

Master Thesis Proposal

Deep Learning-based Organ Segmentation of MR Images in the large-scale UK Biobank (n > 40,000 subjects) for COVID-19 research

Background. Magnetic resonance imaging (MRI) is a non-ionizing tomographic imaging modality, which is widely used in medical practice and research. The UK Biobank is a large-scale research study collecting health-related data of 500,000 subjects in the United Kingdom, whereof more than 40,000 have undergone whole-body MRI during repeated visits. The vast amount of clinical data (e.g. blood tests and life-style questionnaires) combined with imaging data from this study can provide unique insight in the associations between body features and risk factors of pathology or manifested disease. At this large scale, image analysis based solely on manual delineation (segmentation) of organs and tissues is practically difficult to conduct. Instead, automated methods, based on e.g. deep learning, are necessary.

Research group. At the Department of Surgical Sciences, the Research Group PET/MRI studies the relationships between body composition (e.g. amount of fat tissue versus muscle tissue, fat content in various organs and tissues) and health risks or manifested disease. We have developed methods for automated segmentation of liver, kidneys and bone marrow (using both deep learning and multi-atlas methods) and whole-body image registration for voxel-wise image analysis. See segmentation examples in Figure 1. In forthcoming projects, where we aim to study relationships of organ/tissues in COVID-19, we need to develop methods for segmenting additional organs of interest.

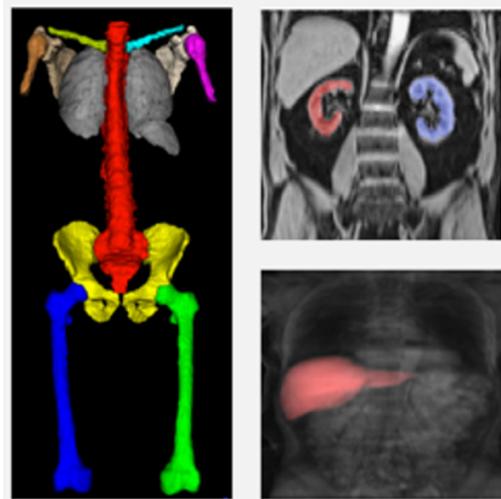


Figure 1. Deep learning segmentation examples of skeleton, kidneys and liver.

Project description. This thesis will focus on the development of methods for automated segmentation of lung lesions and spleen in UK Biobank MRI data.

Project outline:

- Review of possible and previously published approaches of relevance
- Implementation and evaluation of the method(s) with highest potential
- Implementation and evaluation of this/these methods
- Thesis report, according to current guidelines, with aim also for a scientific peer-reviewed article.

Prerequisites. The degree project will be carried out at the Research Group PET/MRI, Dag Hammarskjölds väg 14B, Science Park, Uppsala. Knowledge of MRI, programming, image analysis and anatomy is an advantage. The scope of the degree project is 20 weeks. Start from August 2021, earlier is also possible.

Supervisors/Contacts at the Research Group PET/MRI.

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