

## **VGC Analyzer – a software for statistical analysis of multiple-reader multiple-case visual grading characteristics (VGC) studies**

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Visual grading characteristics (VGC) analysis is a non-parametric rank-invariant method for analysis of visual grading data. In VGC analysis, image quality ratings for two different systems are compared by producing a VGC curve, similar to how the ratings for normal and abnormal cases in receiver operating characteristic (ROC) analysis are used to create an ROC curve. The use of established ROC software for the analysis of VGC data has therefore previously been proposed. However, ROC analysis is based on the assumption of independence between normal and abnormal cases. In VGC analysis this independence cannot always be assumed, e.g. if the ratings are based on the same patients imaged with both systems. The purpose of the present work was therefore to develop a software that takes possible dependencies between ratings into account in the statistical analysis of a VGC study. A computer program that performs a statistical analysis of rating data from a fully-crossed multiple-reader multiple-case VGC study was written in IDL (Research Systems, Inc., Boulder, CO). The software – VGC Analyzer – determines the area under the VGC curve ( $AUC_{VGC}$ ) averaged over the readers and applies non-parametric methods for the statistical tests: a bootstrapping resampling technique to determine the confidence interval of the  $AUC_{VGC}$  and a permutation resampling technique to determine the p-value for testing the null hypothesis that the two compared systems are equal ( $AUC_{VGC}=0.5$ ). A paired resampling is used if there is a dependency between the ratings for the two modalities. Analyses are performed both based on the trapezoidal and the binormal VGC curves and results are given both for the fixed-reader and the random-reader situations. VGC Analyzer can be obtained freely from the authors, and can hopefully simplify the use of VGC analysis in evaluations of image quality.