Ronald Boellaard

Short Biography:

Prof.dr. Ronald Boellaard (M) is appointed as full professor at the Amsterdam University Medical Centers and at the University Medical Center Groningen, The Netherlands. He has a background in biology (MSc) and physics (MSc) and a PhD in science. His research focuses on (pharmacokinetic) quantitative analysis of positron emission tomography (PET), PET image reconstruction and processing. He is member or former member of several international societies and committees (e.g. QIBA technical FDG PET/CT and Amyloid committees, member of EANM NeuroImaging committee, EORTC imaging workgroup, EARL steering board). He is the principal author for the Netherlands and the European guidelines for standardisation of quantitative FDG PET and PET/CT studies (EJNMMI 2010 & 2015). Specialties: quantitative analysis of positron emission tomography studies; image processing, radiomics and artificial intelligence, image reconstruction, pharmacokinetic analysis (brain, onco, cardio), PET standardization and QA and more recently Total Body PET/CT.

Abstract:

Recently, long axial field of view (LAFOV) PET/CT, also referred to as 'Total Body PET/CT', have become available and these systems provided unique opportunities for PET research because of the ultra-high sensitivity and the ultra-large anatomical coverage. Besides new opportunities for research, clinical examinations can be performed in a shorter time and with less activity and/or at prolonged uptake times. Moreover, artificial intelligence is getting more and more integrated in both clinical and research image analysis workflows.

In this lecture, opportunities for use of AI in the context of LAFOV PET will be addressed. First a short summary of PET radiomics and machine learning as well as deep learning applications will be reviewed and subsequently opportunities for LAFOV PET. For example, studies that are typically hampered by high noise levels, such as 89Zr-mAb immunoPET studies, now become suitable for radiomics analysis because of the tremendous improvement in image quality. Similarly, breath-hold PET was shown to be feasible making radiomics analysis more accurate and feasible by reduced motion blurring. Another example would be the application of AI for dynamic whole body studies that are now more feasible by the large anatomical coverage of LAFOV PET/CT and AI may be used to explore or discover tracer kinetic associations across all organs and tumors and/or derived fully corrected plasma input function non-invasively. Parametric kinetic analysis is greatly hampered by the huge datasets generated by LAFOV PET, including larger dynamic scans by using higher temporal sampling. There is an urgent need for faster and more reliable parametric processing of dynamic scans for which AI may play an important role. Deep learning methods, based on convolution neural networks, will enhance total body analysis. Clearly, whole body organ segmentations are now greatly facilitated using so-called nnUnet architectures allowing to delineated all organs within minutes and delineations can subsequently used to derive uptake or tracer kinetics. Deep learning may also support reading images faster and/or with less observer variability and enables the possibly higher throughput possible with LAFOV PET/CT. User in the loop methods may be a good compromise between AI based atomization of clinical reads while still being supervised by the nuclear medicine physician.

In summary, in this lecture we will review several AI applications and discuss opportunities that AI can offer to further optimize the benefits that LAFOV PET/CT can offer.