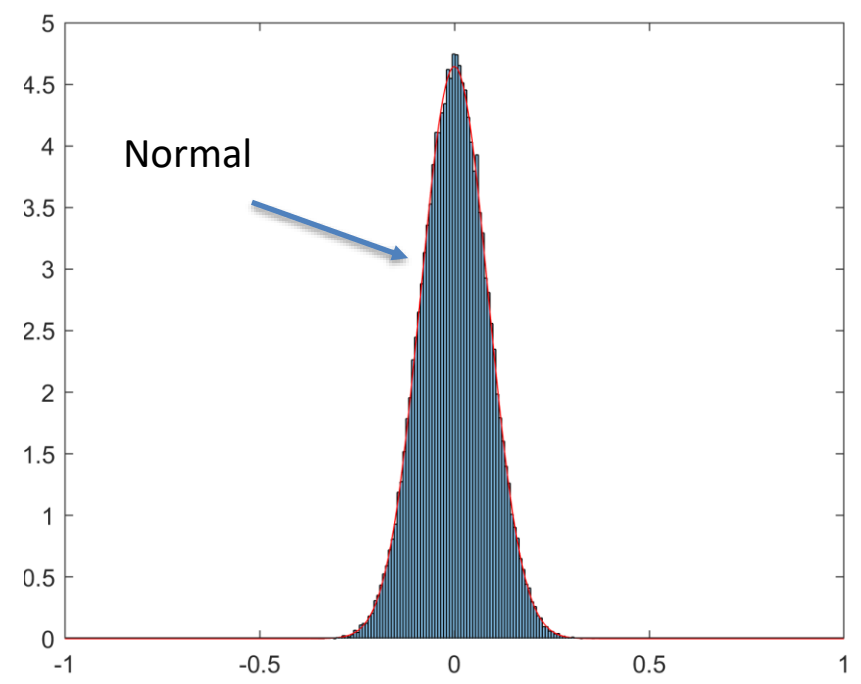
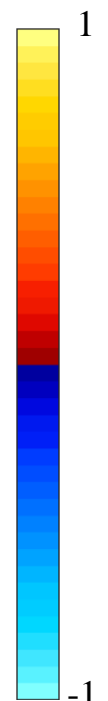
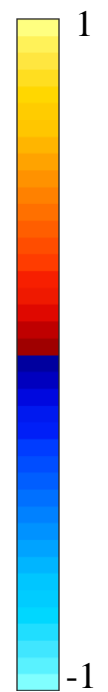
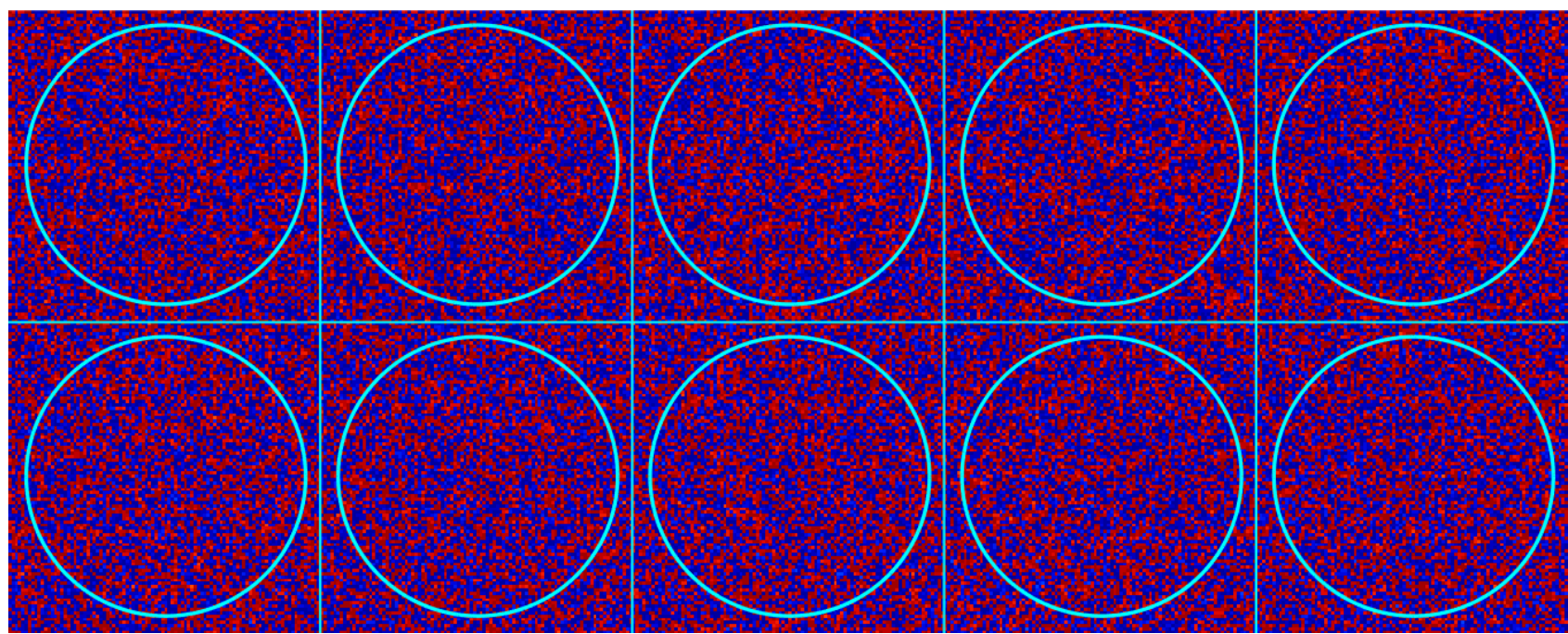


