Eye Movement Classification with K-Means Clustering

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**Abstract:** Eye Tracking is increasingly an area of interest within HCI. It has been demonstrated to provide a more rapid and intuitive interface for many users than traditional user interfaces. However, the effectiveness of eye tracking platforms is often limited by their ability to distinguish fixations (wherein the eyes remain fixed on the neighborhood of a single point) and saccades (where the eye is in transition between fixations). Clustering is a well established within statistics and allows an analyst to programmatically distinguish between groupings within datasets based on a chosen distance measure. K-Means is one of the oldest and most trusted clustering algorithms. This paper demonstrates that K-Means can be effectively employed to classify fixations and saccades based on velocity features extracted from eye tracking data. The results of clustering based eye movement detection are comparable to traditional methods (such as I-VT) in accuracy but future refinements could promise substantial improvements in noise detection and hierarchical classification.

**1. Introduction-** Eye tracking has been an area of focus for at least a hundred years in the field of human-machine interactions. Careful measurements of the eye movements of a subject can yield deep and meaningful insights into the intentions, desires, and physiology of a subject being monitored. As the performance of computing platforms continues to improve it is increasingly necessary to develop user interfaces that are responsive enough to allow users to take full advantage of the full performance of their machines.

Eye movement classification is one of the most fundamental and necessary tasks in the field of eye movement tracking. The human eye is capable of several modes of behavior including fixation, saccade, and smooth pursuit. Distinguishing between fixation and saccade is the most basic form of eye movement classification and is the simplest task that could be employed in order to test the viability of a classification technique.

There is a small body of work that demonstrates the viability of applying clustering algorithms to the task of biosignal processing. However of this corpus very little has been applied specifically to the task of eye movement classification. Clustering as a statistical technique has a decades long pedigree and has had demonstrable success in many disciplines of bioinformatics. Unsupervised machine learning is a very robust array of techniques that has many advantages to offer HCI.