

SAU-Net: Efficient 3D Spine MRI Segmentation Using Inter-Slice Attention

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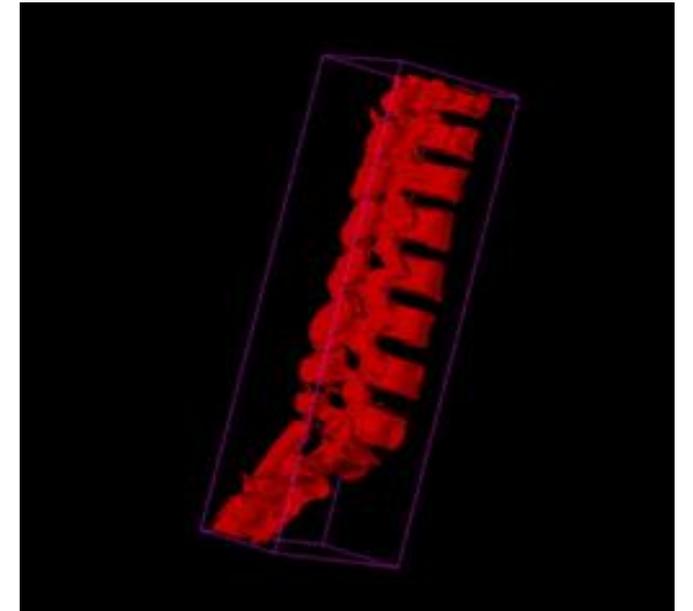
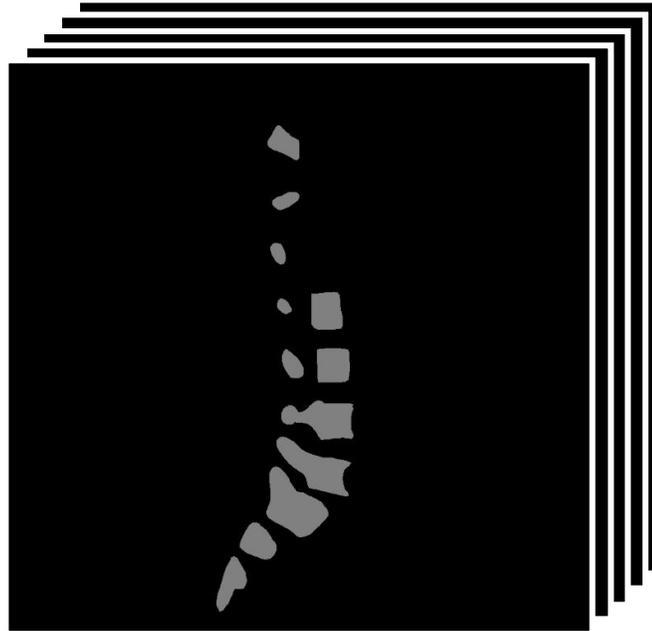
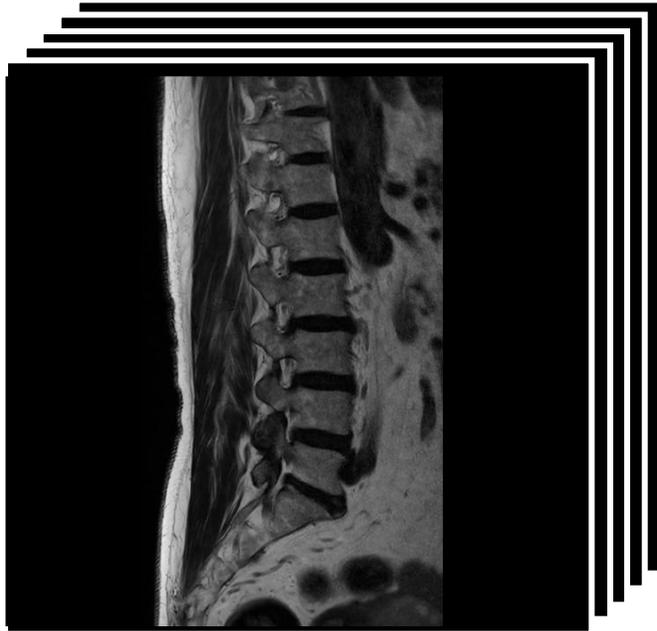
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Presenter : Yichi Zhang



Introduction

Accurate and robust segmentation of spine MR images is an essential tool for identification and quantitative analysis of diseased region.



