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3D Multi-modality Medical Image Registration

with GAN-based Synthetic Image Augmentation

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Introduction

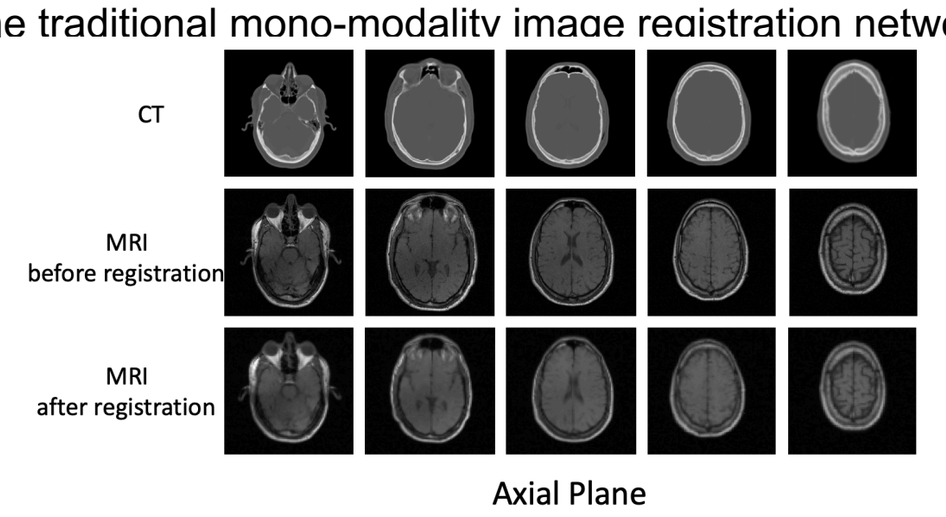
Medical image registration is a crucial yet challenging task in medical image analysis and processing. As far as anatomical brain is concerned, an accurate and automatic image registration algorithm can fix the misalignment of tissue boundary and structure caused by tissue shift, which is helpful in monitoring physiological brain disease development and other medical imaging analysis. What's more, to aggregate the information of various modalities, an accurate multi-modality image registration algorithm is desired.

Method

The project propose an end-to-end unsupervised multi-modality deformable image registration network with CycleGAN augmentation. It is a two-stage method originally designed for intra-subject brain magnetic resonance image – computerized tomography (MRI-CT) registration. First, it generates a synthetic CT image from its corresponding MRI image by using CycleGAN. Second, by feeding the synthetic CT (sCT) and original CT into an unsupervised registration network, the deformation field to align the sCT and CT image is obtained, which is also the deformation field applied to the MRI image to align with CT image. On top of the mono-modality image similarity on CT and warped sCT, a mutual information multi-modality image similarity on CT and warped MRI is also incorporated in the training process.

Novelty

- Transfer the multi-modality image registration task into a mono-modality one by introducing image-to-image translation between MRI and CT.
- Introduce an auxiliary Mutual information loss on top of the traditional mono-modality image registration network.



Conclusion and Future work

The proposed method demonstrates its ability to outperform both current state-of-the-art registration algorithm and existing registration tools both in terms of accuracy and runtime. Except for MRI-CT image registration, the proposed method also shows its generalization ability on MRI-iUS registration.

In the future, we can apply the method on various dataset of different modalities or different anatomical organs.