**Docket #:** S13-015

# A Novel Approach for Detecting Head Collisions in Sports

Stanford researchers have invented a system for identifying head impacts and rejecting spurious motion events. The system has been implemented in an instrumented mouthguard which measures head kinematics on the sports field. It incorporates two subsystems for head impact detection: a support vector machine classifier using features from linear and rotational head kinematics, and a proximity sensing mechanism to detect device dislocation. The system has been evaluated in a controlled laboratory setting, and shown to have 98% sensitivity, 99.99% specificity, 99% accuracy, and 99.98% precision in head impact classification. It may also be used with other accelerometer-instrumented wearable devices, such as skin-patch sensors, helmet sensors, or embedded tooth sensors. On the field, non-impact, high acceleration events greatly outnumber head-impacts. This invention aims to identify the few but critically important head-impact events.

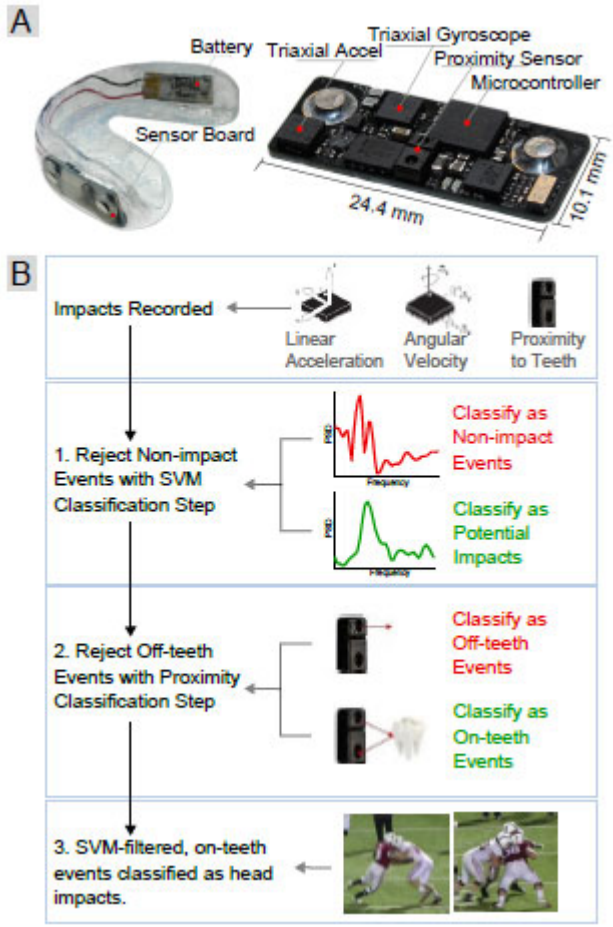



Figure description- Instrumented Mouthguard Design and Impact Detection System Illustration. The instrumented mouthguard used for the head impact detection system is illustrated in A (left) and the embedded sensor board is shown in A (right). Using this instrumented mouthguard, the head impact detection system incorporates 2 stages of classification as shown in B. First the SVM classifier is used to reject the majority of non-impact events. The remaining potential impact events as classified by the SVM classifier are passed through a second proximity classification step to filter out non-impact events where the mouthguard is not worn.

## Applications

- Real-time injury risk assessment on the football field to aid in return to play decisions.
- Record head injury data in sports for the purpose of better understanding the mechanisms of head injuries.

## Advantages

- Effectiveness in rejecting false positives such as mouthguard chewing, dropping, and throwing.
- Significant improvement in distinguishing between truly dangerous head blows and noise, compared to existing technology.

## Publications

- A head impact detection system using SVM classification and proximity sensing in an instrumented mouthguard. *IEEE Trans Biomed Eng.* 2014.
- "Stanford researchers measure impact of football concussions", *Stanford Report* , October 24, 2012.

## Patents

- Published Application: 20140257051
- Issued: 10,172,555 (USA)

## Innovators

- David Camarillo
- Lyndia Chun Wu
- Bruce Cam

## Licensing Contact


### Evan Elder

Associate Director, Licensing and Strategic Alliances, Physica

Email