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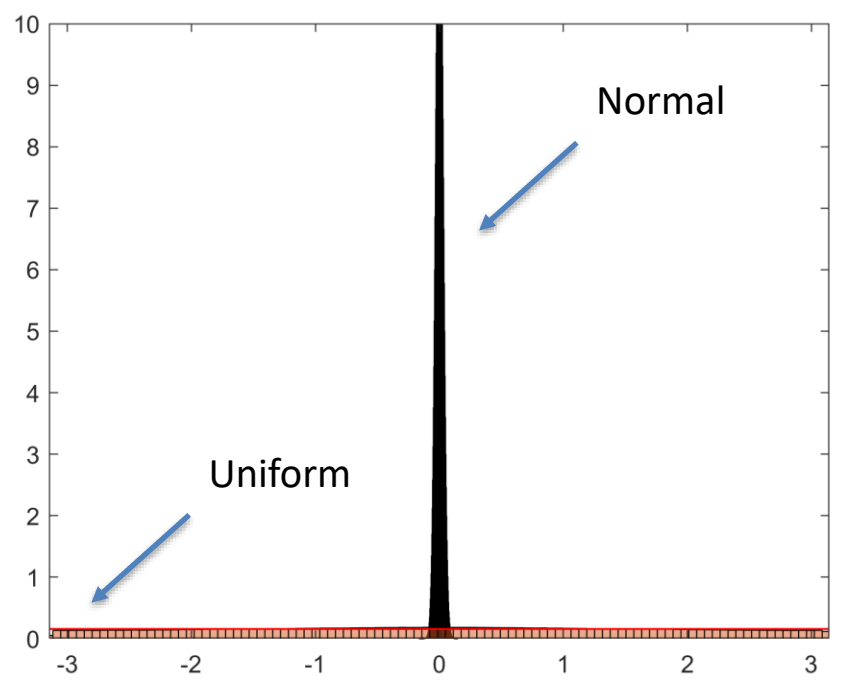
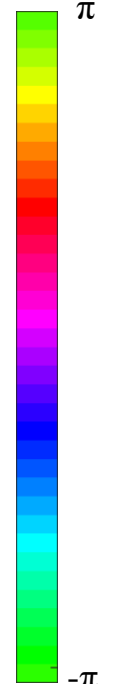
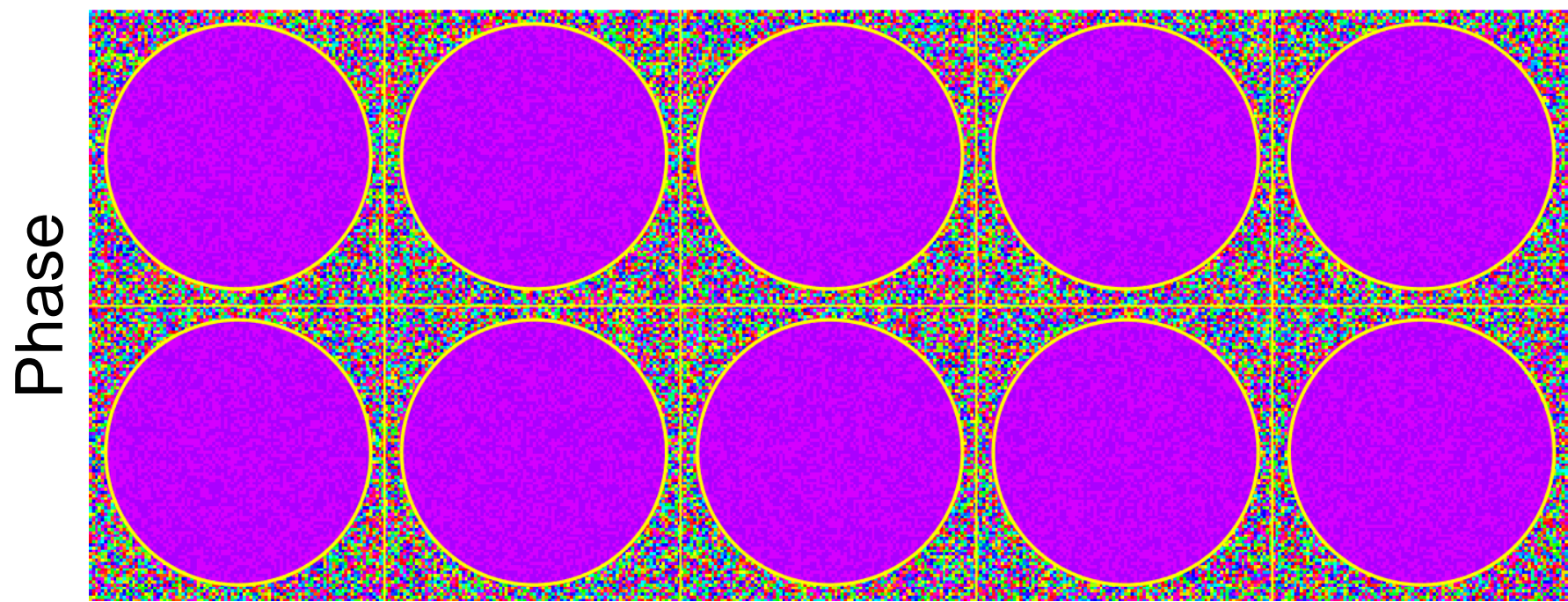
