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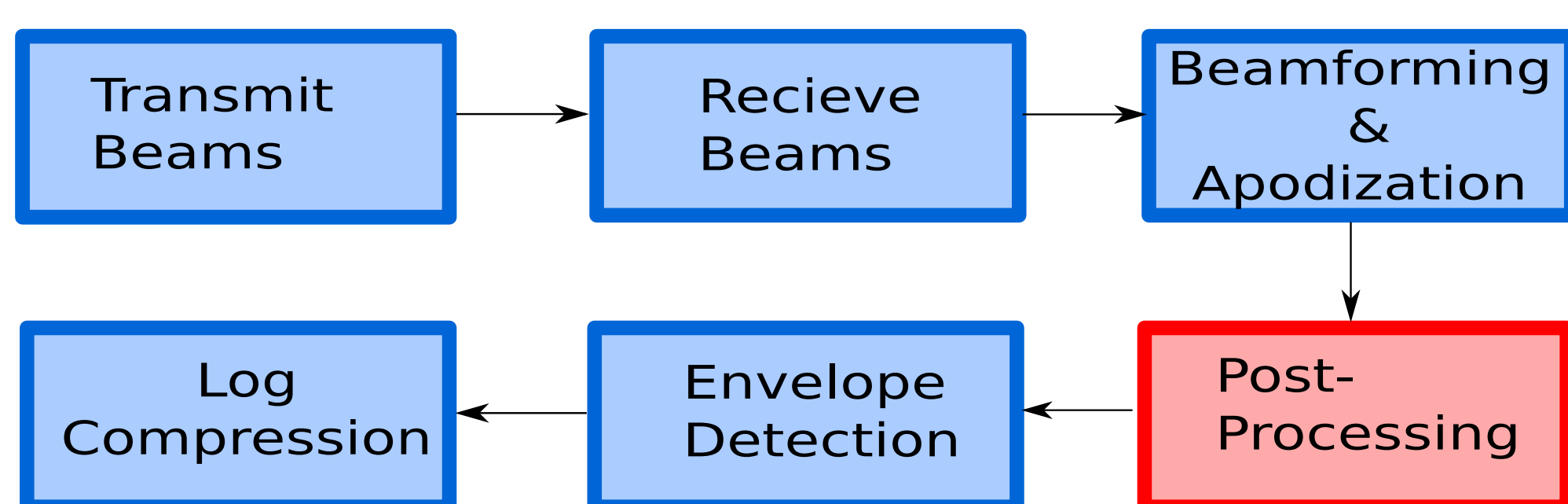
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1. Motivation

Ultrasound (US) is a wide-spread, fast, cost-effective and harmless medical imaging modality.

