Authors

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Description of the Problem:

Among the most interesting applications of eye-tracking technology is in the design of user interfaces. One area of particular interest in the overlap between UI design and eye movement is the creation of task-driven dynamically changing displays. For example, consider the potential advantages of monitors which could detect whether or not the user was reading, and adapt their display characteristics in real time to reduce eye strain. Our objective for this project is related to this concept: we hope to build a classifier which can robustly discriminate between two patterns of oculo-motor behavior (specifically reading and object tracking).

Summary of the Data:

The data for this project are taken from the BioEye 2015 "Competition on Biometrics via Eye Movements" hosted by the University of Texas. We have taken a subset of the available data more suitable to our purposes. Our data therefore consists of 1224 data files (306 subjects, two sets of data collected for each subject a half-hour apart, two tasks– 306*2*2=1224) containing eye movement records. Data was sampled at 1000hz for each subject/trial, then down-sampled to a rate of 250hz in post processing, yielding between 15000 and 25000 eye position recordings per file (the free-viewing task was slightly shorter than the object-pursuit task).

Associated with each sample record are the horizontal deviation of the subject's gaze position in degrees of visual angle from the center of the display and the vertical deviation from the same. These values will be converted into pixel coordinates and collapsed into one of two eye movement types: fixations and saccades. Fixations are periods of little-to-no eye movement; saccades are large, fast, ballistic eye movements designed to place new targets at the center of the visual field. Each eye movement will then be characterized by a number of parameters. These parameter values will comprise the data used for our classifier.

The most significant problems we are likely to encounter when working with this data are violations of the normality assumption for the eye movement parameter distributions (which are often highly skewed), and temporal correlation of parameter values for the eye movement data. We can reduce the violations of the normality assumption for the predictors typically through log-transformation; we may be able to overcome the non-independence of errors through the use of a mixed model.

Methods

The core method used for this project will be binary logistic regression. Our goal is to be able to discriminate between sets of eye movement data collected during two different tasks, and a binary logistic regression is an excellent fit for this task. Given the relatively large number of parameters that can be used to characterize each type of eye movements, subsetting methods will also be used to help optimize the model fits.

References

University of Texas BioEye "Competition on Biometrics via Eye Movements."[Data Files and Instructions]. Retrieved from: https://bioeye.cs.txstate.edu/ on 16 March, 2015.