Computer Vision in Echocardiography: Observer-Independent, Autonomous Echo Analysis Using Wavelet Footprints

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Background: Echocardiography is largely subjective with high observer dependency. Computer-assisted echo image analysis is demanding because of strong noise, absence of continuous boundaries and lack of constant intensities within objects.

Method: Multidimensional multiscale wavelet analysis produces highly specific "footprints" from heart structures. We exploited this fact to create an automatic analysis environment that is based on shape and motion specific wavelet footprints of individual heart structures. To test the feasibility of user-independent analysis, we applied the system for identification of the mitral valve autonomously in 182 echo loops. Gold standard for mitral valve location in the echo sequences was an experienced echocardiographer.

Results: Autonomous analysis was successful in 165 of 182 ultrasound sequences corresponding to 91% accuracy. The use of multidimensional multiscale footprints led to strong enhancement of the predefined structure (mitral valve, middle image) and significantly suppressed noise and non-related cardiac structures as shown in pixel statistics of the mitral valve region versus non related image parts (p < 0.05), yielding reliable automatic valve delineation (right image).

Conclusion: Computer vision technology is applicable to clinical echo and allows observer-independent, automatic analysis of predefined cardiac structures, transforming the subjective and qualitative art of echo into an objective and quantitative science.

DivX Compression Allows Medically Lossless Intra- or Internet Exchange of Coronary Angiograms

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Background: Coronary Angiograms (CA), even compressed, cannot be actually reasonably sent via internet networks due to their very large size. The aim of this study was to assess if DivX compression can generate medically lossless dynamic sequences, and could permit the exchange of dynamic CA.

Method: We compared 30 random runs from 15 different CA PTCA by 13 independent blinded cardiologists. Two different DivX compression rates were analysed: the standard compression (STDvX) and an optimised compression (OpDivX) adapted for CA. For each run, the non compressed file (NCF) and each corresponding DivX compressed file were simultaneously and randomly displayed on 2 identical monitors using the same video player. For each run the following score was given: 0: no visual difference - 1: one screen aesthetically better - 2: small differences not clinically relevant - 3: differences eventually leading to reinterpretation - 4: major differences certainly leading to reinterpretation. Results: Compared to the non compressed files DivX compressions induced a huge decrease in the file size of each run (mean size in MB: NC: 5.2 ± 2.9; STDvX: 0.8 ± OpDivX: 1.1). Table shows that the repartition of the scores between the corresponding NCF and DivX compressed video sequences was mainly 0 or 1 score with no 3 or 4 score for OpDivX. Conclusion: OpDivX compression is associated with a huge decrease in file size allowing Internet/Internet based video communication, while providing medically lossless information.

Cost-Effectiveness of Drug-Eluting Stents

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