20th International Visual Field and Imaging Symposium

ABSTRACT SUBMISSION

Title: A Bayesian Thresholding Procedure for Perimetry that Models Both Spatial Relations and Sensitivity

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Title A Bayesian Thresholding Procedure for Perimetry that Models Both Spatial Relations and Sensitivity

Purpose

To explore the utility of a new Bayesian perimetric thresholding algorithm that exploits relationships between neighbouring locations.

Method

BUSS is a Bayesian algorithm where a probability distribution (pdf) is maintained across all possible pairs of sensitivities for two locations: in this example, (9,9) and (15,15). The prior distribution has pairs where (15,15) is 3dB higher than (9,9) (the eccentricity correction used in the Full Threshold (FT) algorithm) weighted 50 times that of others. The likelihood function is based on a Cumulative Gaussian distribution with standard deviation of 1 dB, and asymptotes of 3%. Stimuli are chosen to minimise the expected entropy of the posterior distributions with a lookahead of one step. The procedure terminates when entropy of the pdf falls below 4, and returns the expected sensitivity at each location.

Using computer simulation, we compare BUSS to FT. We investigate the bias, precision and number of presentations required to estimate all possible thresholds at each location (range 0..40dB) assuming two false positive (FP) rates (3% or 15%), false negatives of 3% and a variability based on Russell et al[ARVO 2011]. Further, a pair of locations from each quadrant of 163 glaucomatous visual fields were tested.

Results

When the first presentation of FT is close to threshold, it is faster than BUSS, on average (FP=3%, up to 2.5 presentations per location; fp=15%, 1.5). Otherwise, BUSS is faster than FT (eg. if one location has reduced sensitivity). About 90% of the 652 pairs of real visual field locations were more accurately determined using BUSS, and 20% were both more accurate and faster. FT was faster and more accurate then BUSS in fewer than 10% of real pairs, with the mean loss in accuracy less than 1dB in all cases.

Conclusions

When the assumptions underlying the "growth pattern" in FT and SITA are violated (eg: at the borders of scotomas or not matching normative database values), BUSS returns more accurate estimates in fewer presentations. The price BUSS pays for improved performance is 1-2 extra presentations per location for pairs that match FT's assumptions.

In future work we will extend BUSS to more than two locations, and explore its utility as a retest algorithm.

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