ETH Zürich
D-ITET
Biomedical Engineering   Master Studies

Biomedical Imaging

Homework #11 - MRI 2

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1 TASK 1

The results of undersampling are shown in Figure 1.1 to Figure 1.5.

Available Signal   Sampled k-Space   Image
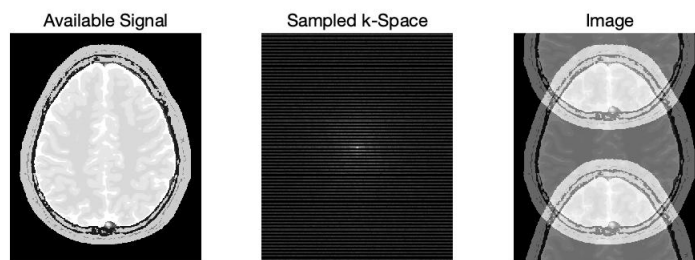
Figure 1.1: Sampling Only Every Second Vertical Line

Available Signal   Sampled k-Space   Image
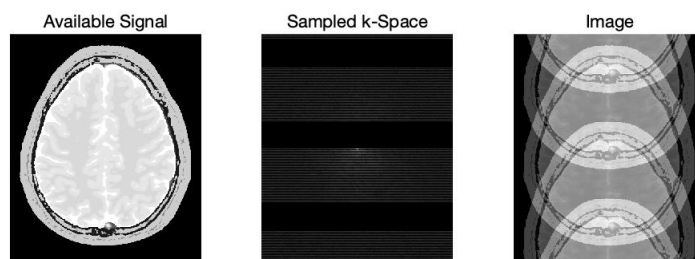
Figure 1.2: Sampling Only Every Third Vertical Line

Available Signal   Sampled k-Space   Image
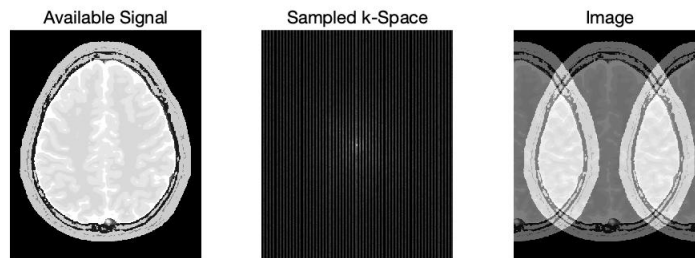
Figure 1.3: Sampling Only Every Second Horizontal Line

Available Signal   Sampled k-Space   Image
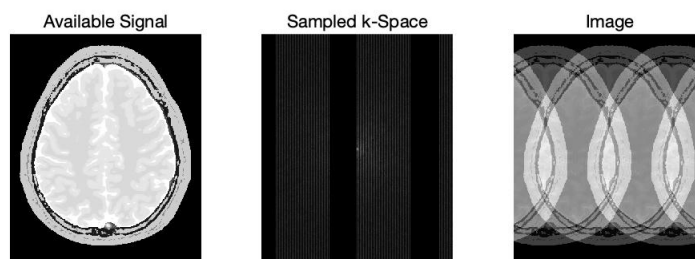

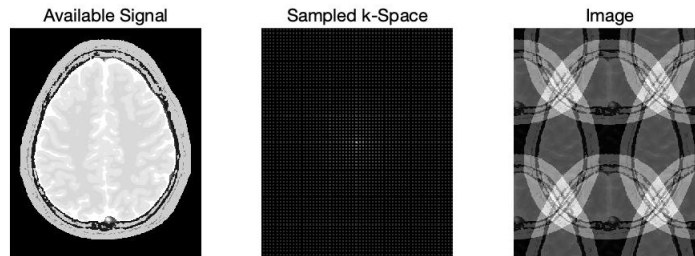**Figure 1.4:** Sampling Only Every Third Horizontal Line

Figure 1.5: Sampling Only Every Second Horizontal and Vertical Line

Undersamplig in k-space equals to multiplication with a comb that is less dense. Since multiplication in Fourier domain equals to convolution in image domain and the Fourier transform of a comb is still a comb of reciprocal spacing, the convolution in image domain with the Fourier transform of a comb function results in the aliasing as we see in the figures above.

