Lung CT Segmentation Challenge 2017 (LCTSC)

Summary

Redirection Notice

This page will redirect to https://www.cancerimagingarchive.net/collection/lctsc/ in about 5 seconds.

This data set was provided in association with an AAPM Thoracic Auto-segmentation challenge competition and a related conference session called Auto-Segmentation for Thoracic Radiation Treatment Planning: A Grand Challenge conducted at the AAPM 2017 Annual Meeting. The initial winners were announced at the AAPM meeting, but the competition website remains open to others who wish to see how their algorithms perform.

> Numerous auto-segmentation methods exist for Organs at Risk in radiotherapy. The overall objective of this auto-segmentation grand challenge is to provide a platform for comparison of various auto-segmentation algorithms when they are used to delineate organs at risk (OARs) from CT images for thoracic patients in radiation treatment planning. The results will provide an indication of the performances achieved by various auto-segmentation algorithms and can be used to guide the selection of these algorithms for clinic use if desirable.

Data Access

Data Access

Data Type	Download all or Query/Filter	License
Images and Radiation Therapy Structures (DICOM, 4.8 GB)	*Download* *Search* (Requires the NBIA Data Retriever.)	CC BY 3.0

Click the Versions tab for more info about data releases.

Additional Resources for this Dataset

The NCI Cancer Research Data Commons (CRDC) provides access to additional data and a cloud-based data science infrastructure that connects data sets with analytics tools to allow users to share, integrate, analyze, and visualize cancer research data.

- Imaging Data Commons (IDC) (Imaging Data)

Additional Resources for this Dataset

The following external resources have been made available by the data submitters. These are not hosted or supported by TCIA, but may be useful to researchers utilizing this collection.

- Additional download options relevant to the challenge can be found on http://www.autocontouringchallenge.org/ and in the Detailed Description tab.

Detailed Description

Detailed Description

Collection Statistics	Updated 2019/05/08
Modalities	CT, RT, RTSTRUCT
Number of Patients	60
Number of Studies	60
Number of Series	120
Number of Images	9,593
Image Size (GB)	4.8

Supporting Documentation and Metadata

To participate in the challenge and to learn more about the subsets of training and test data used please visit www.autocontouringchallenge.org. Some information from the challenge site is included below.

Data description

Average 4DCT or free-breathing (FB) CT images from 60 patients, depending on clinical practice, are used for this challenge. Data were acquired from 3 institutions (20 each). Datasets were divided into three groups, stratified per institution:

- 36 training datasets
- 12 off-site test datasets
- 12 live test datasets

Data will be provided in DICOM (both CT and RTSTRUCT), as commonly used in most commercial treatment planning systems.

Contouring Guidelines The manual contours that were used in clinic for treatment planning were used as ground "truth." All contours were reviewed (and edited if necessary) to ensure consistency across the 60 patients using the RTOG 1106 contouring atlas. Details of contouring guidelines can be found in "Learn the Details". The following organs-at-risk (OARs) are included in this challenge:

- Esophagus
- Heart
- Left and Right Lungs
- Spinal cord

Training data

Each training dataset includes a set of DICOM CT image files and one DICOM RTSTRUCT file. Each training dataset is labeled as LCTSC-Train-Sx-yyy, with Sx (x=1,2,3) identifying the institution and yyy identifying the dataset ID in one institution. You may take advantage of this information to optimize your algorithm for testing data acquired from different institutions.

Training data are available here as a ".tcia" manifest file. Save this to your computer, then open with the NBIA Data Retriever to download the files.

Off-site test data

Each off-site test dataset includes a set of DICOM CT image files and is labeled as LCTSC-Test-Sx-10y, with Sx (x=1, 2,3) identifying the institution and 10y (y=1,2,3,4) identifying the dataset ID in one institution.

Off-site test data are available here as a ".tcia" manifest file. Save this to your computer, then open with the NBIA Data Retriever to download the files.

Live test data

Each live test dataset includes a set of DICOM CT image files and is labeled as LCTSC-Test-Sx-20y, with Sx (x=1,2,3) identifying the institution and 20y (y=1,2,3,4) identifying the dataset ID in one instution.

Live test data are available here as a ".tcia" manifest file. Save this to your computer, then open with the NBIA Data Retriever to download the files.