Challenges:

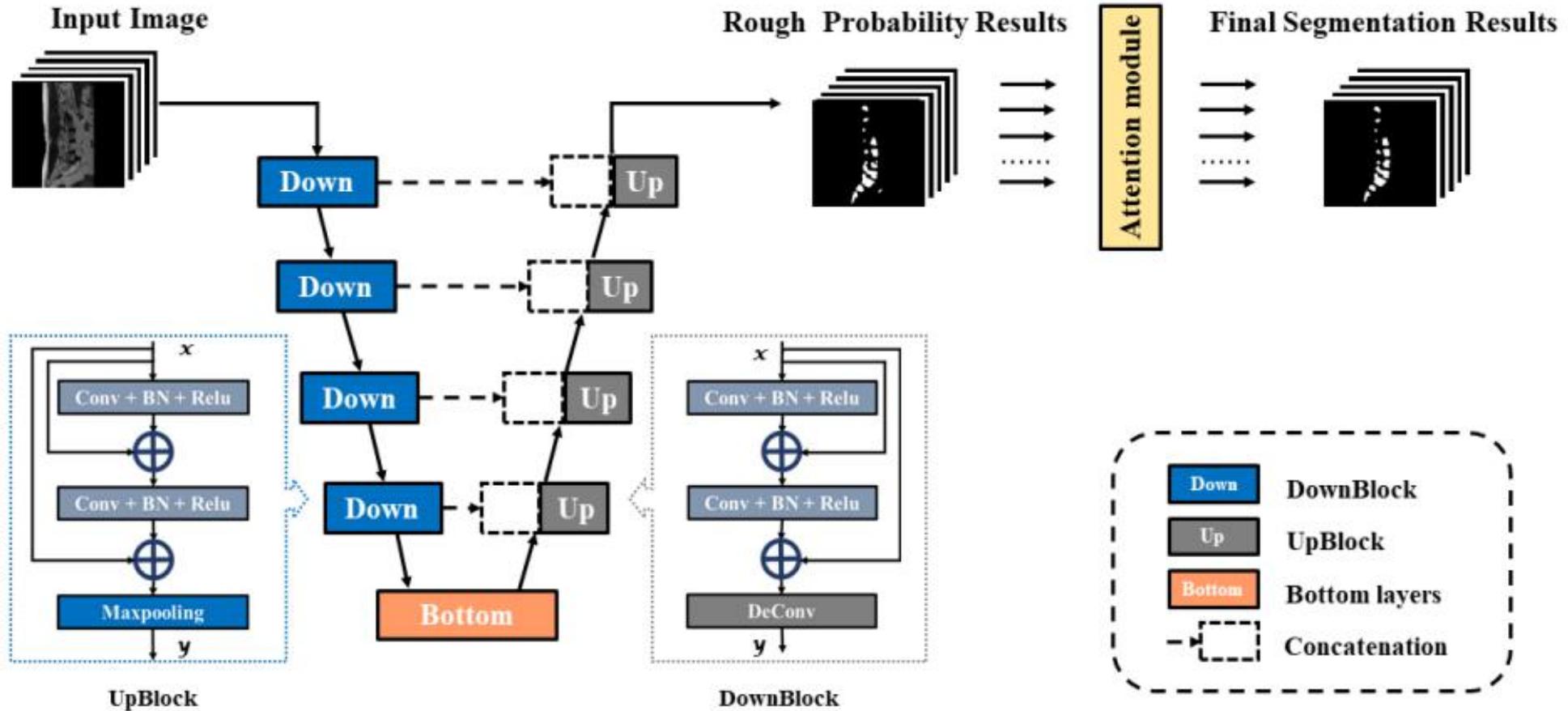
- unclear boundaries
- abnormal spinal curvature
- intricacy of vertebral structures

