・The Comparisons with the Length-based Outlier Filtering

In this section, we compare the performance of the length-based outlier removal method and this proposed method for the representative fibers.

The fibers shown in Fig. 2 form a representative fiber bundle that connects HOGE and FOO in the AAL atlas.

As shown in Fig. 2, the fiber bundle without any outlier-removing filter contains as many fibers as outliers, and the color of these fibers represents the robust statistical value of this proposed method [ref eq].

The white fibers are likely to be outlier fibers, and the black ones are the correct fibers. In general, outlier fibers are characterized by loop shapes and unnatural trajectories. As shown in Fig. 2, the white fibers have such characteristics.

The proposed method removed most of the outlier fibers [ref], but the length-based filtering could not perfectly remove the outlier fibers. Moreover, the length-based filtering method removed the correct fibers in error.

From this result, it was confirmed that the proposed method is superior to the length-based outlier removal method.

・Application to the Optimized Fibers

The three representative fibers applied SIFT and LiFE; the original ones are shown in Fig. 4. As Fig. 4 shows, it can be seen that there are some fibers with looped trajectories out of the region of interest in all the non-filtered fibers. But the result of applying this proposed method shows that the outlier fibers were removed for all three regions.

It was confirmed from Fig. 4 that the fibers with applied SIFT or LiFE could contain the outlier fibers, and the proposed method is effective for the remaining outlier fibers after applying SIFT or LiFE.

From a visual perspective, the most of outlier fibers were removed by the proposed method, and other valid fibers were not removed.

Table 1 shows the change in the total number of fibers in the connectome matrix with the evaluation index E. As shown in Table 1, we successfully removed outlier fibers at an average of 9-10% and a variance of 4%. As shown from Table1, a certain number of outliers exist even after applying optimization methods such as SIFT and LiFE post processed optimization, and it was confirmed that applying a proposed method succeeded in removing a considerable number of outliers. The amount of outlier fibers is considered to depend on the strategies of the seeding, the parameters of tracking algorithms, and many other conditions. However, it is difficult to completely exclude these outliers due to the features of probabilistic tractography, so it is considered necessary to exclude outliers in the literature of the postprocessing statical removing.

・Reduction of variance by removal of outlier fibers

We describe that the variances of the number of fibers were changed by applying the proposed method to 11 subjects. By applying the outlier filter, the variances for the original connectome were decreased by the average 7.3%, the first quarter 3.4%, and the third quarter 10.2%. These results mean that statistical removal of outliers reduces the variance within a healthy subjects group.