FRIEDRICH-SCHILLER-
UNIVERSITÄT
JENA

Multimodal Image registration based on Deep Features

Master thesis proposal

Proposed by: PhD Maha Shadaydeh

Research Objective

Registration of multimodal images is an important task for different applications such as remote sensing and medical image fusion. The main difficulty in multimodal image registration is that similar objects appears differently when imaged by different physical principles. Examples are SAR/Optical remote sensing images, CT/MRI medical images. Defining a proper multimodal similarity measure is a challenging task. Several similarity measures have been used so far, such as the normalized mutual information (NMI) and Kullback Leibler divergence. Recently, similarity metric defined using deep neural network have been proposed in the literature. However, not all regions in the images are relevant to the registration task. It has been shown in [2] that estimation of the similarity metric with emphasis on features/regions of interests in the reference image can considerably improve registration accuracy and simultaneously reduces computational load. This Master thesis aims to use convolution neural network (CNN) for the extraction of the relevant features in the reference image. The extracted features will be then utilized in the registration task for the estimation of the similarity metric, such as the weighted normalized mutual information (NMI) as proposed [2] or the deep similarity metrics proposed in [3] (or [1]).

Research Plan

This Master thesis work will include the following work steps subject to modification based on research progress:

1. Comprehensive literature review on multimodal image registration with focus on deep learning based methods.
2. Implementation of the methods developed within the computer vision group for CNN based feature extraction on medical or remote sensing images.
4. Implementation of the weighted NMI method proposed in [2] with features extracted using CNN (output of step 2).
5. Implementation of the deep similarity metric proposed in [3] (or [1]) with features extracted using CNN (output of step 2).
6. Comparison of the obtained results.

References

[1] Xi Cheng, Li Zhang, and Yefeng Zheng. Deep similarity learning for multimodal medical images. *Computer Methods in Biomechanics and Biomedical Engineering: Imaging & Visualization*, 6(3):248–252, 2018.

[2] M. Shadaydeh and T. Sziranyi. An improved mutual information similarity measure for registration of multi-modal remote sensing images, 2015.

[3] Martin Simonovsky, Benjamín Gutiérrez-Becker, Diana Mateus, Nassir Navab, and Nikos Komodakis. A deep metric for multimodal registration. In *Medical Image Computing and Computer-Assisted Intervention*, volume 9902, pages 10–18. Springer, 2016.