Existing spine MRI segmentation methods :

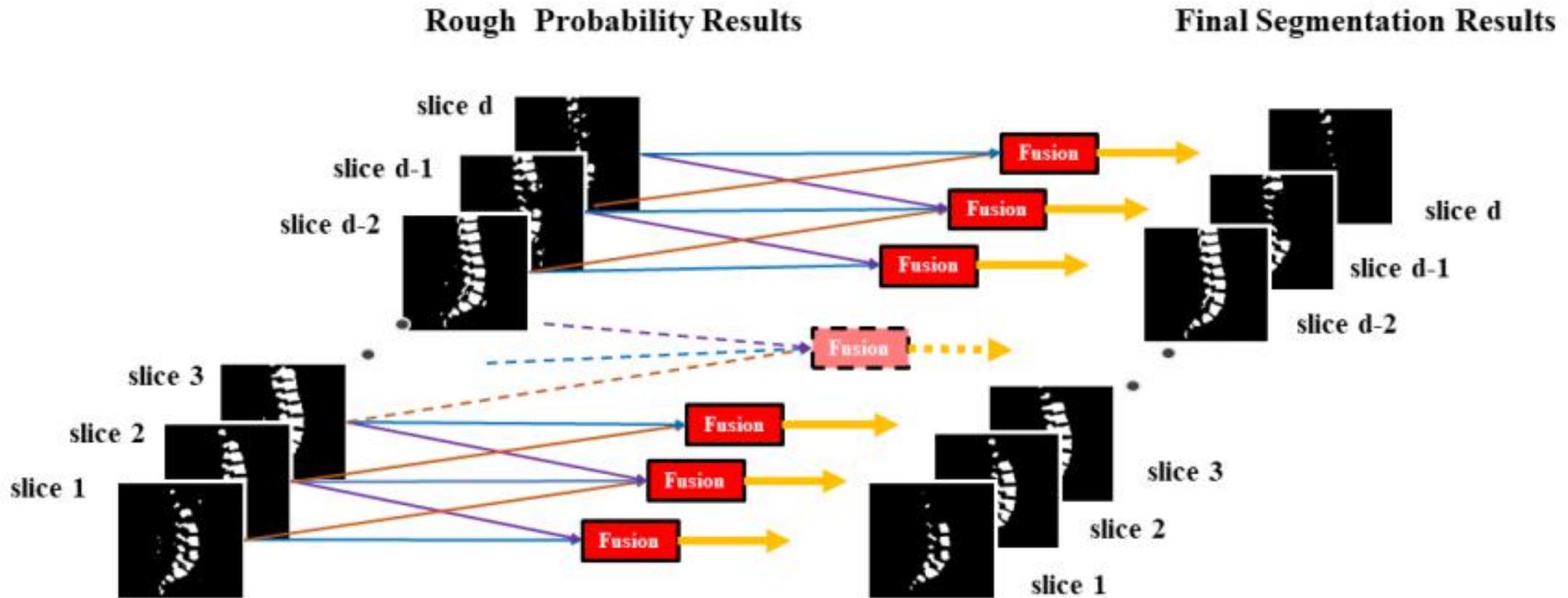
- 2D segmentation methods — ignore the spatial continuity between slices
- 3D segmentation methods — higher computation costs / risk of overfitting

How can we utilize inter-slice information while avoiding redundant computation of 3D CNNs?