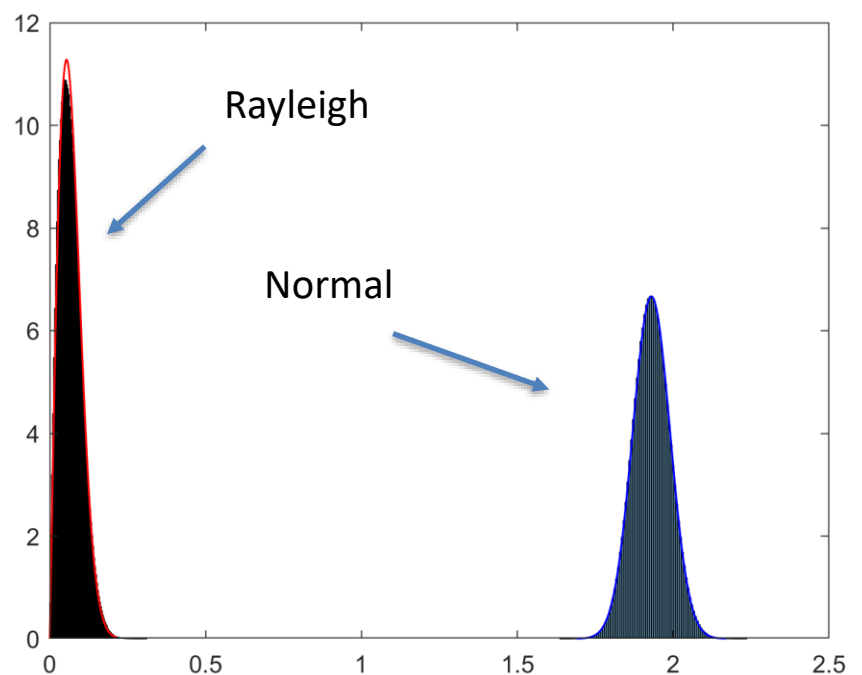
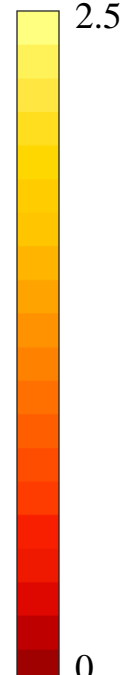
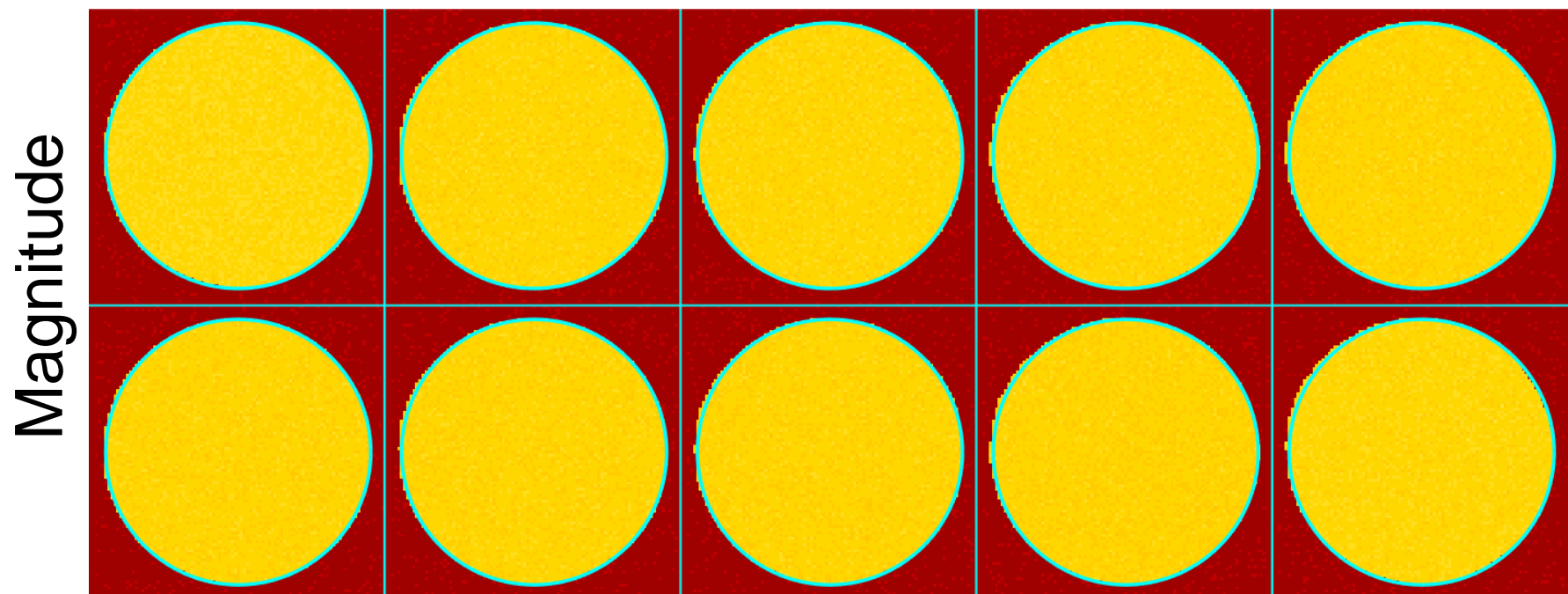
R-I Correlation



