

Convolutional Neural Nets with Template-Based Data Augmentation for Functional Lung Imaging Segmentation

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Rationale and Objectives: We propose an automated segmentation pipeline based on deep learning for ventilation-based quantification which improves on previous methods in terms of robustness and computational efficiency. The large data requirements for the proposed framework is made possible by a novel template-based data augmentation strategy.

Materials and Methods: Convolutional neural net (i.e., U-net) models were generated using a custom multilabel Dice metric loss function and a novel template-based data augmentation strategy. Development occurred within *ANTsRNet*—a growing open-source repository of well-known deep learning architectures first introduced here which interfaces with the Advanced Normalization Tools package and the R statistical project. Training (including template generation and data augmentation) employed 500 images. Evaluation was performed on the remaining 1?? images through comparison with a previously reported automated segmentation algorithm based on Gaussian mixture modelling with Markov Random field (MRF) spatial priors.

Results:

Conclusions: The proposed deep learning framework yielded comparable results as the MRF-based algorithm. Such an approach reduces computational time without sacrificing accuracy.

Key Words: Advanced Normalization Tools, ANTsRNet, hyperpolarized gas imaging, neural networks, U-net

1 Introduction