

Diffusion MRI fiber tractography is a non-invasive technique used to investigate the orientation of white matter fibers in the brain. However, obtaining high-resolution diffusion MRI data is challenging and time-consuming. Super-resolution techniques have emerged as a promising method for improving image resolution by enhancing low-resolution images to high-resolution images after acquiring diffusion MRI data. In this project, we investigated the combination of conventional upsampling techniques with the proposed deep super resolution (DSR) framework to evaluate its impact on subsequent fiber tractography.

We downsampled diffusion MRI data by k-space truncation, then re-upsampled to the original resolution using three different techniques: nearest neighbors, cubic b-spline, and zero padding. The results of the upsampling were then given as input to the DSR network. We considered different types of DSR inputs, including 2D patches, 2D whole slices, and 3D volumes.

The combination of zero-padding and the DSR with a 2D patch approach produced the most optimal overall results compared to zero-padding alone. This approach has been further investigated for fiber tractography to assess the reconstruction of white matter tracts. The results showed minimal visible differences between fiber tractography with the original data, after downsampling, and after DSR implementation.

Overall, these results suggest that the tested DSR networks are promising to improve the spatial detail of diffusion MRI data. However, they are still insufficient to improve the quality of fiber tractography. More work is needed to optimize the technique's performance to obtain optimal reconstruction of brain fiber tractography.