Gijs van Praagh

Short Biography:

Gijs van Praagh is a 4th year PhD candidate at the department of nuclear medicine and molecular imaging of the UMCG. He studied Biomedical Engineering with specialization Medical Imaging at the University of Groningen. He conducted his master thesis at Stanford University about updating the CT protocol for coronary artery calcium scans. His PhD thesis is about quantification of cardiovascular inflammatory and infectious diseases in PET/CT. The ambition of this research is to provide fast and more accurate quantification of these diseases using state-of-the-art technological advances, such as artificial intelligence and radiomics. Clinically, this could improve diagnoses, treatment strategies, and patient monitoring. Additionally, it can speed up cardiovascular PET/CT studies tremendously, which can help understand the physiological principles of these diseases

Abstract:

Multiple studies have demonstrated potential advantages of hybrid positron emission tomography combined with computed tomography (PET/CT) as an adjunct to current clinical inflammatory and infectious biochemical markers for cardiovascular diseases. To quantitatively analyze these diseases at PET/CT, robust segmentation of the heart and vessels is necessary. However, manual segmentation is extremely time-consuming and labor-intensive.

In this presentation, an in-house developed software pipeline will be presented which includes automated segmentation of the aorta using a 3D U-Net, calcium scoring, PET uptake quantification, background measurement, radiomics feature extraction, and 2D surface visualization of vessel wall calcium and tracer uptake distribution. To train the 3D U-Net, 330 non-contrast low-dose CTs from (2-[18F]FDG and Na[18F]F) PET/CTs performed in patients with various vascular pathologies with manual segmentation of the ascending aorta, aortic arch, descending aorta, and abdominal aorta were used. The dataset was randomly split into training (n=264; 80%) and validation (n=66; 20%) sets. Evaluation was performed on an external test set of 49 PET/CTs. The Dice similarity coefficient (DSC) and Hausdorff distance (HD) were used to assess segmentation performance. Automatically obtained calcium scores and uptake values were compared with manual scoring obtained using a clinical software (syngo.via) in six patient images.

Results showed that fully automated segmentation of the aorta using a 3D U-Net was feasible in low-dose CT obtained from PET/CT scans. The test set yielded a DSC of 0.867±0.030 and HD of 1.0 [0.6-1.4] mm, similar to an open-source model with a DSC of 0.864±0.023 and HD of 1.4 [1.0-1.8] mm. Quantification of calcium and uptake values were in excellent agreement with clinical software (ICC: 1.00 [1.00-1.00] and 0.99 [0.93-1.00] for calcium and uptake values, respectively).

Additionally, an overview will be given of other (publicly available) cardiovascular segmentation tools and some examples of potential applications of segmentation of the cardiovascular system in PET/CT.