



Acquisition & Analysis

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## **Retrospective Motion Correction with Improved Performance in Myocardial T1 Mapping Using MOLLI MRI**

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**Introduction:** The modified Look-Locker inversion recovery (MOLLI) technique commonly used for myocardial T1 mapping acquires images with different inversion times. Breathing and involuntary motion, however, could cause image misregistration. In this work, we proposed a method based on generative adversarial network (GAN) to produce virtual MOLLI images with consistent heart positions to reduce misregistration of MOLLI datasets.

**Methods:** Using 1071 MOLLI datasets obtained at 3T from 392 human participants, a GAN model with one single inversion time image as input was trained to generate virtual MOLLI target (VMT) images at different inversion times, which were subsequently used in an image registration algorithm. Various VMT models were investigated, with the best performing one compared against the vendor-provided motion correction (MOCO) technique. The effectiveness of the motion correction technique was assessed using the T1 fitting quality index (FQI), mutual information (MI), and Dice coefficients of motion-corrected images, plus subjective quality evaluation of T1 maps by three independent readers using Likert score. Wilcoxon signed-rank test with Bonferroni correction for multiple comparison. Statistical levels were defined at  $P < 0.05$  for significant differences.

**Results:** The best performing VMT model with iterative registration demonstrated significantly better performance (FQI  $0.88 \pm 0.03$ , MI  $1.78 \pm 0.20$ , Dice  $0.84 \pm 0.23$ , quality score  $2.26 \pm 0.95$ ) compared to other approaches, including the vendor-provided MOCO method (FQI  $0.86 \pm 0.04$ , MI  $1.69 \pm 0.25$ , Dice  $0.80 \pm 0.27$ , quality score  $2.16 \pm 1.01$ ).

**Conclusion:** Our GAN model generating VMT images improved motion correction, which may assist reliable T1 mapping in the presence of respiratory motion. Its robust performance may be beneficial for patients with difficulties in breath-holding. We have established an open-source repository at (<https://mri.ee.ntust.edu.tw/VMT>) available to other centers seeking motion correction algorithms for MOLLI.

**Keywords:** *Myocardial T1 mapping, MOLLI, Generative adversarial networks, Registration*