Learning Tumor Growth via Follow-Up Volume Prediction for Lung Nodules

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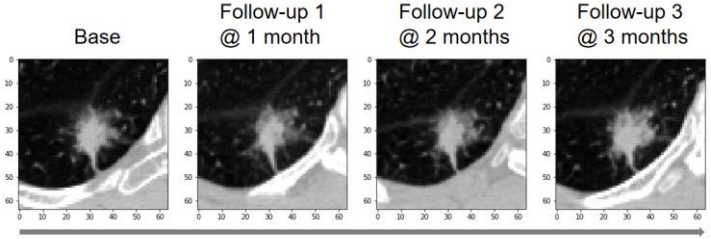
Introduction

➢ Background

- Follow-up serves an important role in the management of pulmonary nodules for lung cancer.
- Accurate prediction of tumor growth could help radiologists evaluate the risk of lung nodules without pathological examination and make clinical decision for each patient.



Pulmonary nodule follow-up example of one case

Materials

➢ Task Formalization

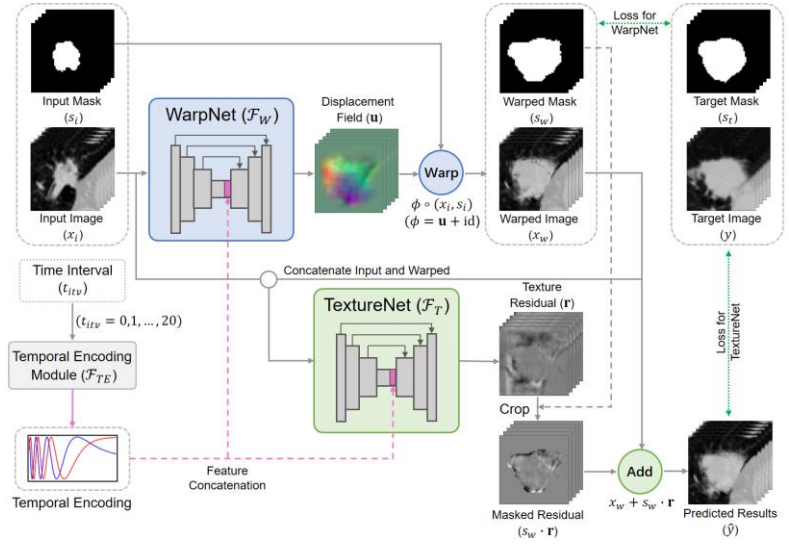
- To predict future volume of a lung nodule, given any time interval and a baseline volume.

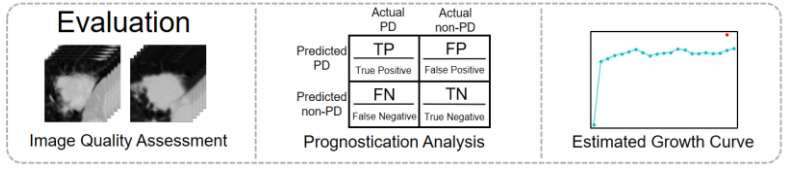
➢ Dataset

- Collect more than 300 pulmonary nodules with long-term follow-up from two cooperative hospitals.
- Each nodule has multiple follow-up examinations, resulting in more than 700 training pairs.
- All nodules of one patient are divided into the same subset while performing 5-fold cross-validation.

Methodology

➢ Nodule Follow-Up Prediction Network Architecture





➢ Model Nodule Growth

- WarpNet: Learn a spatial transformation to model the **size variation** for nodule growth.
- TextureNet: Learn a appearance transformation to model the **texture variation** for nodule growth.
- Temporal Encoding Module (TEM): Encode the relative time interval information in a redundant way.

Results

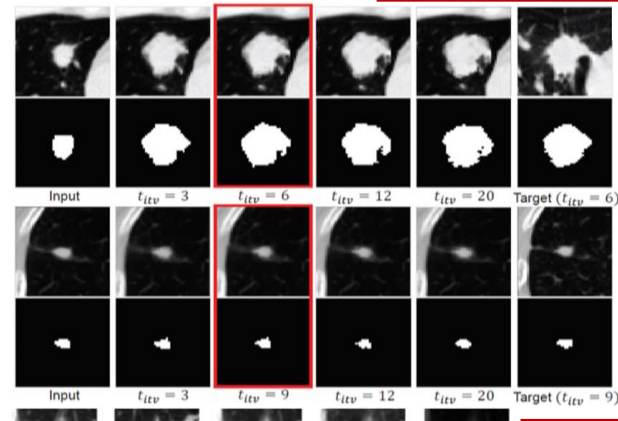
➢ Quantitative Analysis

Method	PSNR	PSNR*	Dice	Sensitivity	Specificity	G-mean
Baseline (U-Net)	4.1213	29.7490	-	-	-	-
+TEM	6.0380	31.8821	-	-	-	-
WarpNet	18.0915	43.1140	0.6301	0.7656	**0.9083**	0.8339
+Warp Seg Loss	18.1952	43.2464	0.6474	0.8594	0.8805	0.8699
+TextureNet	**18.2089**	**43.4904**	**0.6474**	**0.8594**	0.8805	**0.8699**

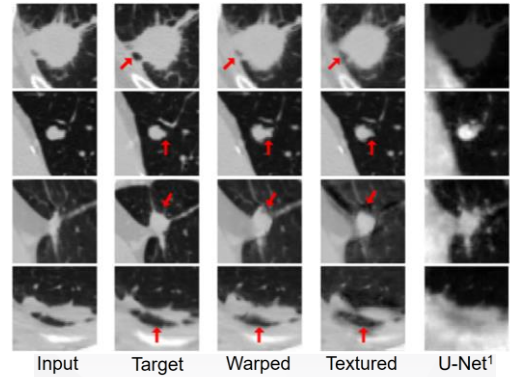
PSNR* means PSNR inside the nodule

➢ Qualitative Analysis

Continuous Prediction



Comparison Results



[1]U-Net with TEM as baseline method