2 TASK 2

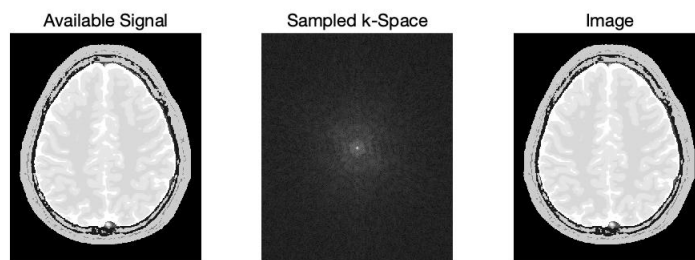The results of reduce the sampling range are shown in Figure 2.1 to Figure 2.3.
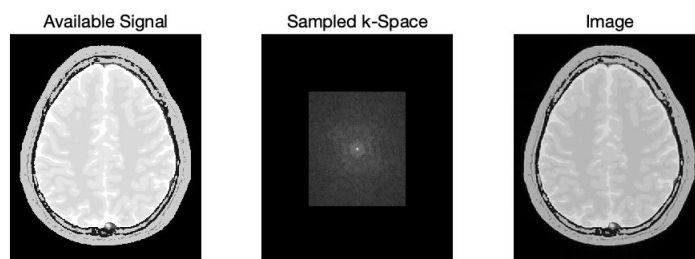

Figure 2.1: Full Sampling Range

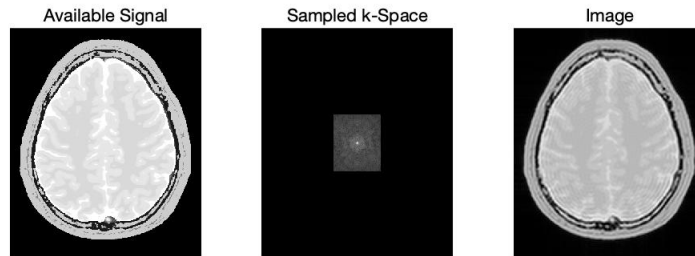**Figure 2.2:** Reducing the Sampling Range to One-half

Figure 2.3: Reducing the Sampling Range to One-forth

Reducing the sampling range in k-space equals to multiplication with a rectangle that is narrower than the original extent. Multiplication in Fourier domain equals to convolution in image domain and the Fourier transform of a rectangle function is a sinc function. If a rectangle is narrower than the original extent, the main lobe of the sinc function will become wider. Thus, convolution with such a 2-D sinc function will result in blurring of the image.
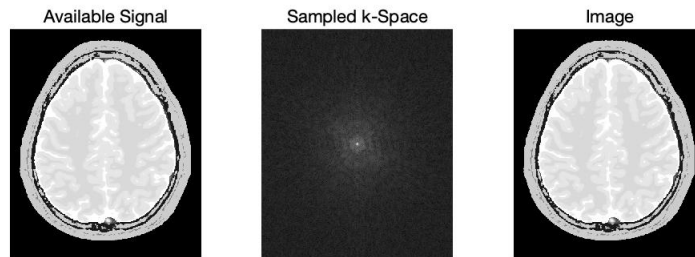
3 TASK 3

Figure 3.1: Proton Contrast

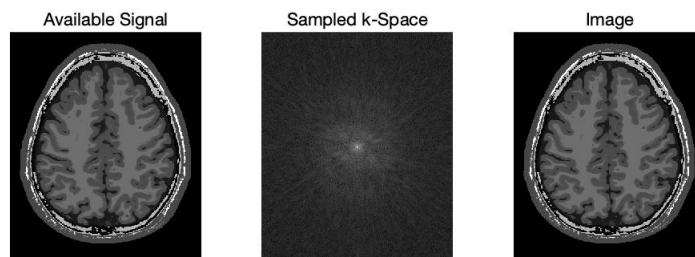Using T1 contrast in steady-state, the result obtained when $T_R = 5ms$ and $\theta = 50°$.

Figure 3.2: T1 Contrast in Steady-State