Manual contours for off-site and live test data

Manual contours for both off-site and live test data are now available in DICOM RTSTRUCT. Each test dataset has one DICOM RTSTRUCT file. These manual contours serve as “ground truth” for evaluating segmentation algorithm performance.

Test data contours are available here as a ".tcia" manifest file. Save this to your computer, then open with the NBIA Data Retriever to download the files.

Contouring Guidelines from the challenge

Esophagus

Standard name: Esophagus

RTOG Atlas description: The esophagus should be contoured from the beginning at the level just below the cricoid to its entrance to the stomach at GE junction. The esophagus will be contoured using mediastinal window/level on CT to correspond to the mucosal, submucosa, and all muscular layers out to the fatty adventitia.

Additional notes: The superior-most slice of the esophagus is the slice below the first slice where the lamina of the cricoid cartilage is visible (+/- 1 slice). The inferior-most slice of the esophagus is the first slice (+/- 1 slice) where the esophagus and stomach are joined, and at least 10 square cm of stomach cross section is visible.

Heart

Standard name: Heart

RTOG Atlas description: The heart will be contoured along with the pericardial sac. The superior aspect (or base) will begin at the level of the inferior aspect of the pulmonary artery passing the midline and extend inferiorly to the apex of the heart.

Additional notes: Inferior vena cava is excluded or partly excluded starting at slice where at least half of the circumference is separated from the right atrium.

Lungs

Standard names: Lung_L, Lung_R

RTOG Atlas description: Both lungs should be contoured using pulmonary windows. The right and left lungs can be contoured separately, but they should be considered as one structure for lung dosimetry. All inflated and collapsed, fibrotic and emphysematic lungs should be contoured, small vessels extending beyond the hilar regions should be included; however, pre GTV, hilars and trachea/main bronchus should not be included in this structure.

Additional notes: Tumor is excluded in most data, but size and extent of excluded region are not guaranteed. Hilar airways and vessels greater than 5 mm (+/- 2 mm) diameter are excluded. Main bronchi are always excluded, secondary bronchi may be included or excluded. Small vessels near hilum are not guaranteed to be excluded. Collapsed lung may be excluded in some scans. Regions of tumor or collapsed lung that are excluded from training and test data will be masked out during evaluation, such that scores are affected by segmentation choices in those regions.

Spinal cord

Standard name: SpinalCord

RTOG Atlas description: The spinal cord will be contoured based on the bony limits of the spinal canal. The spinal cord should be contoured starting at the level just below cricoid (base of skull for apex tumors) and continuing on every CT slice to the bottom of L2. Neuroformanines should not be included.

Additional notes: Spinal cord may be contoured beyond cricoid superiorly, and beyond L2 inferiorly. Contouring to base of skull is not guaranteed for apical tumors.

Citations & Data Usage Policy

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Users must abide by the TCIA Data Usage Policy and Restrictions. Attribution should include references to the following citations:

Data Citation

Yang, J., Sharp, G., Veeraraghavan, H., Van Elmpt, W., Dekker, A., Lustberg, T., & Gooding, M. (2017). **Data from Lung CT Segmentation Challenge (LCTSC) (Version 3) [Data set]**. The Cancer Imaging Archive. https://doi.org/10.7937/K9/TCIA.2017.3R3FVZ08

Publication Citation

Yang, J. , Veeraraghavan, H. , Armato, S. G., Farahani, K. , Kirby, J. S., KalpathyKramer, J. , van Elmpt, W. , Dekker, A. , Han, X. , Feng, X. , Aljabar, P. , Oliveira, B. , van der Heyden, B. , Zamdborg, L. , Lam, D. , Gooding, M. and Sharp, G. C. (2018), **Autosegmentation for thoracic radiation treatment planning: A grand challenge at AAPM 2017**. Med. Phys. https://doi.org/10.1002/mp.13141

TCIA Citation

Clark, K., Vendt, B., Smith, K., Freymann, J., Kirby, J., Koppel, P., Moore, S., Phillips, S., Maffitt, D., Pringle, M., Tarbox, L., & Prior, F. (2013). **The Cancer Imaging Archive (TCIA): Maintaining and Operating a Public Information Repository.** In Journal of Digital Imaging (Vol. 26, Issue 6, pp. 1045–1057). Springer Science and Business Media LLC. https://doi.org/10.1007/s10278-013-9622-7

Other Publications Using This Data

TCIA maintains a list of publications which leverage our data. If you have a manuscript you'd like to add, please contact TCIA's Helpdesk.

