1 Image quality evaluation before and after processing

The following quantitative image quality measures were calculated and compared using images before and after pre-processing:

- histogram-based Pearson correlation coefficient between each fractional image and reference image.
- signal-to-noise ratio (SNR) is the ratio of the mean signal value to the standard deviation within the patient contour
- organ uniformity (UI) describes the intensity variation within specific organs (liver, spleen and right kidney). The equation is given by

$$UI = 1 - \frac{u}{\sigma}$$

where μ and σ are the mean and standard deviation of certain organ, respectively.

- relative mean intensity (RMI) implies the mean value variation from day to day for specific organs (liver, spleen and right kidney) as compared to the value from the reference image.

$$RMI_n = \frac{u_{\mathrm{n}}}{u_{ref}}$$

where u_{n} and u_{ref} are the mean values of n_{th} fraction and reference images, respectively.

Figure 1 shows the comparisons of four different image quality indices before (green bars) and after pre-processing (red bars). As shown at Fig. 1(a), the Pearson correlation coefficient between the histograms of the reference image and each fractional image was significantly increased after processing ($p<0.001$), indicating improved image similarity among intra-patient images. Similarly, the SNR was significantly enhanced with the image processing pipeline ($p<0.001$) (Fig.1(b)). The voxel intensity uniformity for liver, spleen, and right kidney on the processed images were all significantly higher ($p<0.001$) as compared to those from original images (Fig.1 (b)). On the other hand, organ mean value variation among different fractions (RMI) for the three selected organs were all significantly smaller for processed images ($p<0.01$).