AR1 Correlation

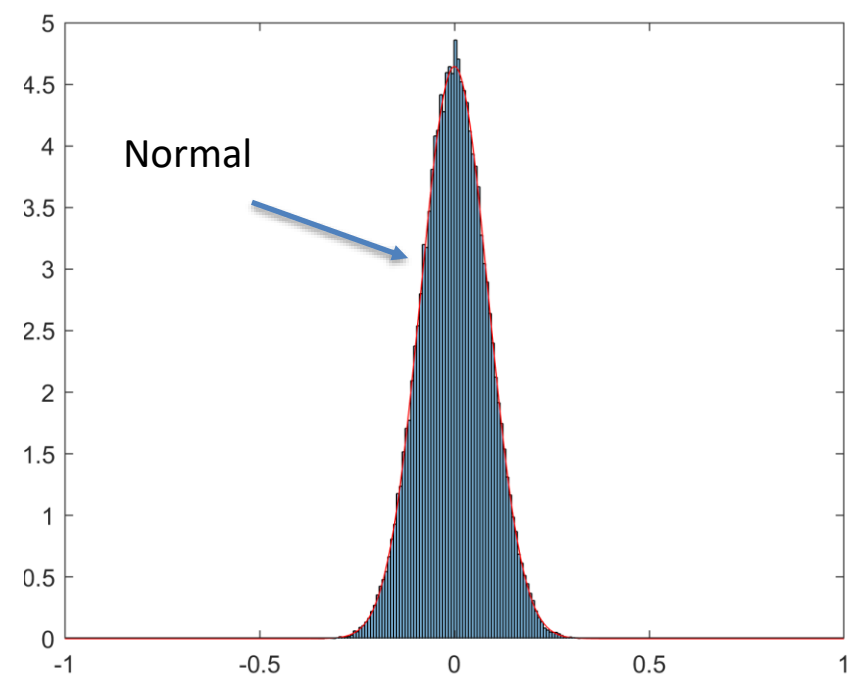
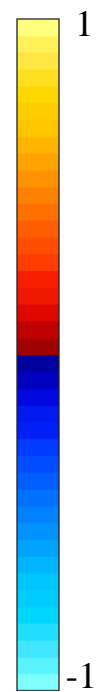
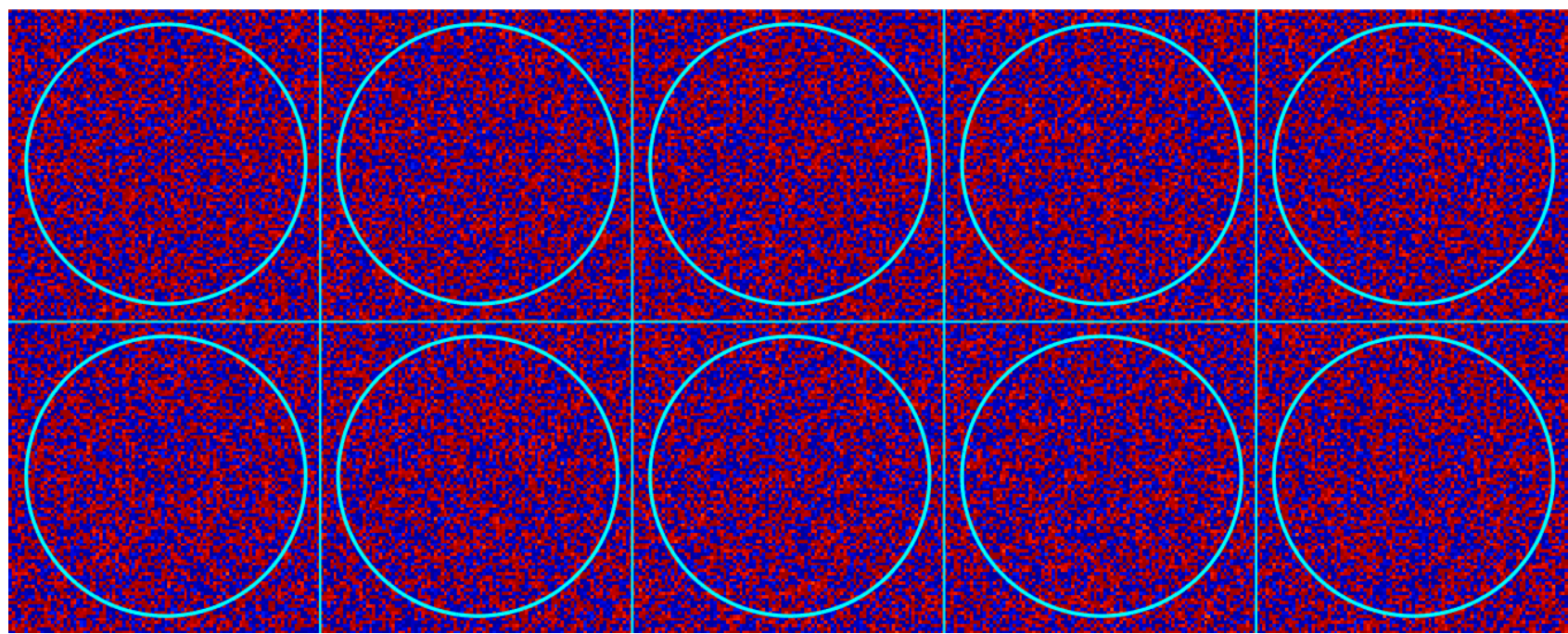