Architecture SAU-Net (spatial attention-based densely connected U-Net)

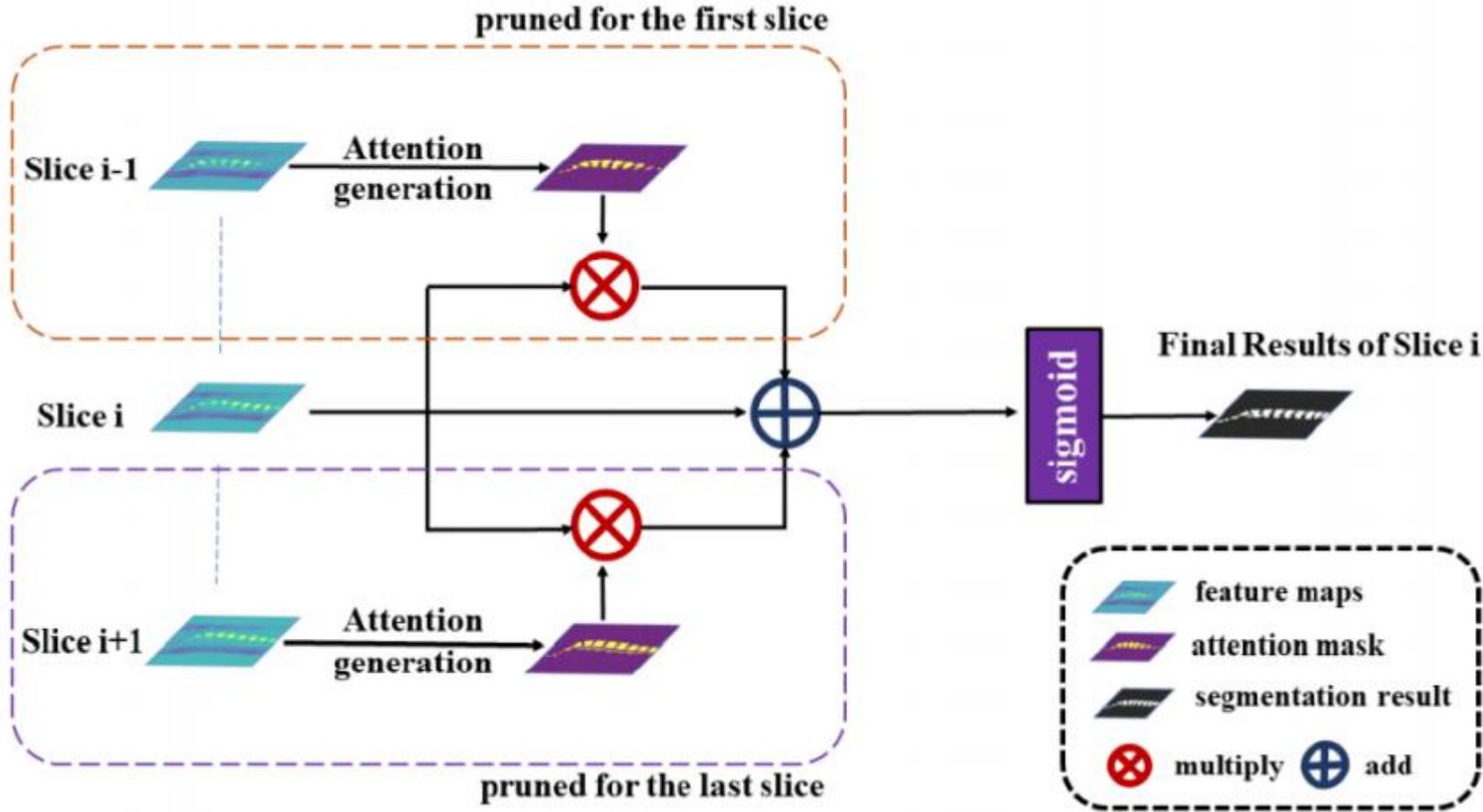


Inter-slice Attention Module (ISA) Incorporating inter-slice information for refinement



Inter-slice Attention Module (ISA)

The structure of spatial attention fusion



Quantitative results of comparison experiments:

