Glaucoma Research Society

UNDERSTANDING CLASSIFICATION OF VISUAL FIELDS USING MACHINE LEARNING CLASSIFIERS - MEDICAL ADVICE FROM GLAUCOMA INFORMATICS (MAGI)

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Purpose: MAGI seeks to improve glaucoma diagnosis and management with state-of-the-art machine learning classifiers. Phase 1 evaluates the feasibility of using such classifiers for a variety of perimetric procedures, structural measures of optic disc and RNFL, and associated risk factors.

Design: Medical Informatics (Artificial Intelligence) Study

Materials/Participants: Visual fields from 189 normal and 146 glaucomatous eyes

Main Outcome Measure: Successful classification of visual field defects

Methods: This report reviews the classification of visual fields from 189 healthy eyes and 146 eyes with glaucomatous optic neuropathy (GON) using machine learning classifiers. Previous results were obtained with supervised learning with reasoning methods that were "hidden" from view. A new approach is presented to help understand the reasoning process by using unsupervised learning. Variational Bayesian Mixture of Factor Analysis (vbMFA) separated the fields into clusters and Independent Component Analysis (vbICA) represented the fields along maximally independent vectors in multidimensional space.

Results: The vbMFA formed 5 distinct clusters. One cluster held 186 of the 189 fields from healthy eyes plus 46 with GON. These fields were also classified as "normal" by the machine learning classifiers, glaucoma experts, and traditional Statpac-like methods. The remaining fields were placed in 4 groups, each of which contained fields with a typical glaucomatous field loss pattern. The vbICA identified six independent axes within the GON field cluster. Variations along each axis showed a continuum of field loss patterns.

Conclusions: vbMFA and vbICA can be used to uncover patterns in visual fields that may contribute to the "hidden" decisions made by machine learning classifiers to correctly separate fields of healthy eyes from those with GON.

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