3. FMRI RF Off No Signal Data + Simulated Signal

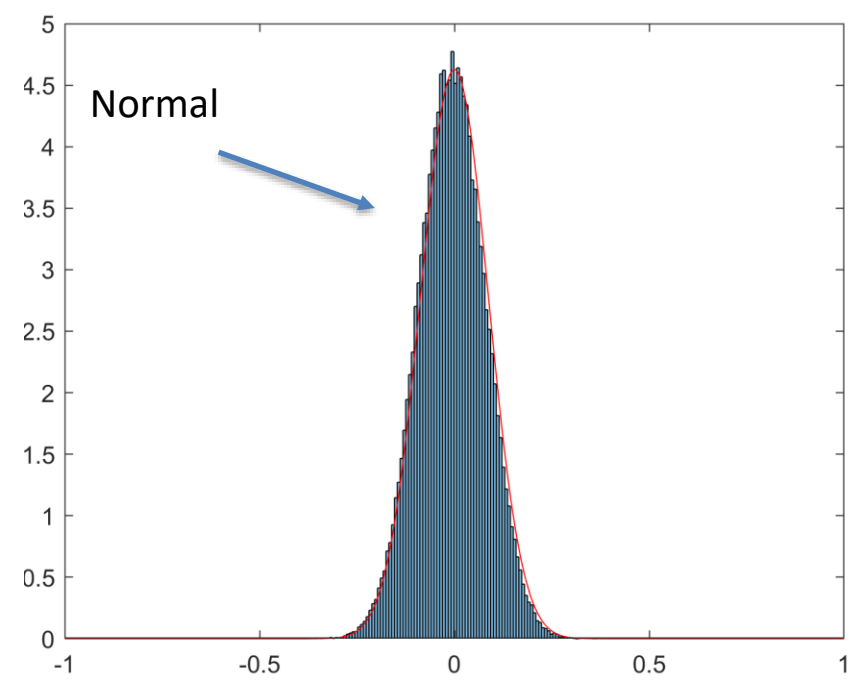
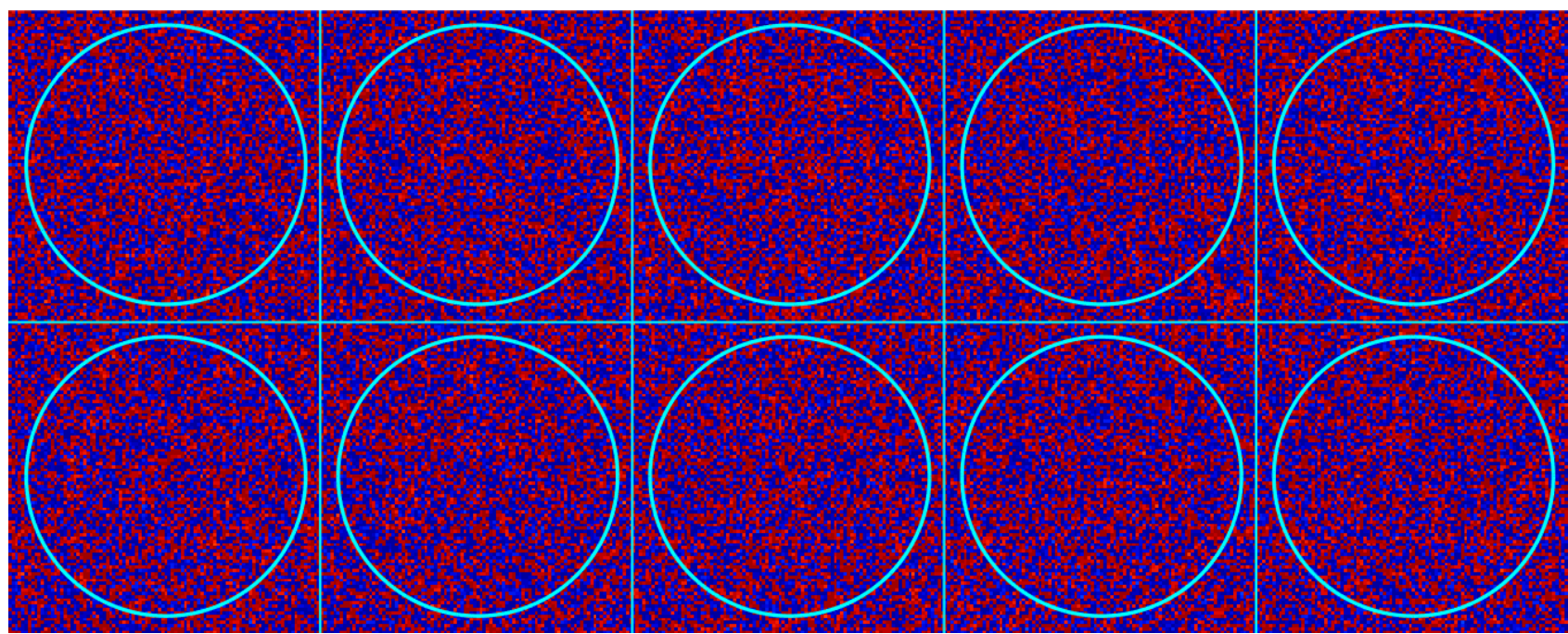