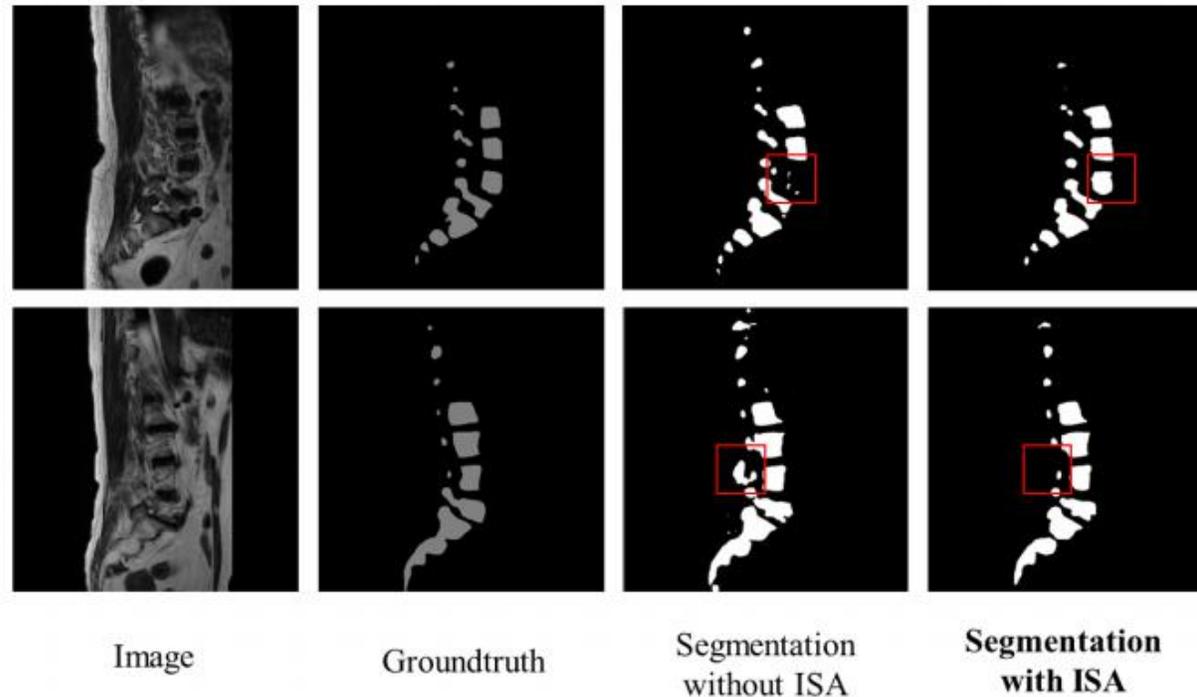
Models	DSC (%)	Precision (%)	Recall (%)	Jaccard (%)	HSD (mm)
2D U-Net	88.06±0.16	86.43±1.24	89.85±0.84	78.86±0.62	3.12±0.035
3D U-Net	89.28±0.33	89.35±0.35	89.54±0.48	80.72±0.88	1.94±0.026
SAU-Net	89.86±0.10	89.75±0.24	90.41±0.36	81.56±0.20	1.76±0.023

Methods	Time Consumption	Model Size
2D U-Net	153s	35M
3D U-Net	534s	83M
SAU-Net	178s	38M

- SAU-Net could efficiently utilize inter-slice information and outperforms 2D/3D U-Net.

Quantitative results of ablation experiments:

	Dice (%)	Precision (%)	Recall (%)	Jaccard (%)	HSD (mm)
Ours w/o ISA	88.89 ± 0.20	87.83 ± 0.94	90.34 ± 0.86	80.11 ± 0.50	2.87 ± 0.039
Ours w/ ISA	89.86 ± 0.10	89.75 ± 0.24	90.41 ± 0.36	81.56 ± 0.20	1.76 ± 0.023



Conclusion

- Using attention mechanism to utilize inter-slice information based on 2D segmentation networks
- Improve the segmentation accuracy and efficiency, which is crucial in the clinical practice
- Easily adopted to other 3D medical image segmentation tasks

Thank you for your attention !

