DOI:
10.1136/heartjnl-2018-BCVI.14

Document Version
Peer reviewed version

Link to publication record in King's Research Portal

Citation for published version (APA):
Oksuz, I., Ruijsink, B., Puyol-Anton, E., Rueckert, D., Schnabel, J. A., & King, A. P. (2018). 15 Automatic mis-triggering artefact detection for image quality assessment of cardiac MRI. *Heart*, *104*, A5-A5. https://doi.org/10.1136/heartjnl-2018-BCVI.14

Automatic mis-triggering artefact detection for image quality assessment of cardiac MRI

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Abstract

Introduction: High quality cardiac magnetic resonance (CMR) images are a prerequisite for high diagnostic accuracy. Analysis of bad quality image data can result in erroneous conclusions, especially in the case of automated analysis algorithms, that are currently being proposed. CMR images can contain a range of image artefacts and assessing the quality of images produced by MR scanners has long been a challenging issue. Traditionally, images are visually inspected experts, and those showing an insufficient level of quality are excluded. In this work, we propose to use a Convolutional Neural Network (CNN) model to automatically detect mis-triggering artefacts.

Methods: We use a deep neural network architecture to detect the mis-triggering artefacts in a large cardiac MR dataset. The input is to the network an intensity normalised 50 temporal frames of 80 $\times$ 80 CMR image, which is cropped using a Fourier transform-based region of interest extraction relying on motion patterns. The proposed network consists of five layers. The architecture of our network follows a 3D Convolutional model and consists of 6 convolutional layers and two dense layers for classification.

Results: We tested our algorithm on a subset of 100 cardiac MR images from UK Biobank in a 10-fold cross-validation setup. Our method achieves 0.85 accuracy and 0.81 precision for detection of the mis-triggering artefacts compared 0.67 accuracy and 0.66 precision of variance of Laplacians, which is a state of the art blurring detection method.

Conclusion: We have proposed a method to automatically detect low quality images with high accuracy in less than 1 ms. Our work brings fully automated evaluation of left ventricular function from CMR imaging a step closer to clinically acceptable standards, addresses a key issue for the analysis of large imaging datasets.