3. FMRI RF Off No Signal Data + Simulated Signal

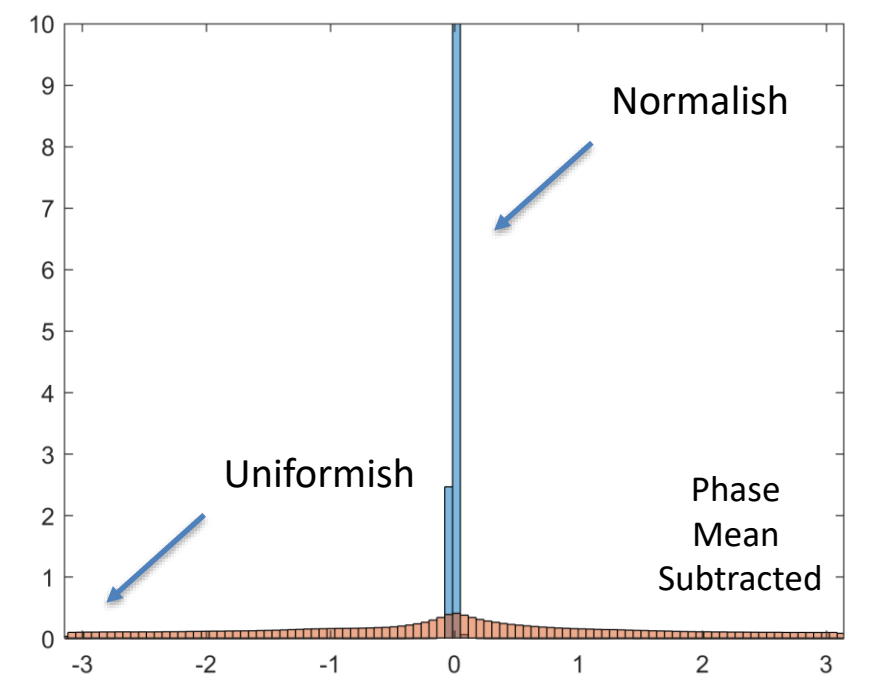
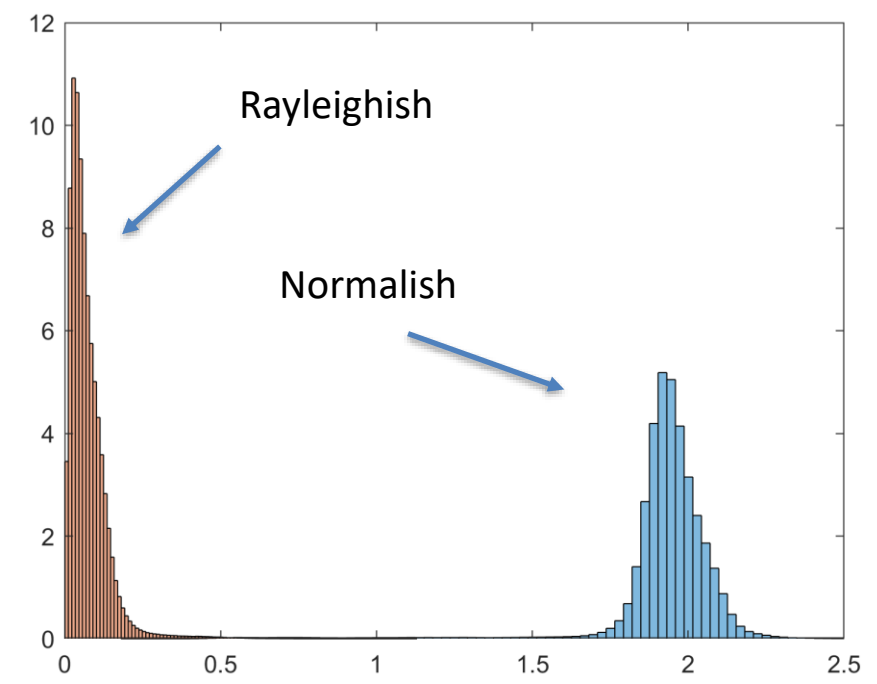
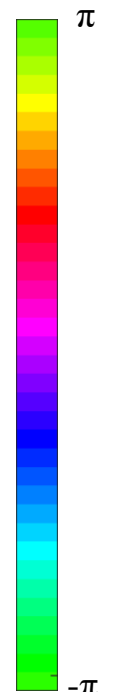
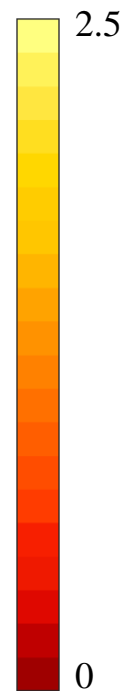
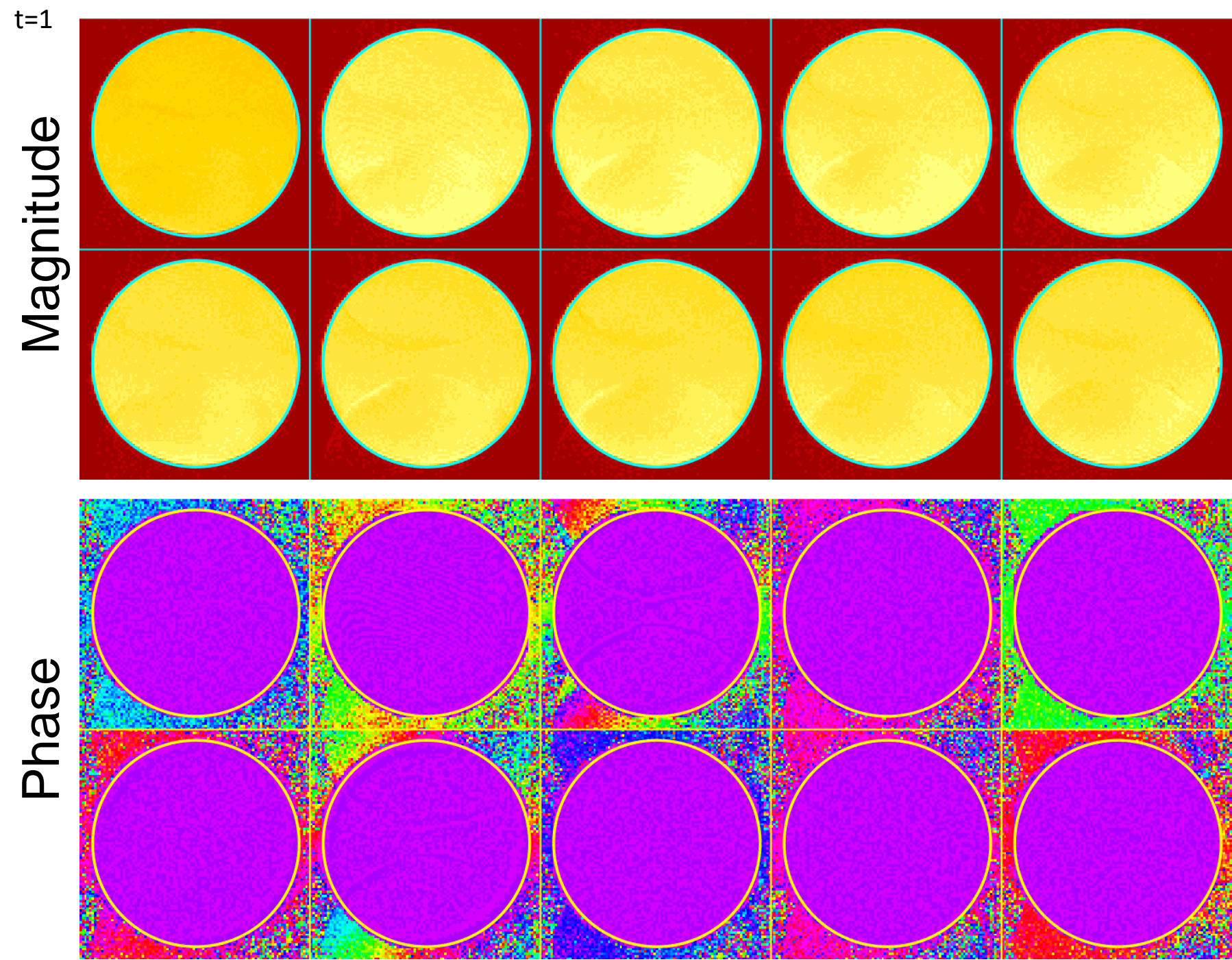
R-I Correlation



