

# SFDI

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## 1 Introduction

The idea for this mesoscopic approach that attempts to validate a mass transport model to reconstructed functional magnetic resonance imaging is to take biopsy tissue and fluoresce any photosensitizer contained within the tissue using spatial frequency domain imaging (SFDI). SFDI is comprised of four components: Demodulation, Diffuse Reflectance Measurement, Model Inversion, and Chromophore mapping (optional).

### 1. Demodulation

This is a process of obtaining the envelope of patterned images. The patterns are modulation transfer functions at a given spatial frequency, overlaid slightly below the camera lense, and is phase-shifted at 0, 120, and 240 degrees. These three images are combined into a single image by demodulation. Any hint of an MTF pattern remaining may be caused by harmonics or fluctuating source intensity. The below figures are some preliminaries on the demodulation process.

I am working with an aggressive brain cancer model. Here is a visualization of the brain with the drug injected intravenously prior and imaged with 7 MTFs.

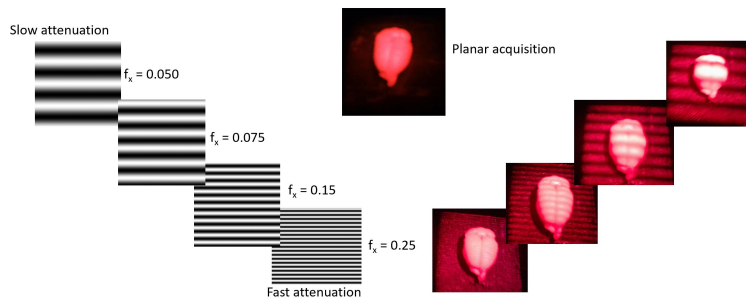


Figure 1: MTFs at different frequencies

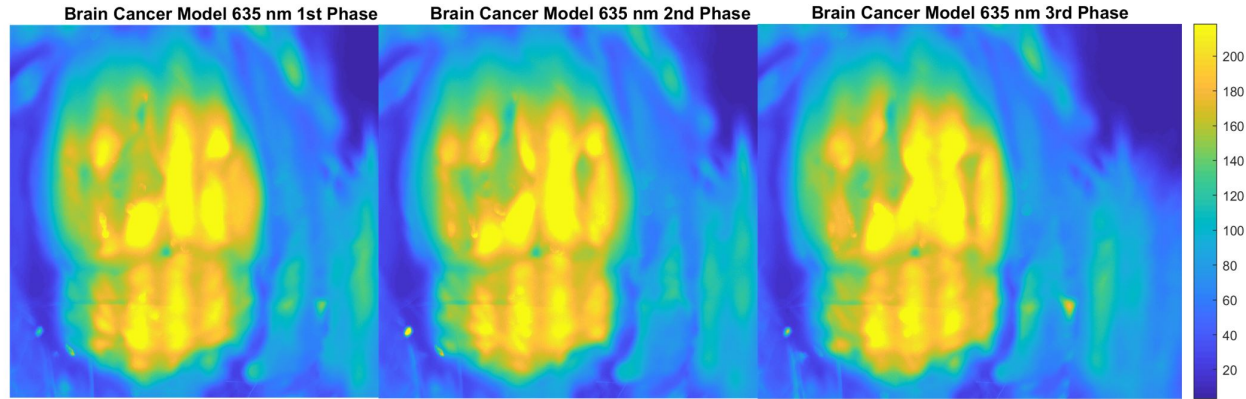


Figure 2: 3 phase technique: 0 degrees, 120 degrees, 240 degrees

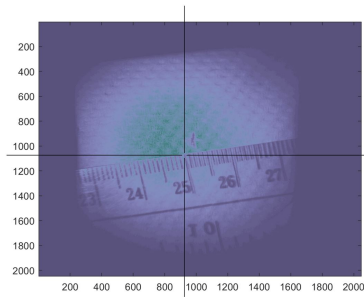


Figure 3: Determining pixel dimension

After observing the MTF at the three phase shifts (Figure 2), obtain the pixel dimension of your field of view (Figure 3). Next we obtain the Fourier Transform of each image (cannot be automated) using a line profile, which may be quite tedious but important.

The fundamental is at 7 cycles per row (Figure 4 below).

As we peruse other MTF datasets, harmonics may be observed (Figure 5). Note the second harmonic at 11 cycles/row. We may see artifacts in our demodulation as a consequence and will have to re-measure our sample or discard the measurement entirely.