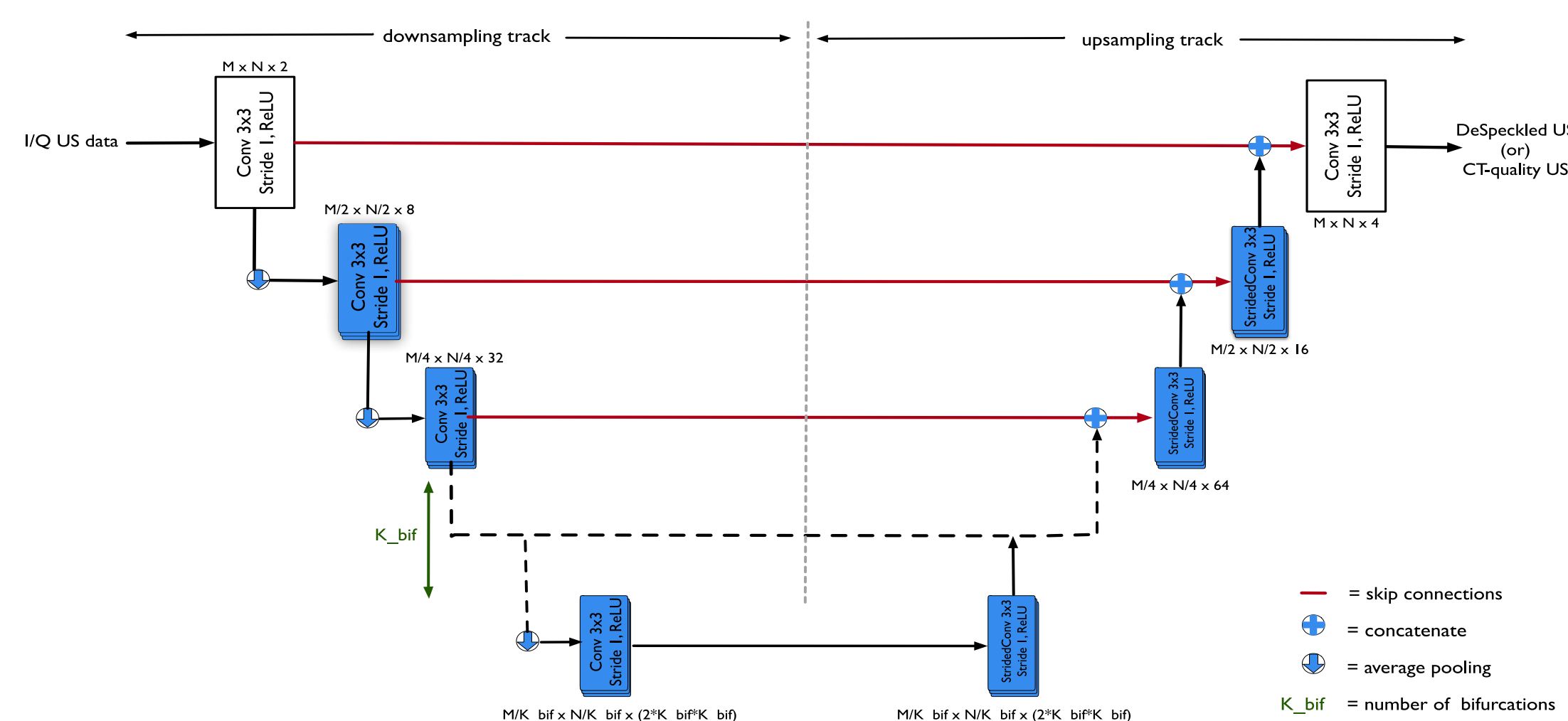
Beamforming based image formation produces granular speckle noise, blurring, shading and other undesired artifacts.

In this work we aim to optimize and speed-up the post-processing stage with convolutional neural networks (CNN).



Ultimate goal: Reconstruct tissue acoustic properties by solving a full-wave propagation inverse problem.

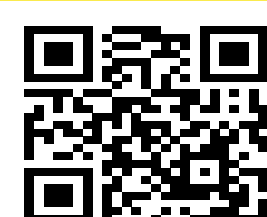
2. Network Architecture



3. Simulated Data

The US Radio Frequency (RF) data (I/Q) for training and testing our suggested CNN-based method was generated by our fast simulator from *in-vivo* CT patches (TCIA repository). The simulation parameters were set to mimic standard linear array probe characteristics with a central frequency of 5 MHz and an approximated Q-factor of 0.5.