AR1 Correlation



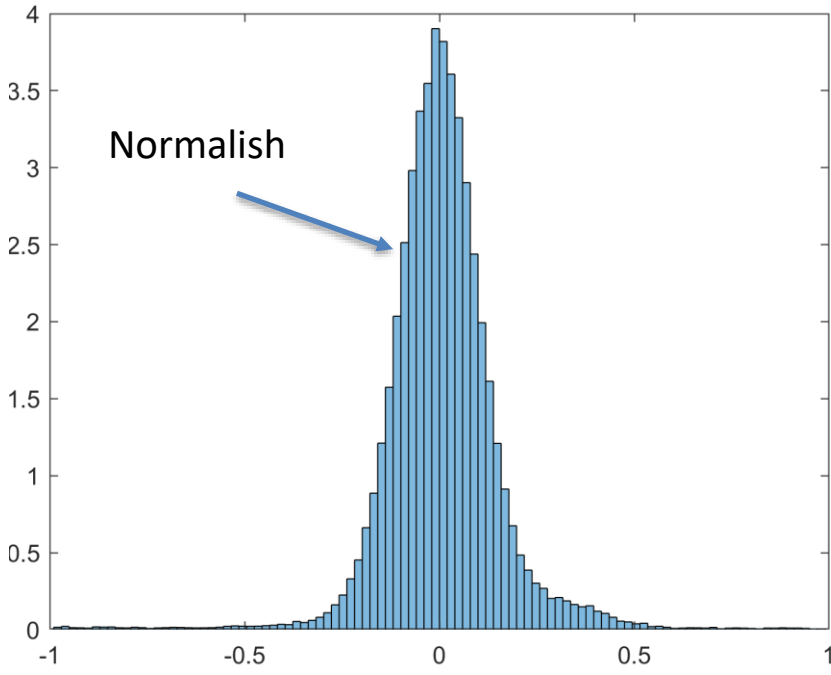
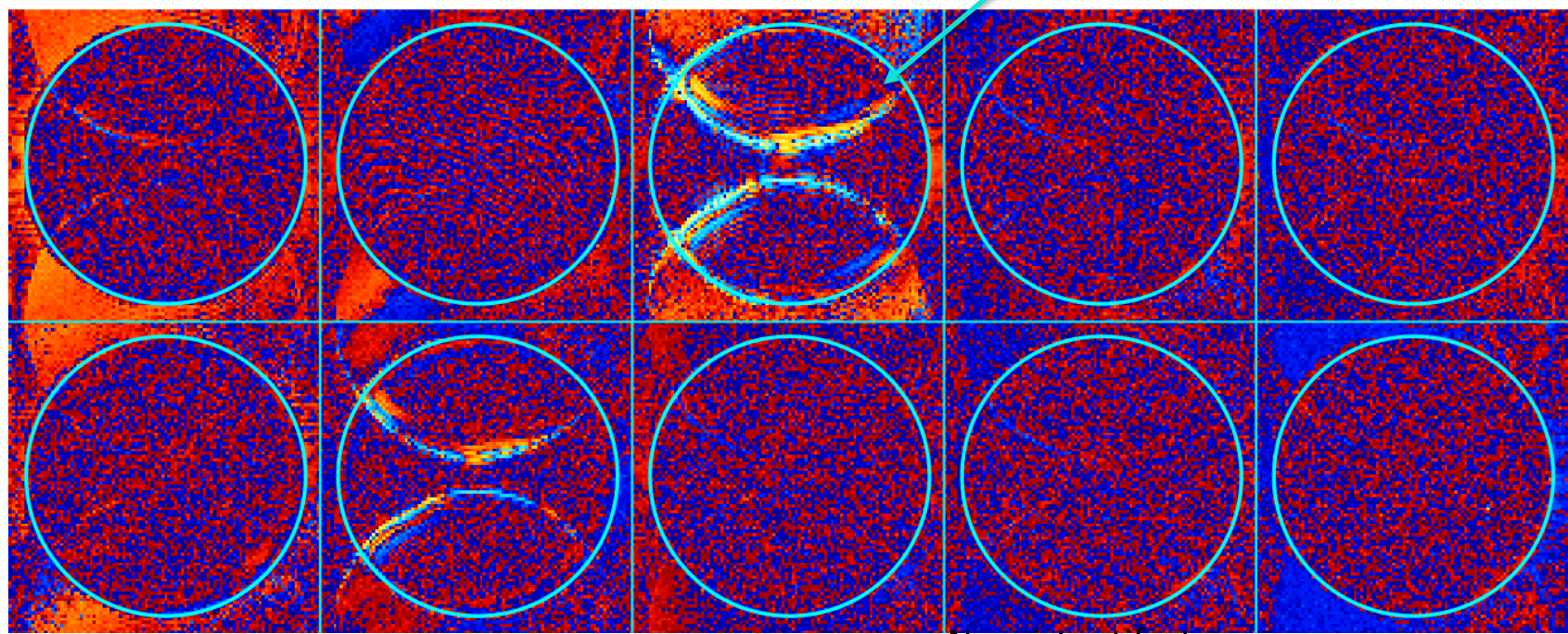
4. FMRI RF On Signal Data + Noise



