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Benchmarking the performance of auto-segmentation algorithms in head and neck cancer images

Head and neck cancer is a common cancer affecting hundreds of patients in Denmark annually. A majority of head and neck cancer patients will receive radiotherapy as part of their treatment. Planning of radiotherapy is patient individual and based on a CT scan of the patient. In the CT scan, the tumour as well as all relevant organs at risk are delineated (salivary glands, muscle structures, oral cavity etc), and the radiation dose is optimized with a focus on avoiding organs at risk while delivering the prescribed dose in the target. The delineation is a time-consuming manual process performed by professionals (doctors and physicists), involving substantial subjective assessment and decision making by the involved professionals. Autosegmentation algorithms have been developed to alleviate the time spent, and homogenize delineations.

We have recently collected a large database consisting of around 800 head-and-neck cancer patients treated at Aarhus University Hospital in the period 2005-18. The data set contain CT scans and clinically used structure sets (delineations).

In the clinic, a socalled atlas-based autosegmentation algorithm is used for assisting delineation of organs at risk. The quality of the results is debatable, and it is still time consuming to edit the structures. In our research, we have developed a deep-learning based autosegmentation model with good results, however it is not used clinically (yet). The aim of this project is to investigate the performance of the deep learning model compared to the atlas-based algorithm, and finally to the clinically used delineations. This will include performing parametrization of the delineated structures for both models (e.g. quantifying structure parameters, such as volume, width, location, etc), and search for patterns in the data.