Project Proposal: Transfer Learning from MRI Data to CT Data

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Topic description

Our project aims to provide a new method to translate the Computed Tomography (CT) image into Magnetic Resonance (MR) image. CT scan uses radiation, specifically, X-ray to produce images, whereas MRI utilizes magnetic field. For this reason, MRI is considered as a safer imaging system than the CT. However, since MRI scan is generally more expensive than CT scan, synthesizing a CT image from an MR image will reduce the medical cost as well as simplify the clinical workflow. We deemed that this process will also eliminate registration errors.

Datasets description

RIRE datasets (https://www.insight-journal.org/rire/) is the Retrospective Image Registration Evaluation Project, which consist of both MRI and CT image from the same subject. It provides a non-invasive avenue for the visualization of function (PET) in the context of anatomy (MR) and soft tissue (MR) in the context of bone (CT). In the case of our project, we just need the MR image data and CT image data.

Literature Review

Several methods have been investigated to estimate the CT image based on the MR image, which can be found in machine learning area.

D. Boye *et al.* [1] demonstrated the feasibility of using motion information from 4D-MRI to 4D-CT on the basis of a single static 3D-CT data set . Y.X. Yang *et al.* [2] presented a novel hybrid approach to generate synthetic 4D-CT dataset by fusing a static 3D-CT volume with a 4D-MRI dataset. T. Huynh *et al.* [3] proposed the use of multiple sources of information in characterizing the information gain in random forest and proposed a general model to predict CT image from MRI data. W. Yang *et al.* [4] proposed KNN-regression method to predict CT from multi-modality MR image. A. Largent *et al.* [5] proposed a novel learning-based approach to predict a pseudo CT image from a MR image based on a random forest regression with a patch-based anatomical signature to capture the relationship between CT and MR image . D. Nie *et al.* [6] developed a 3D fully convolutional network model for estimating CT Image from MRI Data by directly taking MR image patches as input and CT patches as output. X. Yang *et al.* [7] proposed a multi-CIRF and patch-based approach to generate pseudo-CT from MRI. Results suggest that their approach can be used for MRI-based radiotherapy treatment planning. D. Prokopenko *et al.* [8] gave an improved DualGAN model to translate the CT image to MR image and showed that the translation architecture transforms the initial image retaining the structural information. B. Kaiser *et al.* [9] outlined in detail the pre-processing steps necessary to prepare available datasets for the task of MRI to CT translation. They concluded that the lack of sufficient data is still a major holdback of this specific task.

How we deal with our problem?

We will develop a new method to synthesis CT image drawn from the MR image. This method is a development form of Neural Network. We plan to develop a more efficient loss function and neural network suitable for this task.

Intended experiments

We will use the RIRE datasets to train and test the considered methods of paired MRI to CT translation. We will use the MAE between the pseudo-CT and the real CT image to evaluate our model's accuracy.

Reference

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