1. Almeida, G., & Tavares, J. M. R. S. (2021). Versatile Convolutional Networks Applied to Computed Tomography and Magnetic Resonance Image Segmentation Journal of Medical Systems, 45(8), 79. doi: https://doi.org/10.1007/s10916-021-01751-6
2. Diniz, J. O. B., Diniz, P. H. B., Valente, T. L. A., Silva, A. C., & Paiva, A. C. (2019). Spinal cord detection in planning CT for radiotherapy through adaptive template matching, IMSLIC and convolutional neural networks. Comput Methods Programs Biomed, 170, 53-67. doi: https://doi.org/10.1016/j.cmpb.2019.01.005
3. Han, C. H., Kim, M., & Kwak, J. T. (2021). Semi-supervised learning for an improved diagnosis of COVID-19 in CT images. PLoS One, 16(4), e0249450. doi: https://doi.org/10.1371/journal.pone.0249450
4. Mason, J. H. (2018). Quantitative cone-beam computed tomography reconstruction for radiotherapy planning. (PhD). The University of Edinburgh, Edinburgh, Scotland. Retrieved from http://hdl.handle.net/1842/33193
5. Williams, J., Kolehmainen, J., Cunningham, S., Ozel, A., & Wolfram, U. (2022). Effect of patient inhalation profile and airway structure on drug deposition in image-based models with particle-particle interactions. Int J Pharm, 612, 121321. doi: https://doi.org/10.1016/j.ijpharm.2021.121321
6. Wong, J., Fong, A., McVicar, N., Smith, S., Giambattista, J., Wells, D., . . . Alexander, A. (2019). Comparing deep learning-based auto-segmentation of organs at risk and clinical target volumes to expert inter-observer variability in radiotherapy planning. Radiother Oncol, 144, 152-158. doi: https://doi.org/10.1016/j.radonc.2019.10.019
7. Wong, J., Huang, V., Giambattista, J. A., Teke, T., Kolbeck, C., Giambattista, J., & Atrchian, S. (2021). Training and Validation of Deep Learning-Based Auto-Segmentation Models for Lung Stereotactic Ablative Radiotherapy Using Retrospective Radiotherapy Planning Contours. Front Oncol, 11, 626499. doi: https://doi.org/10.3389/fonc.2021.626499
8. Woo, M., Devane, A. M., Lowe, S. C., Lowther, E. L., & Gimbel, R. W. (2021). Deep learning for semi-automated unidirectional measurement of lung tumor size in CT. Cancer Imaging, 21(1), 43. doi: https://doi.org/10.1186/s40644-021-00413-7
9. Yang, J., Veeraraghavan, H., van Elmpt, W., Dekker, A., Gooding, M., & Sharp, G. (2020). CT images with expert manual contours of thoracic cancer for benchmarking autosegmentation accuracy. In Medical Physics (Vol. 47, Issue 7, pp. 3250–3255). Wiley. https://doi.org/10.1002/mp.14107
10. Zhang, G., Yang, Z., Huo, B., Chai, S., & Jiang, S. (2021). Automatic segmentation of organs at risk and tumors in CT images of lung cancer from partially labelled datasets with a semi-supervised conditional nnU-Net. Comput Methods Programs Biomed, 211, 106419. doi: https://doi.org/10.1016/j.cmpb.2021.106419

Versions

Version 3 (Current): Updated 2020/02/25

Data Type	Download all or Query/Filter

Images (4.80 GB)	*Download* *Search* (Requires the NBIA Data Retriever.)

Change note: One subject's RTSTRUCT had a mis-named structure. It was "Lung L", "Lung R" instead of "Lung_L", "Lung_R" and has been corrected.

Version 2 : Updated 2019/05/08

Data Type	Download all or Query/Filter
Images (4.80 GB)	*Download* (Requires the NBIA Data Retriever.)

Added RTSTRUCT files.

Version 1: Updated 2017/05/17

Data Type	Download all or Query/Filter
Images (4.76 GB)	*Download* (Requires the NBIA Data Retriever.)