Integrating Dual-Supervision and Region Fusion Attention for COVID-19 Image Segmentation

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Introduction

Automated tools for delineating infection regions from chest radiology scans are crucial during pandemics like COVID-19.

Existing deep-learning models often analyze entire radiology images, risking segmentation of areas outside the lung region.

Our work proposes parallel flows for lung and infection regions, integrating dual-supervision and the Region Fusion Attention Module for enhanced segmentation precision.

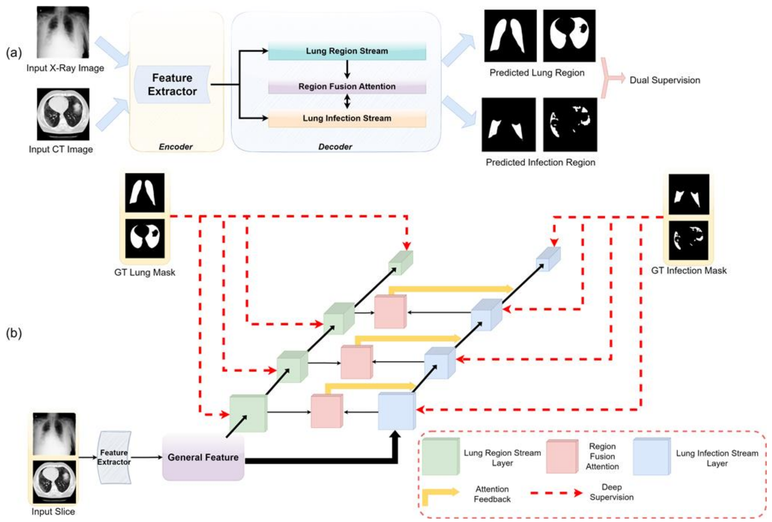
Our proposed work achieves superior segmentation performance compared to existing state-of-the-art networks, with both co-supervision and enhanced region attention modules significantly contributing to overall performance.

Method

Our proposed deep-learning network for infection segmentation, employing **Co-Supervision and Enhanced Region Attention.**

Dual-Supervision **integrates lung region and infection data** during training, **improving infection region identification**.

Region Fusion Attention Module refines region attention using infection region data, enhancing precision.



Conclusion

Our novel segmentation network enhances COVID-19 chest infection segmentation in CT and X-ray images by leveraging lung region information.

Dual-Supervision integrates lung region and infection data during training, improving infection region identification.

Region Fusion Attention Module refines region attention using infection region data, enhancing precision.

It outperforms existing methodologies, showcasing efficacy and utility in accurate lesion segmentation.

Result

(A) CT images

(B)Chest X-Ray images

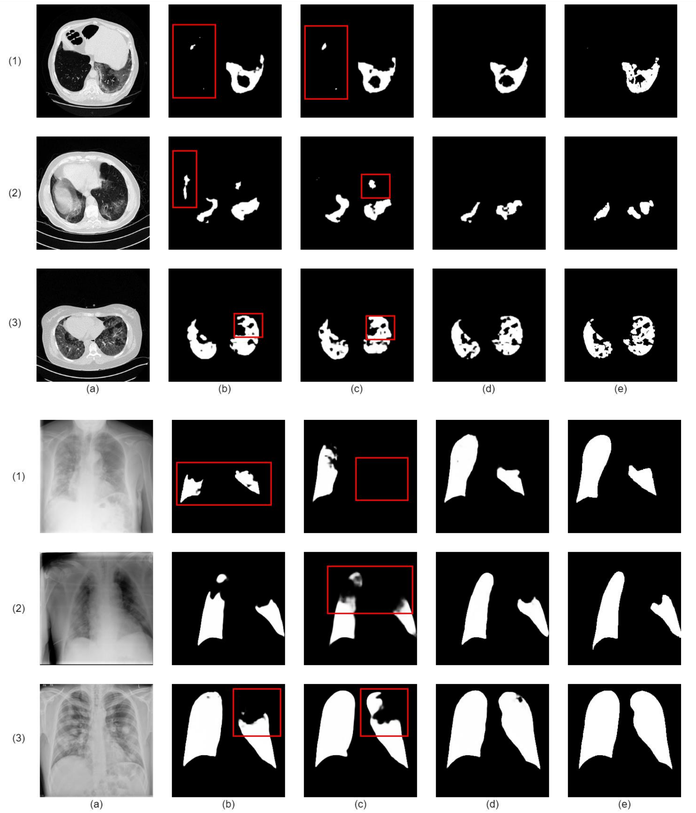


Figure 1. (a) Input CT/X-Ray image. (b) Segmentation without Lung Region and Attention (c) Segmentation with Lung Region, without Attention. (d) Segmentation with Lung Region and Attention (e) Ground-Truth. (Red highlight wrong segmentation)

(A) CT images

Network	Lung Region	Region Fusion Attention	IoU↑ Mean	IoU↑ STD	Dice↑ Mean	Dice↑ STD	MAE↓ Mean	MAE↓ STD	F-Score↑ Max	F-Score↑ Mean	F-Score↑ STD
Baseline			0.5094	0.1686	0.6521	0.1815	0.0099	0.0117	0.6866	0.6500	0.1796
Baseline	✓		0.5512	0.1783	0.7262	0.1751	0.0077	0.0080	0.7485	0.6862	0.7485
Our Method	✓	✓	0.6553	0.1517	0.7945	0.1435	0.0050	0.0054	0.8373	0.7984	0.1325

(B)Chest X-Ray images

Network	Lung Region	Region Fusion Attention	IoU↑ Mean	IoU↑ STD	Dice↑ Mean	Dice↑ STD	MAE↓ Mean	MAE↓ STD	F-Score↑ Max	F-Score↑ Mean	F-Score↑ STD
Baseline			0.6446	0.2431	0.7488	0.2267	0.0428	0.0358	0.7833	0.7594	0.2297
Baseline	✓		0.6640	0.2417	0.7660	0.2095	0.0412	0.0336	0.7890	0.7643	0.2143
Our Method	✓	✓	0.6736	0.2317	0.7711	0.2094	0.0411	0.0336	0.7989	0.7683	0.2144

Table of ablation study. V means the existence of functions. Red highlight the highest performance.