An Image Transformer-based Encoded Model for Tumor Lesions Segmentation in Whole-body PET/CT

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Abstract: In quantitative PET/CT analysis, segmentation of tumor lesions is a crucial processing step enabling feature extraction and image-based clinical staging of tumors. However, manual segmentation is laborious and infeasible, and recent research of automatic tumor segmentation in whole-body PET/CT is still challenging as FDG uptake can be occurred in normal organs. Hence, we propose an advanced network which has encoder layer with attentions extracted from visual image transformers and dense blocks on decoder. It can prevent inductive bias and optimize the performance during using greatly varied data as the case of tumor lesions in Whole-body PET/CT.

Keywords: Visual image transformer, Dense blocks, Whole-body PET/CT

Methods

- **Data preprocessing:** The House Unit values (HU) of the collected CT volume data were rescaled [-1024, 1024] to [0, 1]. Also, the data used for training were resized to small size (192×192×192) in consideration of learning time and computed memory.
- **Method description:** The input of the proposed learning model was designated as two channels: PET and CT, and there are two important approaches. One is, in the learning process, the feature map extracted by an image transformer is utilized as attention in each encoder layer and this structure is combined with the decoder of U-net architecture to improve inductive bias. The other one is dense blocks of segmentation flow on decoder that connects all layers with matched feature-map. It can prevent inductive bias and optimize the performance during using greatly varied data as the case of tumor lesions in Whole-body PET/CT. We also used AdamW optimizer and Learning rate scheduler in the training environment. In experiment, based on the results of the prior trial, training sets consisted of 486 patient sets with tumor lesions and 108 normal sets and randomly divided 15 sets with lesions and 15 normal sets each were used as validation sets.
- **Postprocessing:** The evaluated data is resized to the size of the original data provided by *the challenge autoPET 2022* to validate the performance of proposed model in the same way as others.

- **Results**

The performance of tumor lesions segmentation was evaluated quantitatively by Dice score (DSC), achieving 0.367 of DSC. It means that this network can improve quantitative and qualitative PET/CT analysis of tumor lesions.

Github URL: https://github.com/seolyujin/autoPET2022