**Classification of lung nodules in chest computed tomography imaging by using deep learning methods on novel spectral CT data**

The presence of nodules in lung CT’s can be an indication of cancer. To determine the treatment plan it is important to know whether the nodules in the thorax CT are benign or malign. Furthermore, when malign nodules are present, it is useful to know whether they are a primary lung cancer or metastases from another tumor. The earlier this can be determined, the better the treatment can be planned accordingly.

Automated detection as well as classification on malign and benign of lung nodules has been studied widely. However, classification of patients on primary tumor site has not been performed previously. In this study thorax CT’s of a novel spectral CT will be used to develop a machine learning method to classify lung nodules. A spectral CT has the advantage over a normal CT that it detects on two different energies, acquiring more information in one scan. Therefore, it is the hypothesis that by using the Spectral CT scans an improved classification accuracy can be achieved compared to using traditional CT.

In Utrecht UMC the spectral CT has been in use for two years now, resulting in a dataset of thorax CT scans which can be used. However, this dataset contains no annotations but is only labeled per scan belonging to a certain class. Therefore it is not possible to validate the detection of nodules on this dataset. To overcome this problem public databases containing annotated thorax CT scans will be used to develop and validate a nodule detector, which will then be applied to the clinical spectral dataset. The obtained nodule distribution and the classifications will subsequently be used to train a classifier on tumor origin.

In summary, this study consists of three parts:

1. Develop a 3D nodule detector trained and validated on the available database images.
2. Apply the detector to the spectral CT images, obtaining the detected nodules in the scan.
3. Develop a classifier to determine the type of nodules in the patient per scan. The scan will be classified as a whole, and not per nodule. Examples of classes will be: benign, benign multinodular, primary lung tumor and metastases (different groups for different origins, dependent on the groups in the available data)