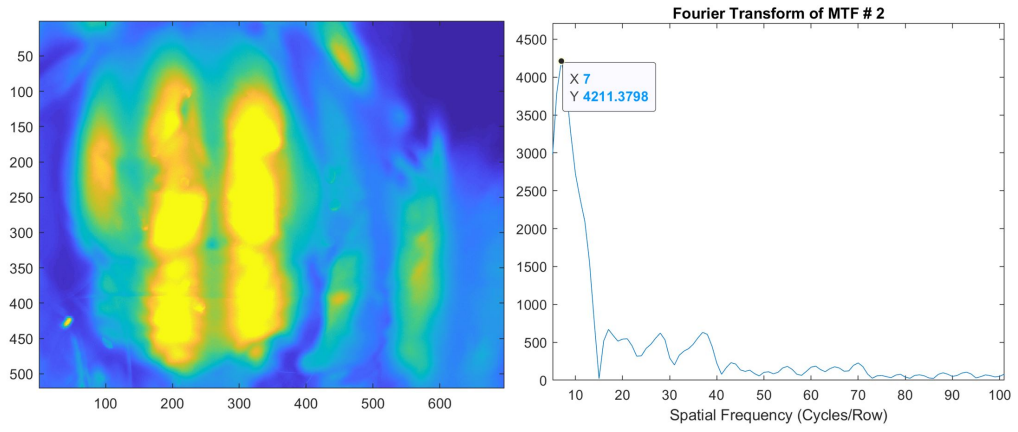


Figure 4: Fourier Transform of MTF at 0.05/mm. Fundamental at 7.

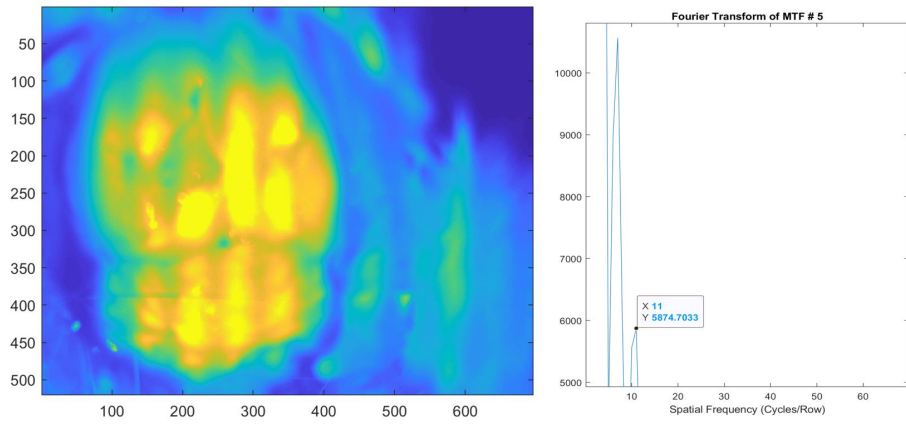


Figure 5: Fourier Transform of MTF at 0.075/mm. Second harmonic at 11.

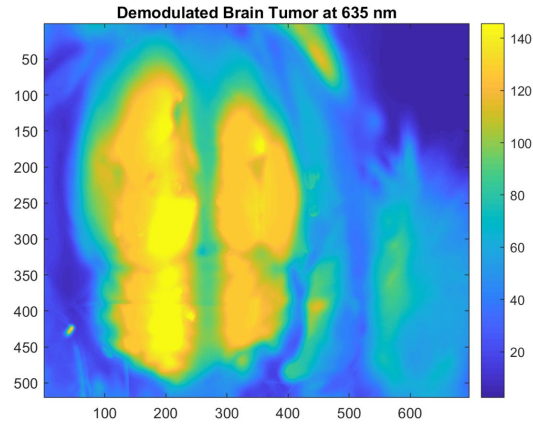


Figure 6: Demodulation of MTF at 0.05/mm

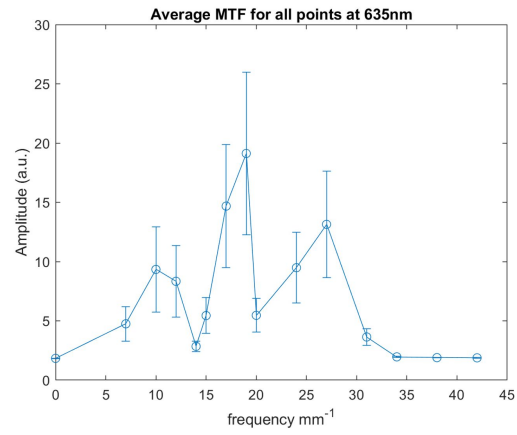


Figure 7: The largest standard deviation appears between 16 to 19/mm

