Thoracic Volume and Pleural Effusion Segmentations in Diseased Lungs for Benchmarking Chest CT Processing Pipelines (PleThora)

Summary

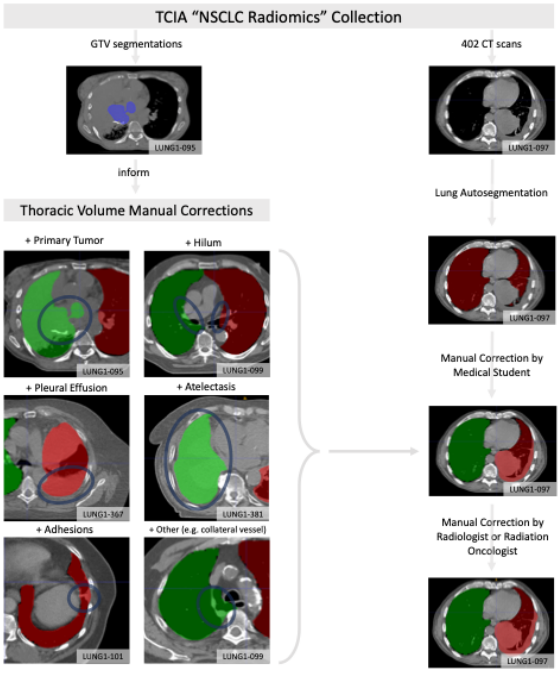
Automated or semi-automated algorithms intended for chest CT analyses typically require the creation of a 3D map of the thoracic volume as their initial step. Identifying this anatomic region precedes fundamental tasks such as lung structure segmentation, lesion detection, and radiomics feature extraction in analysis pipelines. However, automatic approaches to segment the thoracic volume maps struggle to perform consistently in subjects with diseased lungs – yet this is exactly the circumstance for which pipeline analyses would be most useful.

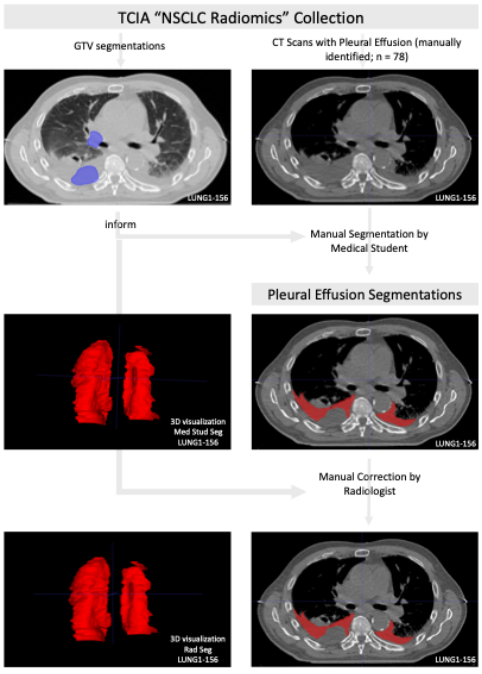
To address this need, we have created PleThora, a dataset of **ple**ural effusion and **thora**cic cavity segmentations in subjects with diseased lungs. PleThora consists of left and right thoracic cavity segmentations delineated on 402 CT scans from The Cancer Imaging Archive NSCLC Radiomics collectio n as well as separate segmentations labeling pleural effusions alone. Thoracic cavity segmentations include lung parenchyma, tumor, atelectasis, adhesions, and effusion. PleThora is a tool for medical image preprocessing and segmentation researchers to build and compare approaches for region-of-interest identification and analysis.

The thoracic cavity segmentations were generated automatically by a U-Net based algorithm trained on chest CTs without cancer, manually corrected by a medical student, and revised by a radiation oncologist or a radiologist. Pleural effusion segmentations were manually delineated by a medical student and revised by a radiologist. Expert GTV segmentations already provided by the NSCLC Radiomics collection helped inform our segmentations, and areas of the effusion that overlap with GTVs are not included. Researchers interested in discriminating between GTV and effusion using imaging biomarker inputs may find our pleural effusion segmentations useful, especially when paired with the GTV segmentations provided in the NSCLC Radiomics collection.

Tabular data are also provided, including GTV, thorax, and effusion volumes (in cm3), tumor location, and image metadata. Additionally, we standardized a train/test split for training deep learning algorithms with the thoracic cavity segmentations.

Note: These segmentations use the RPI orientation, but the original DICOM files are oriented using the RAI convention. As a result, some tools such as ITK-SNAP will not render the segmentations in the correct orientation when visualized. The authors of these data suggest using software like Mango (http://ric.uthscsa.edu/mango/) or to convert to DICOM files to Nifti with software like dcm2niix (https://github.com/rordenlab/dcm2niix) to address this issue.