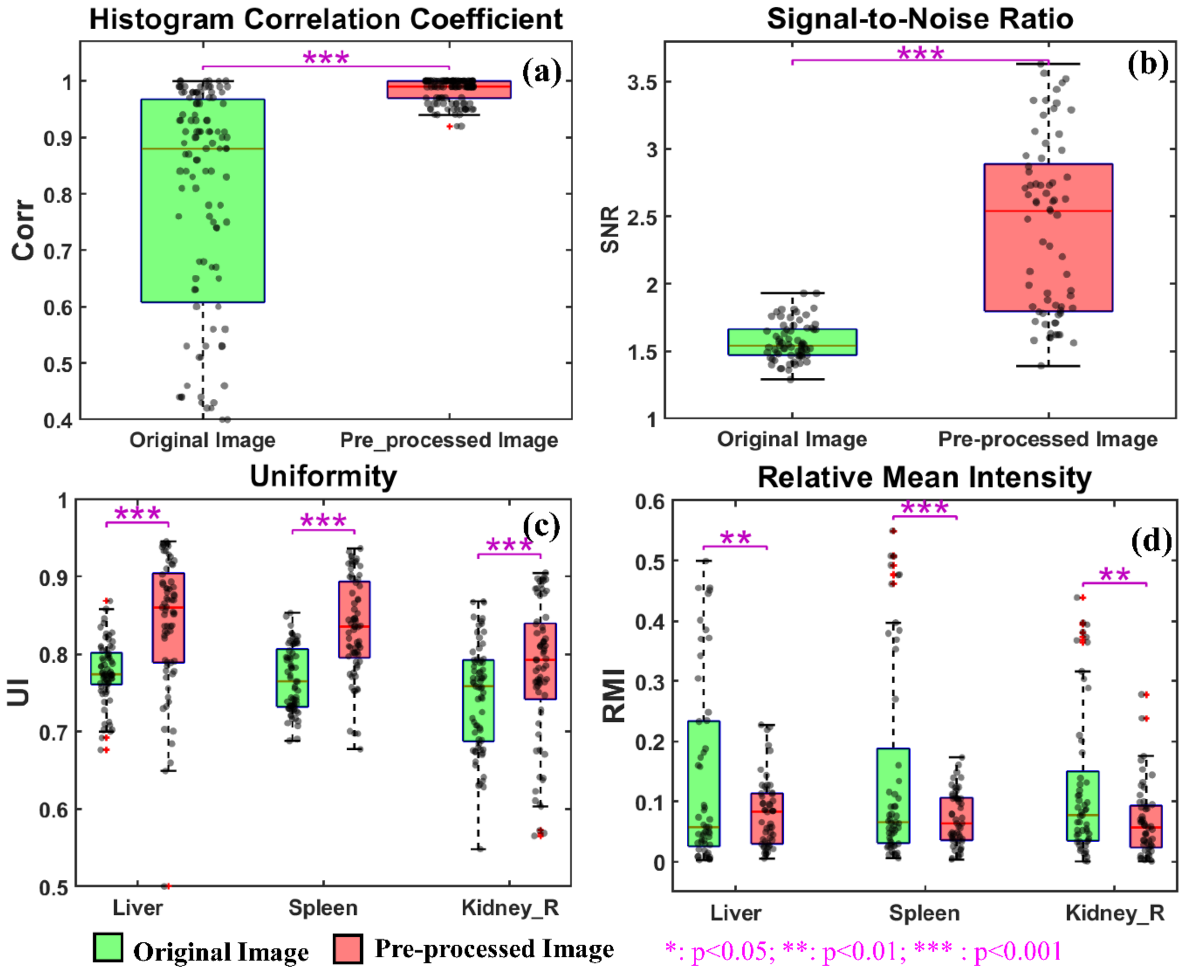
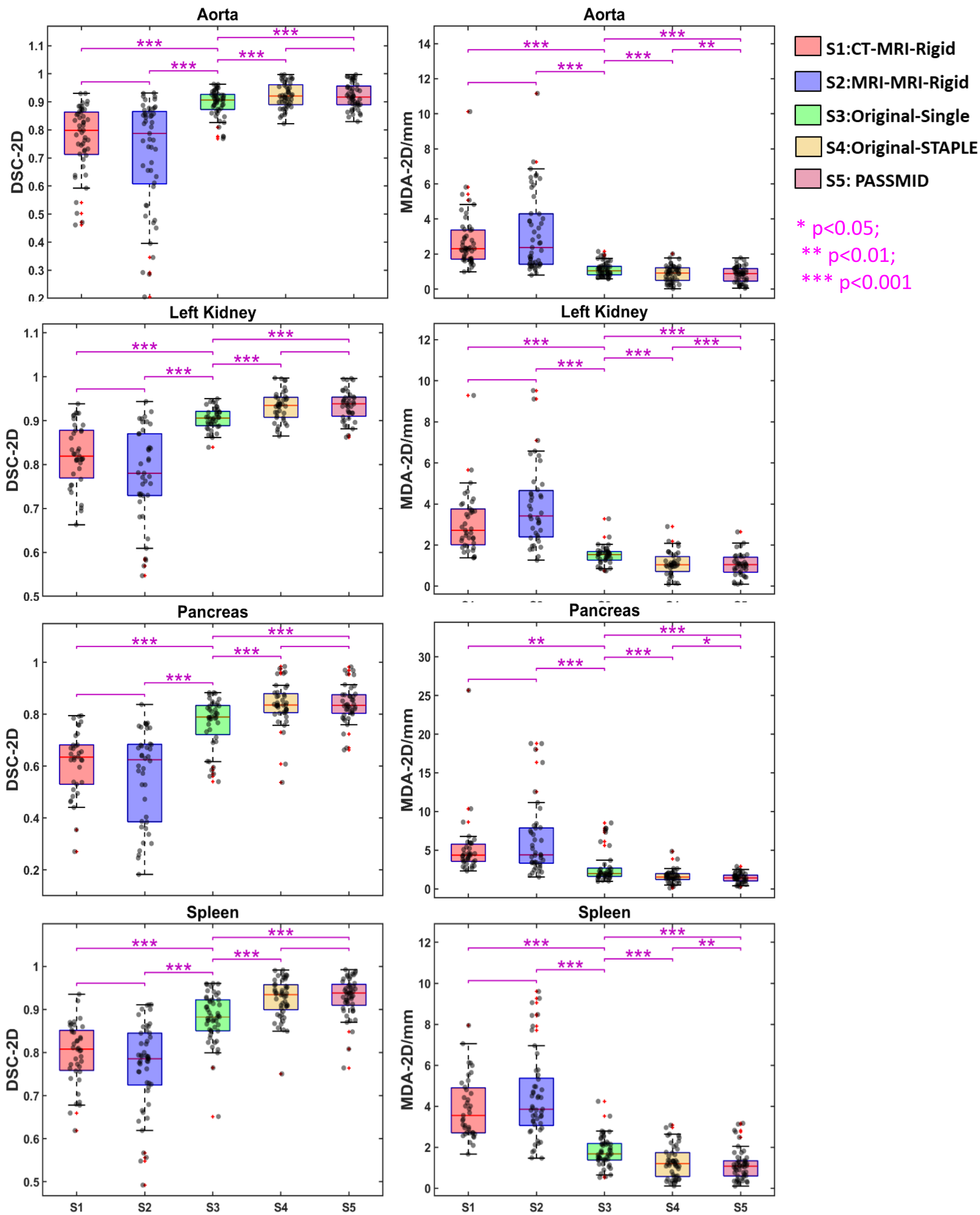


