

INTRODUCTION

- Cardiac MRI cine sequences are used for quantifying global cardiac functions.
- Cardiac MRI tagging sequences are used for quantifying regional cardiac functions.
- Acquiring two sequences result in longer and expensive cardiac MRI exam.
- The CMR feature tracking technique generates regional cardiac functions from cine images, but the lack of intramyocardial markers poses a limitation of the technique compared to conventional CMR tagging.
- In this study, we developed a deep neural network algorithm for extracting regional cardiac function parameters from the cine images after the network is trained on corresponding gold-standard tagged images.

METHODS

- The developed algorithm is based on image-to-image translation using generative adversarial network.
- The algorithm generates the myocardial displacement fields from cine images.
- The inputs of network are cine difference images generated by subtracting consecutive cine images.
- The target images to train the network are corresponding tagged images acquired of the same slice and cardiac phases.
- The tagged images using SinMod method generated myocardial displacement field.
- 1114 and 20 images were used for training and testing, respectively, which were from rats scanned on a 9.4T Bruker MRI scanner.
- The generated displacement fields against the gold-standard measurements were compared.

RESULTS

- The generated output displacement fields (**Fig 1**) showed myocardium shape similar to that in the input images as well as regional signal intensities at corresponding locations to those in the gold-standard displacement fields generated from the tagged images.
- Bland-Altman analysis (**Fig 2**) showed good agreement between measurements from the output and corresponding displacement fields, where almost all the measurement differences lied within the $\pm 2SD$ agreement level.
- Student t-test showed insignificant differences ($p > 0.05$) between all paired measurements.
- Lin's concordance correlation coefficients were 0.96 & 0.89 for x- and y-displacement fields, respectively.

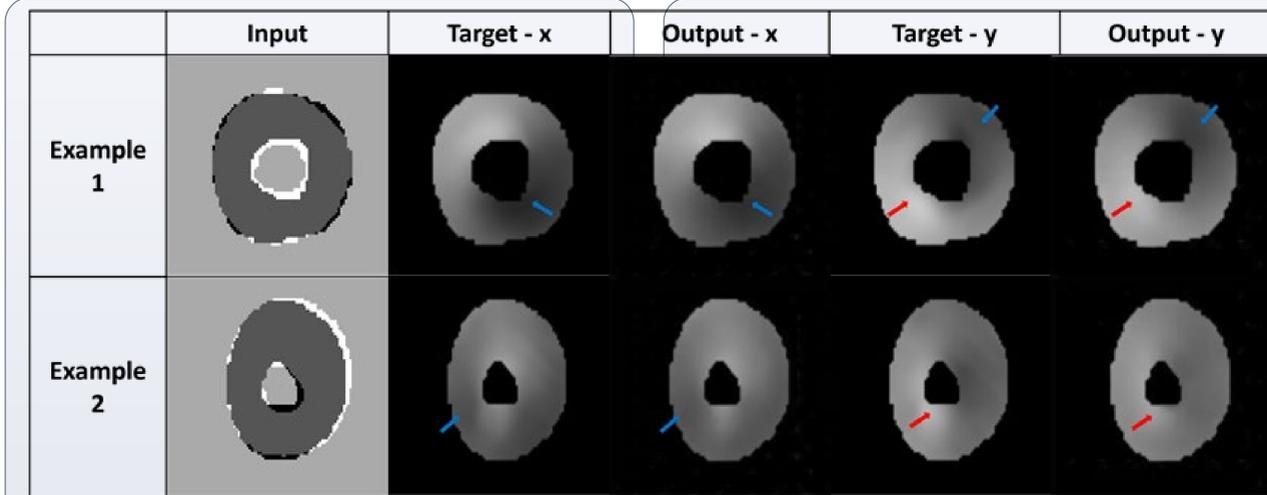


Figure 1. Comparison of x- and y-displacement fields generated from the cine images using the proposed method versus gold-standard displacement fields generated from the corresponding tagged images using the SinMod method. The input images are cine difference images, where the myocardium and background are represented by dark-gray and mid-gray colors, respectively, while the myocardium border movement is represented by white and black in opposite directions. The arrows point to similar features in the output and target images; blue arrows: dark spots, red arrows: bright spots.

CONCLUSION

The developed deep learning-based method allows for ultrafast and accurate generation of myocardial tissue displacement fields from cine images without the need for acquiring tagged images, which would help reduce scan time and data analysis time and improve CMR value imaging.

References

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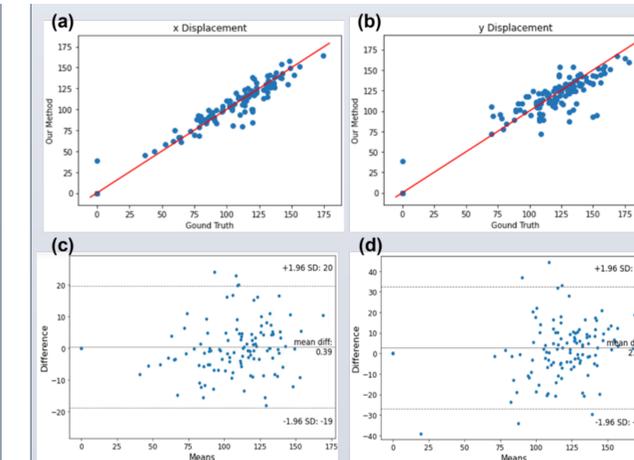


Figure 2. Scatter plots showing the generated versus gold-standard measurements (represented by signal intensity units, a.u.) for (a) x- and (b) y-displacements. The identity lines are shown in red. (c,d) Bland-Altman plots showing good agreements between the generated and gold-standard displacements in the (c) x- and (d) y-directions, where almost all differences lied within the 2SD agreement level.

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