For the full paper scan me:



Acknowledgment

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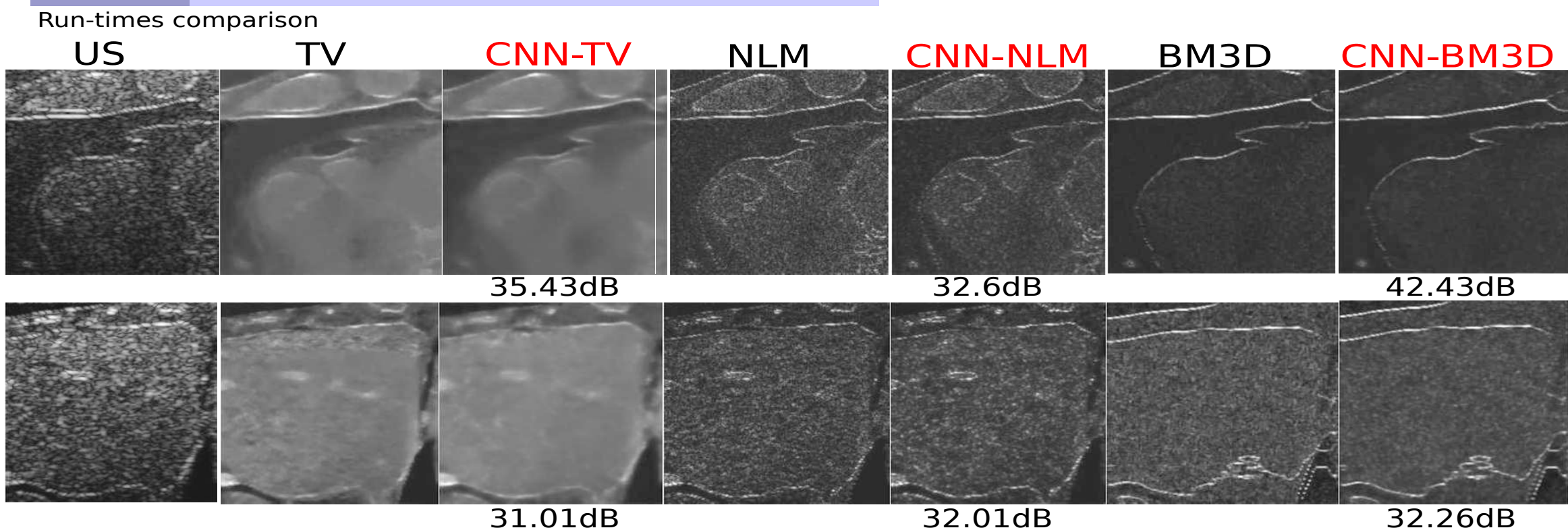


4. Real-time Ultrasound Despeckling

Proposed Scheme: Train an end-to-end CNN to approximate state-of-the-art despeckling algorithms on pairs of simulated US I/Q patches and their corresponding conventionally (TV, NLM, BM3D) despeckled patches.

Results: 4 times relative speed-up on GPU and 8-250 times relative speed-up on CPU, without loss of image quality.

	BM3D	NLM	TV	CNN (ours)		BM3D	NLM	TV
CPU	390.7s	400.3s	12.8s	1.5s	Average pSNR for CNN approximation	34.4	35.33	41.66
GPU	-	-	0.78s	0.2s				

