Results: The system was evaluated on multivendor CT datasets of 10 patients presenting from early stage to locally advanced NSCLC or pulmonary metastases. OARs taken into consideration in this study were: heart, lungs, oesophagus, proximal bronchus tree, spinal canal and trachea. Interactive contours were generated by a physician using the proposed system. Delineation of the OARs obtained with the presented system was approved to be usable for RTP in more than 90% of the cases, excluding the oesophagus, which segmentation was never approved (Fig 1). On the accepted reported cases, more than 90% of the interactive contours reached a Dice Similarity Coefficient higher than 0.7 with respect to manual segmentations (Fig 2). Therefore, our interactive delineation approach allows users to generate contours of sufficient quality to be used in RTP up to three times faster than manually.

Conclusion: An interactive, accurate and easy-to-use computer-assisted system for OARs segmentation in thoracic oncology was presented and clinically evaluated. The introduction of the proposed approach in clinical routine was approved to be usable for RTP in more than 90% of the cases, excluding the oesophagus, which segmentation was never approved (Fig 1). On the accepted reported cases, more than 90% of the interactive contours reached a Dice Similarity Coefficient higher than 0.7 with respect to manual segmentations (Fig 2). Therefore, our interactive delineation approach allows users to generate contours of sufficient quality to be used in RTP up to three times faster than manually.

Material and Methods: ATLAAS, an Automatic decision-Tree based Learning Algorithm for Advanced Segmentation was developed and validated in previous work. ATLAAS (patent pending PCT/GB2015/052981) is a predictive segmentation model, trained with machine learning to automatically select and apply the best PET-AS method, according to the tumour characteristics. The ATLAAS model was trained on 500 simulated PET images with known true contour. The PET-AS used in the model included adaptive iterative thresholding, region growing, watershed-based segmentation, deformable contours, and clustering with K-means, fuzzy C-means and Gaussian Mixture Models, applied to the detection of 2 to 8 clusters. In this work, ATLAAS was applied to the segmentation of PET images containing synthetic tumours generated using the fast PETSTEP simulator. The data included 5 Head and Neck (H&N), 5 lung, 5 abdominal and 5 brain tumours. The contours obtained with ATLAAS were compared to the true tumour outline using the Dice Similarity Coefficient (DSC). DSC results for ATLAAS were compared with results obtained for thresholding at 42% (RT42) and 50% (RT50) of the maximum intensity.

Results: ATLAAS contours were closer to the true contour for all cases. The DSCs obtained with ATLAAS were 5.3% to 123% higher across cases than DSCs obtained for RT50 and 4.1% to 74% higher than for RT42. The largest differences between ATLAAS and relative thresholding were obtained for lung images, the smallest differences for H&N and Brain tumours. The minimum conformity of ATLAAS contours on the whole dataset was 0.81 DSC compared to 0.38 and 0.47 for RT50 and RT42 respectively.

Conclusion: Our results show that ATLAAS is capable of providing highly accurate segmentation for different tumour sites, largely outperforming single-value thresholding methods. The ATLAAS machine learning algorithm represents a standardized approach to PET auto-segmentation. The robustness and adaptability of ATLAAS makes it a very promising tool for PET segmentation in radiotherapy treatment planning.

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Cardio-respiratory motion compensation for 5D thoracic CBCT in IGRT
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Purpose or Objective: Accurate information about patient motion is essential for precise radiation therapy, in particular for thoracic and abdominal cases. Patient motion assessment based on daily on-board CBCT images immediately before treatment potentially allows accounting for organ motion during the treatment. Especially for patients with tumors close to organs at risk, the organ positions need to be precisely known as a function of time. In case of the heart 5D