Figure 1 Box-and-whisker plots for the image quality indices for the original (green) and pre-processed (red) images over all the patients. (a) histogram-based Pearson correlation coefficient; (b) signal-to-noise Ratio; (c) organ uniformity; and (d) relative mean intensity. The symbols '*', '**' and '***' represent P < 0.05, 0.01, 0.001, respectively, based on the paired t-test of the linked two boxes.

2. Contour Quality Evaluation

Figure 2 shows the comparison of DSC and MDA of the organs that were not presented in the manuscript (aorta, left kidney, pancreas and spleen).



Aorta
Left Kidney
Pancreas
Spleen
DSC-2D
MDA-2D/mm
S1
S2
S3
S4
S5
S1:CT-MRI-Rigid
S2:MRI-MRI-Rigid
S3:Original-Single
S4:Original-STAPLE
S5: PASSMID
* p<0.05;
** p<0.01;
*** p<0.001

Figure 2 Box-and-whisker plots of DSC-2D (left) and MDA-2D (right) for auto-generated contours of aorta, left kidney, pancreas, and spleen using different methods. The sample distribution is also shown with black dots. The symbols '*', '**' and '***' represent $P < 0.05, 0.01, 0.001$, respectively, based on the paired t-test of the linked two boxes.

3. Comparison with state-of-art machine learning based auto-segmentation methods

Table 1 Comparison of the segmentation accuracy between the proposed PASSMID method and selected state-of-art machine learning based auto-segmentation for abdominal MRIs

	Method	**Training Dataset**	**Pancreas**	**Liver**	**Left Kidney**	**Right Kidney**	**Stomach**	**Spleen**	**Duodenum**	**Small Bowel**	**Colon**
Ref 1, 2018	FCNN[2]	138	0.69	-	-	-	-	-	-	-	-
Ref 1, 2018	FCNN	45	-	0.91	0.73	0.78	0.56	0.93	-	-	-
Ref 2, 2018	CNN[3]	120	-	0.95	0.93	0.93	0.85	-	0.66	0.87	
PASSMID in this study[1]	patient-specific multi-input DIR	⩾ 3 prior images /contours	0.85	0.94	0.94	0.94	0.87	0.93	0.84	0.74	0.73

1, 3D DSC were reported for ref 1,2 and 2D DSC for this study.
There is a linear relationship between 3D and 2D DSC for fully contoured organ, and 2D DSC is slightly smaller than 3D DSC.
2, FCNN, fully convolutional neural network; 3, CNN, convolutional neural network

1. Bobo, M.F., et al., *Fully Convolutional Neural Networks Improve Abdominal Organ Segmentation.* Proc SPIE Int Soc Opt Eng, 2018. **10574**.
2. Fu, Y., et al., *A novel MRI segmentation method using CNN-based correction network for MRI-guided adaptive radiotherapy.* Med Phys, 2018. **45**(11): p. 5129-5137.