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Regarding "Segmentation of heterogeneous or small FDG PET positive tissue based on a 3D-locally adaptive random walk algorithm" By DP. Onoma, *et al*.

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To the editor,

We read with interest the paper of Onoma, *et al.* regarding the development and evaluation of a novel PET image segmentation method based on a random walk algorithm and called 3D-LARW [1]. In order to evaluate 3D-LARW, it was applied to three different datasets: a physical phantom containing homogeneous spheres acquired in a single PET/CT scanner, synthetic heterogeneous tumors generated by blurring and adding noise to a manually defined ground-truth, and 14 clinical tumors (for which the surrogate of truth was provided by manual delineations carried out by two different experts). This evaluation showed that 3D-LARW performed very well across the range of datasets considered.

After optimization, 3D-LARW was also compared with threshold-based methods (a fixed threshold at 40% of SUV_{max} and an adaptive thresholding) and the FLAB approach [2].

Regarding the results reported for the homogeneous spheres in the phantom acquisition, FLAB obtained similar or worse results than both threshold-based methods. Similar hierarchy between FLAB and the threshold-based methods was reported for the synthetic heterogeneous tumours, both small and large, and the 14 clinical images.

The authors cited the original work presenting a 2-class implementation aimed at homogeneous uptakes delineation [2], but not the 3-class version of FLAB developed to delineate heterogeneous tumours [3]. As previously published, the 2-class version applied to heterogeneous objects is not appropriate and can only lead to unsatisfactory results [3]. On the one hand, this could contribute in explaining the poor results compared to threshold-based methods reported in this work for heterogeneous objects, in contradiction to previously published results using FLAB with three classes [3]–[6] (see also figure 1).

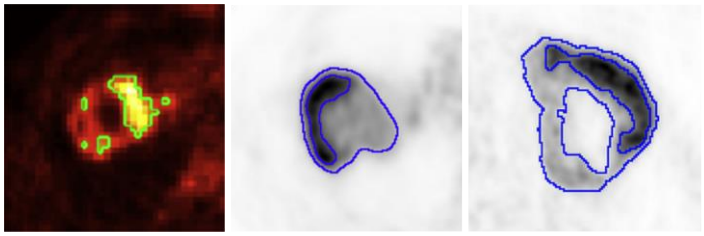

Figure 1. On the left, the result of FLAB applied to a heterogeneous tumour, reproduced from [1]. In the middle and on the right, results of FLAB using 3 classes, applied to two similarly heterogeneous tumours, reproduced from [7][4]**.**

On the other hand, the results of FLAB on the homogeneous spheres of the phantom acquisition are more surprising because they concern homogeneous uptakes. They contradict previously published results that demonstrated significant improvements of FLAB over threshold-based methods [2], [8], improvements similar to those demonstrated here for 3D-LARW. These results are also in disagreement with these published by different groups using the originally published FLAB implementation provided within the context of research agreements. It is worth noting that these works have covered different activity distribution patterns, contrasts, and noise levels with FDG as well as other radiotracers [9]–[12].

We should emphasize that these observations do not decrease in any way the merits of the 3D-LARW method as it was demonstrated to provide significant improvements over threshold-based methods.

The comparison with FLAB carried out here raises the issue of comparing methods and re-implementing algorithms. Some (threshold-based methods for instance) are very easy to implement and associated results are thus fairly easy to reproduce. On the contrary, more complex methods may involve a higher level of know-how, implementation details and other parameterization choices, which may result in a substantial impact on the implemented method's performances, as it seems to have been the case here. This highlights the need to provide a rigorous framework for such a comparison, with both standardized datasets and optimized methods' implementation. The current efforts led by the American Association of Physicists in Medicine Task Group 211[1] "Classification, Advantages and Limitations of the Auto-Segmentation Approaches for PET" in developing such a benchmarking framework (called 'PETASset') are promising in that regard. PETASset will provide, within a user-friendly interface, test datasets (phantom, simulated and clinical images with associated ground-truth), evaluation metrics and tools to compare and rank methods [13].

[1] http://aapm.org/org/structure/default.asp?committee_code=TG211

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