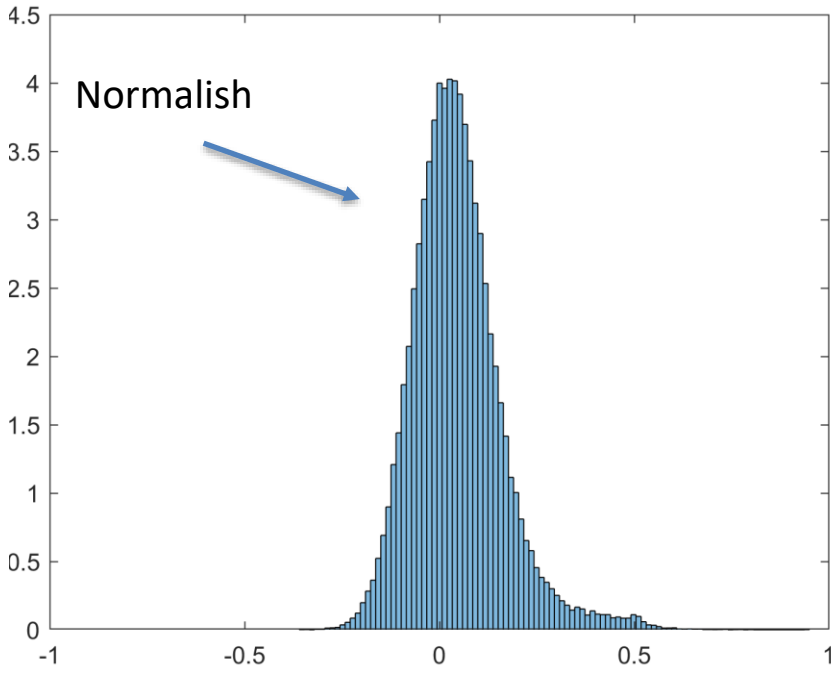
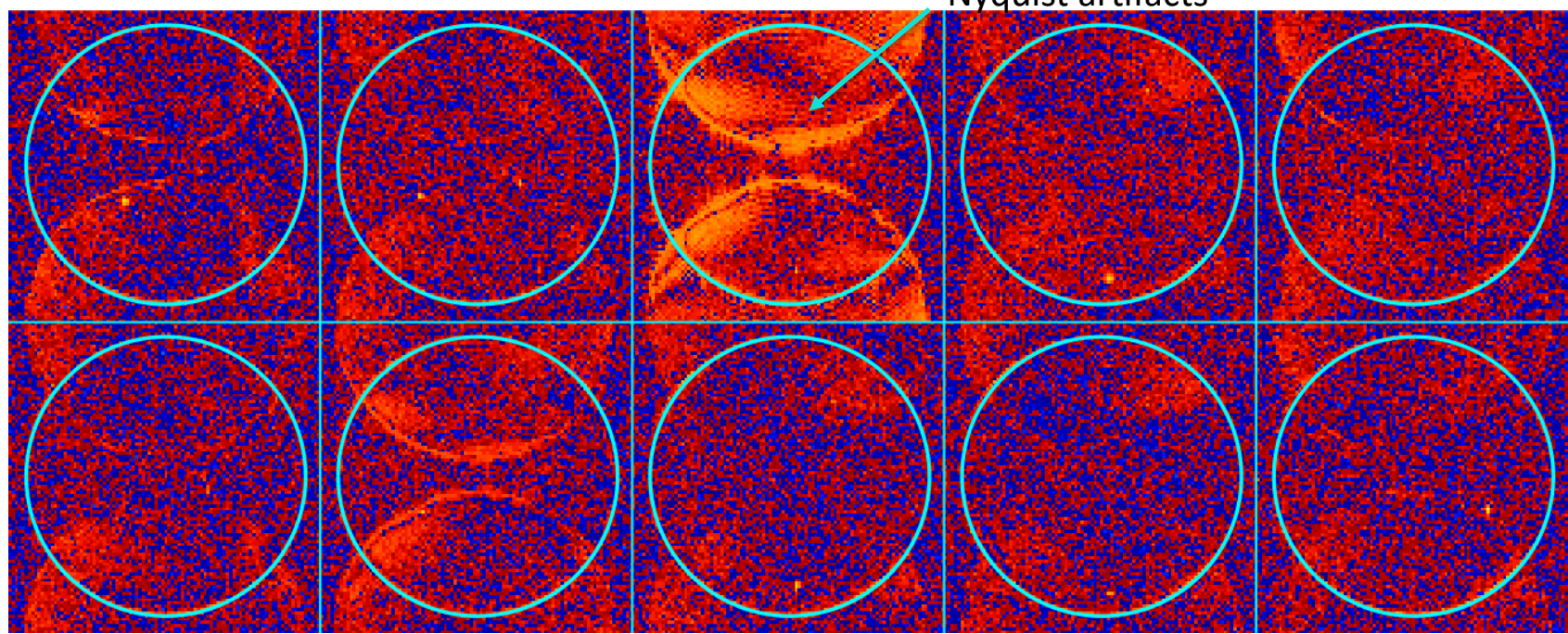
4. FMRI RF On Signal Data + Noise

Nyquist artifacts

R-I Correlation



AR1 Correlation



5. Discussion

This phantom is like a step function and difficult to remove ghosting.

Always be sure to look at your images for potential artifacts.

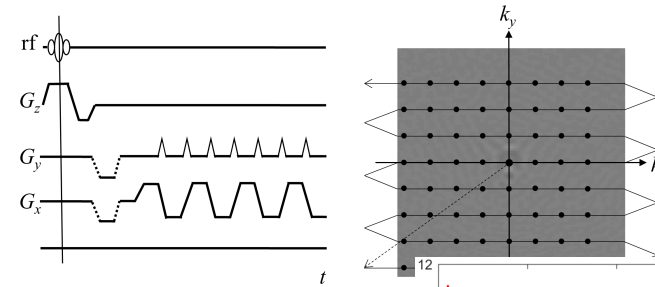
There many of possible errors that are not seen and simply modeled.

This data was from an old scanner that has been decommissioned.

This data is very useful in illustrating the ideal data properties.

5. Discussion

Presented FMRI Data Acquisition

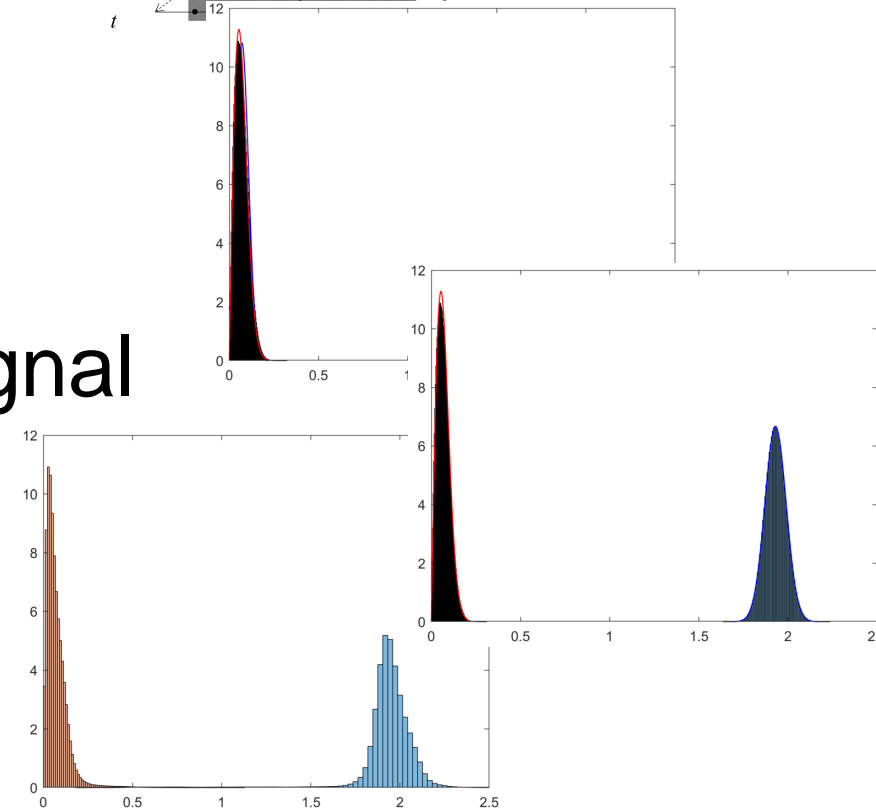


Presented FMRI RF Off No Signal Data

Presented FMRI RF Off + Simulated Signal

Presented FMRI RF On Signal + Noise

Presented FMRI Discussion



Thank You

Questions?