Project Task 1

Applied Medical Image Analysis

Alam Jamal

Eichleitner Daniel

Peck Sarah

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**Introduction**

Susceptibility Weighted Imaging (SWI) is a magnetic resonance imaging (MRI) technique that enhances the visibility of veins, hemorrhages, and iron deposits in the brain. This method leverages the differences in magnetic susceptibility between tissues to generate high-contrast images.

**Data Preparation and Loading**

The SWI process begins with the loading of NIfTI files containing magnitude, phase, and mask data. The magnitude image provides the base intensity values, the phase image captures the phase shifts, and the mask isolates the region of interest.

**Mask Application and Image Enhancement**

1. **Masking**:
   * The phase image is masked to focus on specific areas of interest. This involves multiplying the phase image by the mask to exclude irrelevant regions.
2. **High-pass Filtering**:
   * A Gaussian low-pass filter is applied to the masked phase image slice-wise. The high-pass filtered phase image is obtained by subtracting the low-pass filtered image from the original masked phase image.

**SWI Mask Creation and Image Generation**

1. **Phase Mask Creation**:
   * A phase mask is generated based on the high-pass filtered phase image. This mask is created by setting threshold conditions to enhance the contrast in the final SWI image.
2. **SWI Image Formation**:
   * The final SWI image is produced by combining the magnitude image with the phase mask. This step amplifies the signal differences, making structures like veins and hemorrhages more prominent.
3. **Minimum Intensity Projection (MIP)**:
   * To further enhance the visibility of small structures, a Minimum Intensity Projection (MIP) is performed. This technique projects the lowest intensity values along the viewing direction, highlighting the target structures.

**Visualization and Saving**

The processed images, including the magnitude, masked phase, high-pass filtered phase, SWI, and MIP SWI images, are displayed for visual inspection.