

Supplementary Material

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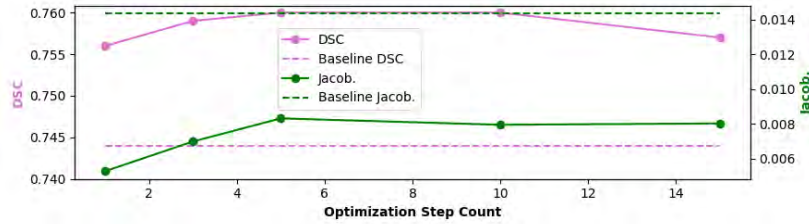


Fig. 1. Ablation on optimization steps (TransMorph on IXI). Results show that 5 to 10 steps offer optimal balance, with no notable benefits from exceeding this range. Thus, we recommend to use 5 to 10 steps.

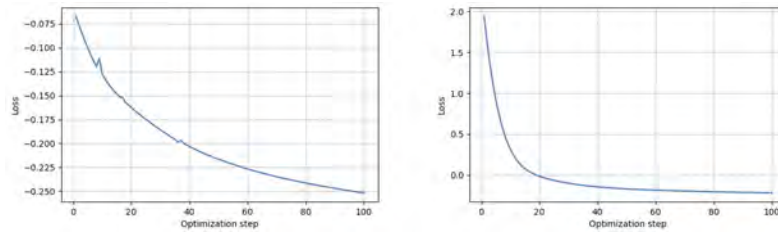


Fig. 2. The optimizer can quickly and effectively refine the deformation field even deformation from models with random initialization (left) or random parameters (right). With DSC increasing from 0.4260 to 0.5436 (left), and 0.4260 to 0.5101 (right).

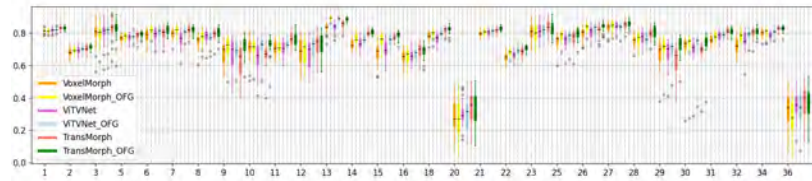


Fig. 3. Evaluation results for each label and different methods on IXI. OFG provides significant and substantial improvement on the unsupervised learning-based methods for most labels, it also surpasses the self-training and optimized self-training method.

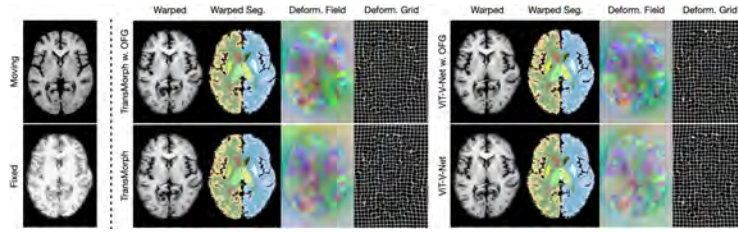


Fig. 4. Registration results comparisons on IXI. Demo randomly extracted from the comparison results between baseline TransMorph, ViT-V-Net (row 2) and their respective model trained with OFG (row 1). OFG shows improved smoothness.

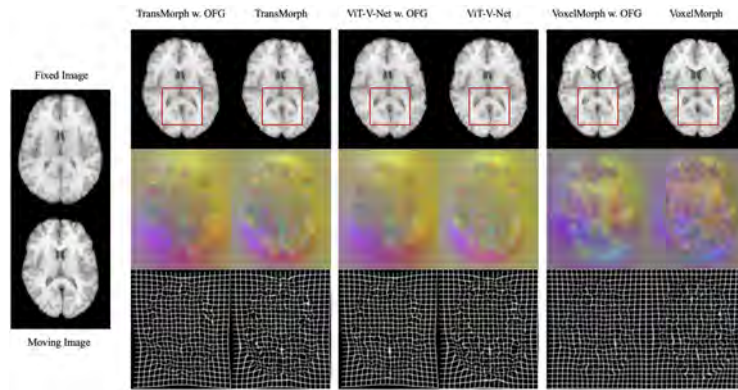


Fig. 5. Registration results comparisons on LPBA40. The red bounding box outlines a region in which we can easily compare the difference between registration outcomes. We can also observe that the deformation fields are smoother for models with OFG.

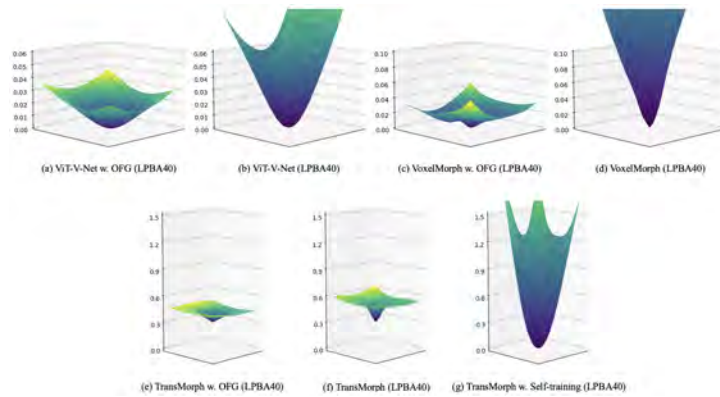


Fig. 6. Loss landscape visualization for comparing model trained with and without OFG, showing OFG with significant improvement in loss landscapes for ViT-V-Net, VoxelMorph and TransMorph on LPBA40. In Addition, for the comparison of TransMorph, we also illustrated the landscape for self-training, which is significantly less smooth compared with OFG.