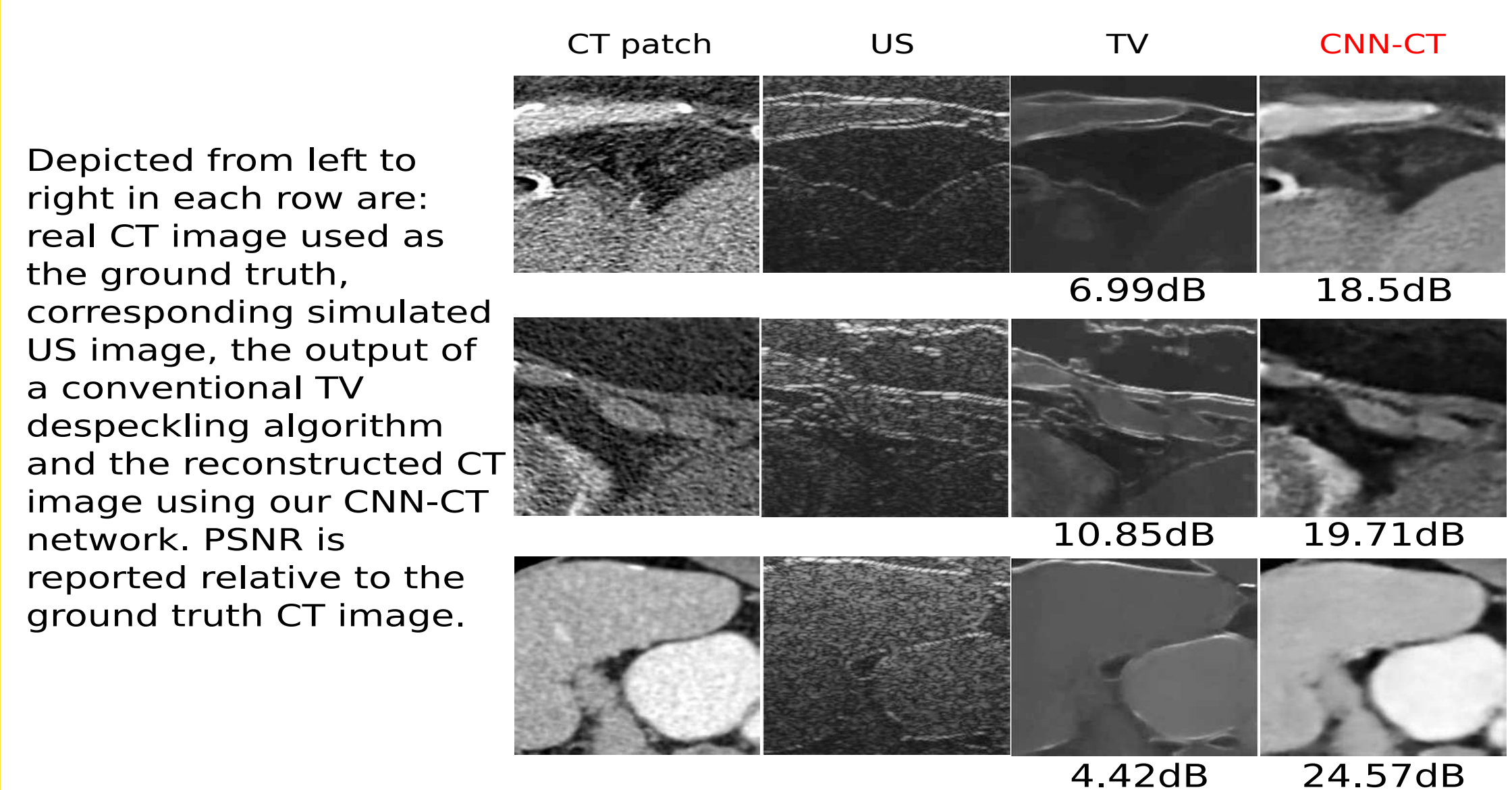


Two test patches for CNN despeckling approximation with their corresponding pSNR

5. CT-quality Ultrasound Imaging

Aiming to go beyond the quality of despeckling, we propose training a CNN for converting regular US scans into corresponding "CT-like" images.

Improved Scheme: Train an end-to-end CNN on pairs of simulated US I/Q patches and their corresponding CT patches.



Depicted from left to right in each row are: real CT image used as the ground truth, corresponding simulated US image, the output of a conventional TV despeckling algorithm and the reconstructed CT image using our CNN-CT network. PSNR is reported relative to the ground truth CT image.

6. Conclusions & Future work

- Conventional despeckling can be approximated by CNN, thus provides a major speed-up.
- CNN can reconstruct a CT-quality image from US I/Q images within the same run-time range.
- Real CT-US paired data is difficult to obtain. Further research focuses on tackling this problem, possibly by an unsupervised/semi-supervised framework.
- Tackling earlier stages in the US acquisition pipelines to reconstruct high quality US image.