Cluster signal-to-noise analysis for evaluation of the information content in an image

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（様式３）

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論 文 内 容 の 要 旨

Objectives: (1) To develop an observer-free method of analysing image quality related to the observer performance in the detection task and (2) to analyse observer behaviour patterns in the detection of small mass changes in cone-beam CT images.

Methods: 13 observers detected holes in a Teflon on phantom in cone-beam CT images. Using the same images, we developed a new method, cluster signal-to-noise analysis, to detect the holes by applying various cut-off values using ImageJ and reconstructing cluster signal-to-noise curves. We then evaluated the correlation between cluster signal-to-noise analysis and the observer performance test. We measured the background noise in each image to evaluate the relationship with false positive rates (FPRs) of the observers. Correlations between mean FPRs and intra- and interobserver variations were also evaluated. Moreover, we calculated true positive rates (TPRs) and accuracies from background noise and evaluated their correlations with TPRs from observers.

Results: Cluster signal-to-noise curves were derived in cluster signal-to-noise analysis. They yield the detection of signals (true holes) related to noise (false holes). This method correlated highly with the observer performance test (R^2 = 0.9296). In noisy images, increasing background noise resulted in higher FPRs and larger intra- and interobserver variations. TPRs and accuracies calculated from background noise had high correlation with actual TPRs from observers; R^2 was 0.9244 and 0.9338, respectively.

Conclusions: Cluster signal-to-noise analysis can simulate the detection performance of observers and thus replace the observer performance test in the evaluation of image quality. Erroneous decision-making increased with increasing background noise.