Filtering MRI images to Improve Pharmacokinetic Modeling of GdDO3NI in Brain Tumors
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Objective: Model GdDO3NI in Hypoxic and Normoxic Brain Tumors
Hypoxia is a lack of adequate oxygen in cells & tissues. Hypoxia is a critical marker in the progression of diseases including cancer, stroke, and traumatic brain injury (TBI). In cancer, hypoxia initiates a complex cell signaling network resulting in angiogenesis, metastasis, and resistance to therapy.

GdDO3NI is a T1-weighted MRI contrast agent that has been shown to visualize hypoxia in tumors and post-TBI brain. Pharmacokinetic modeling allows extraction of tissue characteristics from time course T1-weighted MR images. K-space filtering can potentially allow improved pharmacokinetic modeling via improvements in signal-to-noise ratio (SNR).

Introduction

Methods

- Acquisition of T2-weighted, and time-course pre and post contrast (GdDO3NI) T1-weighted images of rat brains with 9L or C6 tumors
- Creation and refinement of fermi filters in MATLAB
- Parsing of raw k-space data and application of filters in k-space
- T1-mapping using the following equation:

\[ M = M_{inf} \times (1 - e^{-t/T1}) \]

- Pharmacokinetic modeling using filtered images and the model developed for TBI

Preliminary Results

- Filtering reduced error for K1 and K2
- Little improvement was observed for Vp and Diff
- Large differences in K1, K2, and CM were observed between hypoxic and normoxic fractions

Pharmacokinetic Model

- A. Time course image at CM (top), T2-weighted image (middle), and T1 map (bottom) for a representative animal
- B. K1, K2, Vp, error, CM, Creco (reconstructed concentration), and Diff (CM-Creco) values across the brain and muscle
- C. Hypoxic tumor fraction values

Conclusion & Future Directions

- Filtering reduced error for K1 and K2
- Little improvement was observed for Vp and Diff
- Large differences in K1, K2, and CM were observed between hypoxic and normoxic fractions

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