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- John P. and Kathrine G. McGovern Medical School, Houston, TX. Department of Diagnostic and Interventional Imaging.

Data Access

Data Access

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Pleural Effusion Segmentations (NIfTI, 1.7 MB)	Download
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Data Citation

Kiser, K.J., Ahmed, S., Stieb, S.M., Mohamed, A.S.R., Elhalawani, H., Park, P.Y.S., Doyle, N.S., Wang, B.J., Barman, A., Fuller, C.D., Giancardo, L. (2020). *Data from the* **Thoracic Volume and Pleural Effusion Segmentations in Diseased Lungs for Benchmarking Chest CT Processing Pipelines**[Data set]. The Cancer Imaging Archive. https://doi.org/10.7937/tcia.2020.6c7y-gq39 .

Publication Citation

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TCIA Citation

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In addition to the dataset citation above, please be sure to cite the following if you utilize these data in your research:

Data Citation

Aerts, H. J. W. L., Wee, L., Rios Velazquez, E., Leijenaar, R. T. H., Parmar, C., Grossmann, P., … Lambin, P. (2019). Data From **NSCLC-Radiomics** [Data set]**.** The Cancer Imaging Archive. https://doi.org/10.7937/K9/TCIA.2015.PF0M9REI

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Versions

Version 3 (Current): Updated 2020/07/28

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Version 3 changes:

2D U-Net

- Incorrectly reported the 2D U-Net achieved segmentations with Dice similarity coefficients of 0.90 and 0.94 for left and right lungs.
- The performances should be 0.94 and 0.94.

3D U-Net

- Incorrectly reported the 3D U-Net achieved segmentations with Dice similarity coefficients of 0.82 and 0.94 for left and right lungs.
- The performances should be 0.95 and 0.96.

Data Dictionary

Added *Auto-MS Thorax DSC* description.

Version 2: 2020/06/26

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Baseline UNet 3D Summary (PDF)	Download
Data Dictionary (DOCX)	Download

Version 2 changes:

- The dataset is now named “PleThora” for “**Ple**ural effusion and **thor**acic cavity segmentations in diseased lungs.”
- All NIfTI files have been compressed for convenience (.nii à .nii.gz)
- All thoracic cavity primary reviewer segmentations have been renamed from “lungMask_edit.nii” to “[CaseID]_thor_cav_primary_reviewer.nii.gz” to more specifically identify each file’s contents and avoid confusion.
- Eighty-six thoracic cavity secondary reviewer segmentations have been added. These are named “[CaseID]_thor_cav_secondary_reviewer.nii.gz.”
- Interobserver variability analysis between primary and secondary reviewer thoracic cavity segmentations revealed four cases in which interobserver agreement was anomalously lower than all other cases. These cases were manually re-reviewed by another physician. In three cases (LUNG1-026, LUNG1-157, and LUNG1-354) it was deemed that the secondary reviewer’s segmentation excluded structures that should have been included. These were corrected. In one case (LUNG-088) it was determined that the primary reviewer segmentation included a large (400 cm3) nodal conglomerate. Our original thoracic cavity segmentation definition did not intend to include nodal conglomerates, so for consistency’s sake we corrected the primary reviewer segmentation accordingly. However, the segmentation with the nodal conglomerate is still valuable, so we provide it as well and name it “LUNG1-088_thor_cav_primary_reviewer_with_nodal_conglomerate.nii”
- We manually reviewed the pleural effusion segmentations of the primary physician reviewer and determined that in many cases the reviewer had not been sufficiently careful. Therefore, all 78 primary reviewer segmentations were re-reviewed by another physician and corrected as necessary. They are now re-submitted as “[CaseID]_effusion_first_reviewer.nii.gz”
- Seventy-eight pleural effusion secondary reviewer segmentations have been added. These are named “[CaseID]_effusion_second_reviewer.nii.gz.”
- Fifteen pleural effusion tertiary reviewer segmentations have been added. These are named “[CaseID]_effusion_third_reviewer.nii.gz.”
- We add two documents that describe baseline performances for 2D and 3D U-Net segmentation algorithms and define a reproducible train/test split.
- Data Dictionary: we provide a data dictionary to describe the meanings of column names in the “Thorax and Pleural Effusion Segmentation Metadata” spreadsheet.

Version 1: 2020/04/03

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Segmentation Features and Image Metadata (CSV)	Download
Corresponding Original CT Images (DICOM) from NSCLC Radiomics (24 GB)	Download