Assessing Validity of Visual Field Clustering Schemes for Standard Perimetry Using Machine Learning Classifiers

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Abstract

Purpose: To evaluate the validity of 4 different visual field clustering schemes used to discriminate glaucomatous from healthy eyes by assessing their performance with machine learning classifiers.
Methods: Commonly used schemes for clustering 24-2 visual field locations ("maps") were compared - Garway-Heath et al., Weber et al., Glaucoma Hemifield Test Sectors (GHTs) and GHT Difference (GHTd) maps. Glaucoma patients (156 eyes/156 patients) had IOP>23 mmHg and glaucomatous optic neuropathy by masked stereophotograph review. Normal controls (189 eyes/189 participants) had no history of elevated IOP and normal optic discs. Raw thresholds from standard perimetry Humphrey full-threshold field locations were averaged within each cluster ("cluster thresholds"), for all clusters within each map. Four types of statistical and machine classifiers [Linear Discriminant Function (LDF), constrained Mixture of Gaussian (cMoG) and Support Vector Machines (SVM linear; SVM gaussian)] were trained separately on each of the "maps" using cluster thresholds plus age,.and tested using cross-validation techniques.
Results: Areas under the ROC curves ranged from 0.77±0.02 (GHTd with SVMl and LDF) to 0.93±0.01 (Garway-Heath with cMoG). Sensitivities for detection of GON at a specificity of 96%, for example, generally ranged from 0.50 (Garway-Heath with LDF) to 0.75 (Garway-Heath with cMoG), although GHTd with LDF and SVMl were lower with sensitivities of 0.35 and 0.33 respectively.
Conclusions:
All maps appear to aggregate the visual field locations with similar effectiveness. None of the maps reduce performance compared to a full set of 52 field locations[1] and no single map outperformed the others. This suggests that the choice of map for comparison of the visual field with structural locations on the optic disc is open and determined by the needs of a particular study.
[1] Goldbaum et. al.(2002), IOVS, 43, 162-9.

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