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GOALS

- Predict the shape of <u>3D</u> CT from X-ray without CT supervision by incorporating realistic X-ray distributions during training of a reconstruction model
- Improve Tuberculosis (TB) classification accuracy using synthetically generated CT images

OVERVIEW

- In many rural and under-served populations, access to radiology is limited. X-rays, which are more accessible, do not provide the nuanced insight multiple slices of imaging a CT scanner provides
- Due to lack of paired X-ray+CT datasets, existing model (X2CT [1]) trains on synthetically generated Xrays and relies on CycleGAN [2] to merge the synth2real domain gap, but leads to under penetrated (i.e., 'whitened') X-Rays
- Building on the CT generative model X2CT [1], we introduce a shape induction loss that compares projections (sum along an axis) from the predicted CT and the input X-ray. In this case, real X-ray images are used for training directly (no CycleGAN [2]), and no pairs (X-ray, CT) are necessary



OPTIMIZATION OBJECTIVE



BIBLIOGRAPHY

RESULTS

Trained with shape induction, the proposed method obtains both the highest classification accuracy and the best recall of TB examples. On the other hand, we find that the cycleGAN [2] CT offers less prediction value, with lower classification scores and lower TB recall rates.

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	X2CT (Ying et al., 2019)	X2CT+CycleGAN (Zhu et al., 2017)	Our Method
Classification Accuracy	$\underline{0.925\pm0.003}$	0.882 ± 0.005	$\textbf{0.939} \pm \textbf{0.003}$
TB Recall	$\underline{0.789 \pm 0.008}$	0.693 ± 0.038	$\textbf{0.826} \pm \textbf{0.006}$
TB Precision	0.915 ± 0.019	0.866 ± 0.021	$\textbf{0.934} \pm \textbf{0.008}$

The proposed method better captures anatomical details, such as the shape of the lung and the pleural and thoracic integrity, avoiding gaps in the thoracic wall and pleural membrane surrounding the lungs seen on the projected X-rays and their corresponding generated CTs (not shown.



X2CT+CvcleGAN

Conclusions and Future Work

- Offer a step towards developing a tool which can classify types of pulmonary disease, including TB and its specific subtypes, as well as provide clinicians with CT imaging after obtaining only chest X-rays
- Need to evaluate for "shortcut learning"

[1] Xingde Ying, Heng Guo, Kai Ma, Jian Wu, Zhengxin Weng, and Yefeng Zheng. X2CT-GAN: reconstructing CT from bi-planar x-rays with generative adversarial networks. In CVPR, 2019. [2] Jun-Yan Zhu, Taesung Park, Phillip Isola, and Alexei A Efros. Unpaired image- to-image translation using cycle-consistent adversarial networks. In ICCV, 2017.