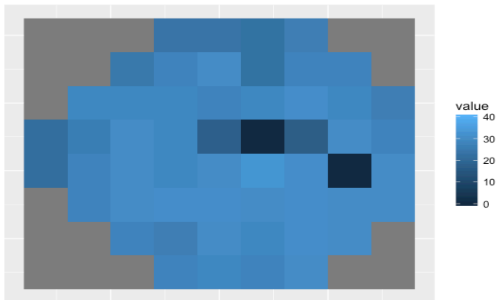
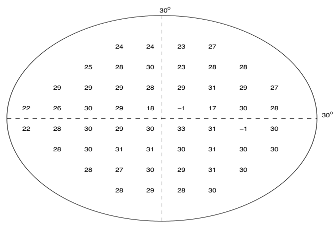
Master's Thesis Proposal

Strategies for Efficient and Fast Perimetry Testing

Background: Standard Automated Perimetry (SAP) is one of the most commonly used techniques for measuring a subject's perceived visual ability. For a given eye, it provides quantitative measurements of visual function represented as a 2D spatial visual field map (see Fig. 1). As a medical imaging tool, it is of great clinical importance for diagnosing and monitoring numerous ophthalmic diseases (e.g., glaucoma) and for detecting neurological conditions [5, 6].

SAP determines at each location of the visual field the sensitivity threshold i.e., the brightness level with which a subject observes a stimulus 50% of the time. The test proceeds as in the following: while fixating their gaze at a central point on a screen, a subject is presented with light stimuli of adaptively selected brightness at different locations of the visual field and is asked to press a button whenever the stimulus is perceived. While presenting all brightness levels at all locations multiple times would provide many responses, doing so would be extremely time-consuming (i.e., more than 15 minutes per eye) increasing false responses. Conversely, testing one stimulus at a handful of locations would produce highly inaccurate visual fields. Many strategies for making perimetry testing fast and accurate have been proposed in the literature [1,2,3], however neither method could efficiently improve the speed-accuracy trade-off.





Purpose: The goal of the project is to propose a new test strategy that is faster and at least as accurate as the state-of-the-art strategies.

Materials and tools: Student will benefit from the tools and methods in optimization, machine learning and deep learning domains in order to propose a data-driven test strategy. A patient simulation environment (Open Perimetry Interface, OPI [4]) as well as visual field data sets are available for developing and testing new strategies.

Nature of the thesis: Literature review: %10, theory: %30, data analysis and interpretation: %20, implementation: %40

Requirements: Familiarity with Machine Learning, Deep Learning, Python experience

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References:

[1] King-Smith, P.E., Grigsby, S.S., Vingrys, A.J., Benes, S.C., Supowit, A.: Efficient and unbiased modifications of the QUEST threshold method: theory, simulations, experimental evaluation and practical implementation. Vision research 34(7), 885-912 (apr 1994)

[2] Morales, J., Weitzman, M.L., Gonzalez de la Rosa, M.: Comparison between tendency-oriented perimetry (TOP) and octopus threshold perimetry. Ophthalmology 107(1), 134-142 (2000)

[3] Weber, J., Klimaschka, T.: Test time and efficiency of the dynamic strategy ing laucoma perimetry. German journal of ophthalmology 4(1), 25-31 (jan 1995)

[4] Turpin, A., Artes, P.H., McKendrick, A.M., et al.: The Open Perimetry Interface: An enabling tool for clinical visual psychophysics. Journal of Vision 12(11), 22{22 (jan 2012)