Image quality measurement in cardiac X-ray imaging: A machine vision approach

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Introduction

Modern cardiovascular X-ray imaging systems employ an automatic dose control system that does not account for image content. We have previously developed a machine vision algorithm that estimates image quality based on an image contrast metric[1,2]. Here we compare the performance of the algorithm to that of human observers.

The algorithm automatically locates iodine-filled coronary arteries in angiograms and at selected points fits a vessel model from which the image contrast can be estimated.

A collection of estimates is aggregated into a single mean contrast image quality metric.

Methods

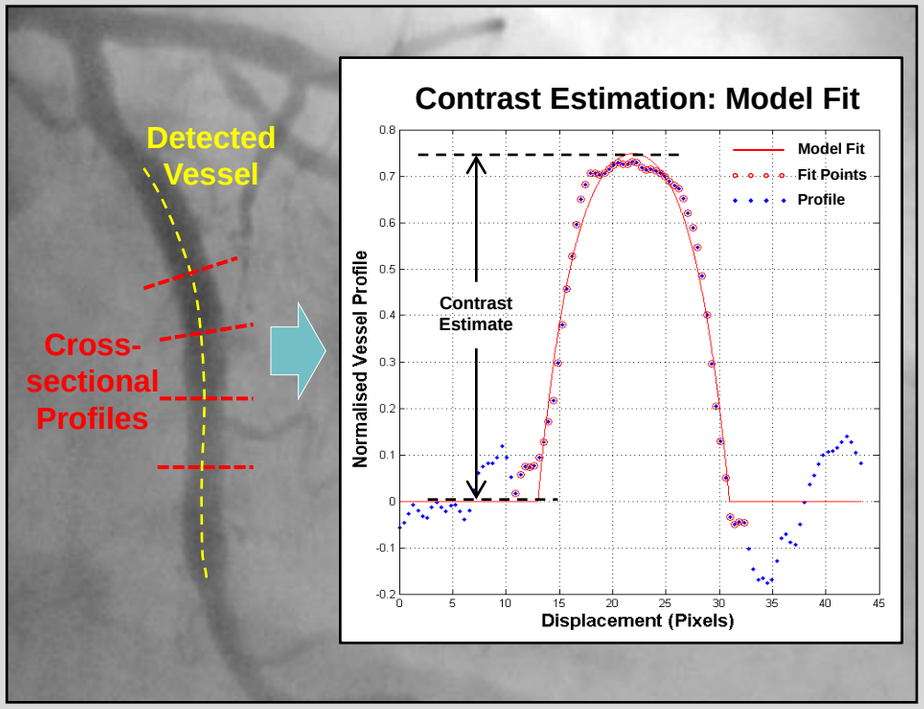
Angiogram images were acquired from a cardiac x-ray imaging system, and comprised 30 left coronary artery (LCA) and 29 right coronary artery (RCA) image sequences.

The machine vision algorithm detected and measured the mean image contrast of iodine-filled vessels in each sequence.

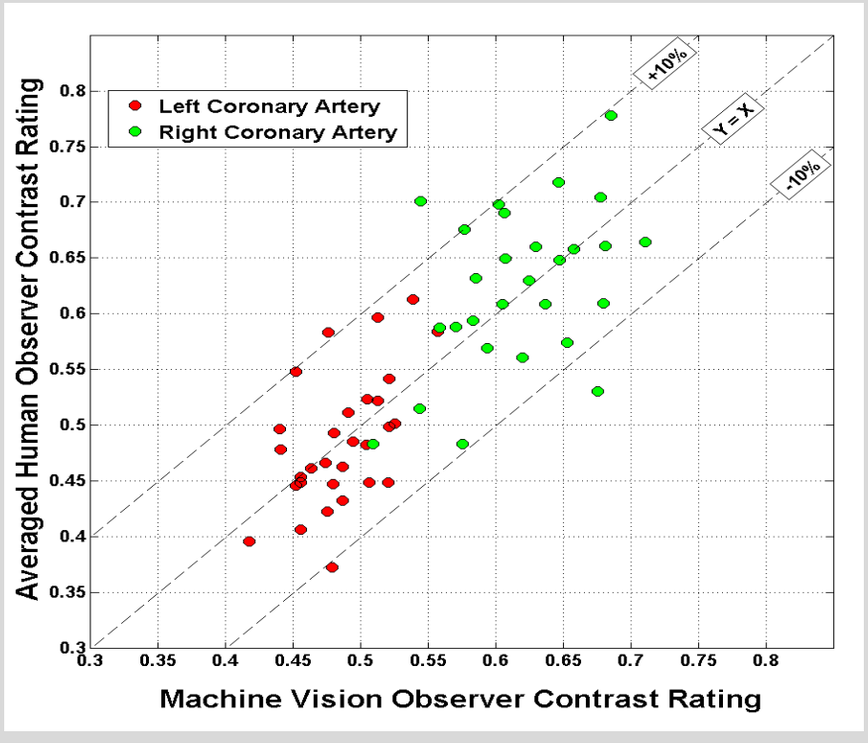
Four observers viewed the sequences on a medical-grade monitor and scored the overall contrast on a continuous scale.

Pearson's correlation coefficient was computed between the mean observer score and machine vision contrast metric.

Methods Overview



Human Observers vs Machine Vision Algorithm



Results

Pearson's correlation coefficient between the mean human observer scores and the machine vision contrast metric:

- LCA: 0.55 ($p<0.05$, CI 0.17-0.73)
- RCA: 0.65 ($p<0.05$, CI 0.37-0.82)

Conclusions

The machine vision algorithm has the potential of providing context-sensitive information that is meaningful in terms of the human visual system, so that system automatic dose control parameters could be adjusted on the basis of image content.

Future work will focus on improving the correlation between the machine vision contrast metric and human observer performance.

Acknowledgements

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PANORAMA
Ultra Wide Context Aware Imaging

References

1. Stephen M. Kengyelics, Amber J. Gislason-Lee,, Claire Keeble, Derek R. Magee, and Andrew G. Davies, “Context sensitive cardiac x-ray imaging: a machine vision approach to x-ray dose control.” J. Electron. Imaging. 24(5), 051002 (Sept. 21, 2015).
2. Stephen M. Kengyelics, Amber Gislason-Lee, Claire Keeble, Derek Magee, and Andrew G. Davies, “Machine vision image quality measurements in cardiac x-ray imaging,” Proc. SPIE 9399, Image Processing: Algorithms and Systems XIII, 93990J (March 16, 2015).