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Generation of Pseudo MR from CT for Soft-tissue Sarcoma Based on SRCycle GAN

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PURPOSE

Pseudo MR generated from CT would allow for preserving privileges of both modalities: higher soft-tissue contrast of MR, shorter scanning time and less restrictions for people of CT.

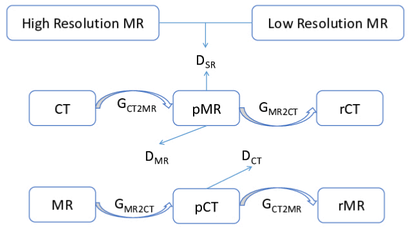
In this work, a novel method for the generation of pseudo MR from CT based on super resolution cycle generative adversarial networks (**SRCycle GAN**), is proposed to assist the diagnosis of soft-tissue sarcoma.

METHOD

SRCycle GAN utilizes:

- 2 generator using **upsampling** layer to avoid the checkboard artifacts
- 2 discriminators from original cycle GAN[1-2]
- 1 **super resolution discriminator**[3] to acquire clearer images
- cycle-consistency loss; **mean P distance loss**[4]; MAE loss

Figure 1. Basic layout of SRCycle GAN (pMR means pseudo MR, and rCT means reconstructed CT. Rest notations are similar)



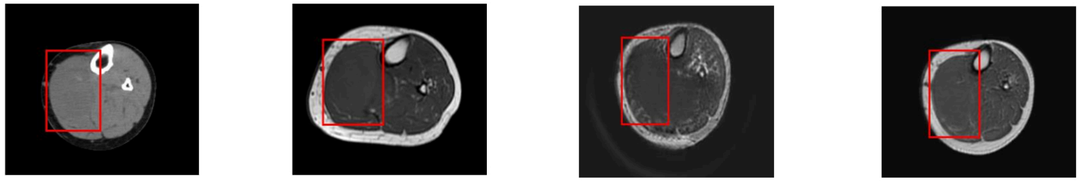
Data Description:

- From TCIA soft-tissue sarcoma dataset[5-6]
- 4216 unaligned images including CT and T1 MRI of 30 patients
- Train dataset (2911 images, 20 patients)
- Test dataset(1305 images, 10 patients).

RESULTS

For verification, **4 experienced radiologists** were invited to visually diagnose all patients in test dataset basing on their CT and real MR, pseudo MR generated by proposed model[7]. To mitigate the error induced by different radiologists, we invited 2 radiologists at each group.

Figure 2. Pseudo MR image generated from (a) CT image using (c) cycle GAN and (d) proposed method. The corresponding T1 MRI scan for (a) is shown in (b)



(a) (b) (c) (d)

Because the same patient can't be diagnosed twice, we provide real MR of patients 1-5 and pseudo MR of patients 6-10 for 1st group. As for the 2nd group, the setting is just opposite so as to make all pseudo MR examined by radiologists. The average accuracy of all radiologists using CT and MR, pseudo MR generated by proposed model is: 95%, 85%, which means the quality of pseudo MR from SRCycle GAN is very close to real MR's. Specific results are as follows.

Table 1. The diagnosis accuracy of 2 Radiologists in 1st group

Patients	1-5	6-10
Diagnostic Basis	CT	
	Real MR	Pseudo MR (SRCycle)
Radiologist 1	100%	80%
Radiologist 2	80%	80%

Table 2. The diagnosis accuracy of 2 Radiologists in 2nd group

Patients	6-10	1-5
Diagnostic Basis	CT	
	Real MR	Pseudo MR (SRCycle)
Radiologist 1	100%	100%
Radiologist 2	100%	80%

CONCLUSIONS

A novel method for generation of pseudo MR from CT has been developed that produces clearer images than original cycle GAN does. The results show that our model could assist in diagnosing soft-tissue sarcoma.

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