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Albumentations3D: A Python Package for 3D Medical Imaging Augmentation

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Summary

Computer-aided diagnosis/detection (CADx/CADe) has been a prominent area of research for the subfield of medical image processing. While recent advancements in this field have increased model performance, the success of these models still largely relies on a significant amount of labeled and annotated training data. Because of the medical nature of the subject material, only medical professionals are allowed to annotate and label this medical data [CITE], which makes the annotation process extremely expensive. As a result, data augmentation plays a crucial role in increasing the size and diversity of the limited data, which in turn, reduces the possibility of overfitting and improves the capability of these models to generalize.

Statement of need

Albumentations3D is a Python package based on the popular image augmentation library Albumentations (Buslaev et al., 2020) but with specific enhancements for working with volumetric 3D images, such as CT scans and other volumetric imaging. This package provides a collection of powerful and efficient augmentation techniques that can be seamlessly integrated into a machine-learning pipeline to augment 3D images and volumes.

While many image augmentation libraries, like the popular Albumentations library, excel at performing augmentations on traditional 2D or RGB images, they lack the utility to complete these augmentations on 3D images. Albumentations3D addresses this need by extending the success of the Albumentations library for 2D image augmentation to the realm of volumetric 3D images, offering a comprehensive set of transformations and augmentations, ranging from pixel-level intensity transformations to spatial transformations, all designed and optimized for 3D data.

One aspect that sets this package apart from other 3D augmentation packages such as Volumentations (Solovyev et al., 2022) is the inclusion of physics-based transformations that can utilize metadata commonly found in DICOM files. TALK ABOUT NPS NOISE (Solomon et al., 2012)

TALK ABOUT CURRENT RESEARCH USING NPS TRANSFORMATIONS

The Albumentations3D package provides researchers and clinicians with an efficient and user-friendly solution for augmenting 3D medical imaging datasets. Its capabilities are invaluable where data augmentation is a critical step in the training of a robust and accurate deep-learning model. By providing a comprehensive and user-friendly API for the augmentation of 3D images, Albumentations3D contributes to advancing research in fields such as medical diagnosis, object recognition, and remote sensing. In all, The Albumentations3D package aims to fill a significant gap between the computer vision community and medical imaging community by providing

a specialized toolset for augmenting volumetric 3D images that follows a familiar structure commonly used by computer vision experts.

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