

Systems Design of Knee Motion Sensor

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Abstract: Injury statistics have shown every year more than 200,000 Americans sustain Anterior Cruciate Ligament (ACL) injuries. ACL injuries occur when the strain on the ACL, known as the Tibial Shear Force (TSF), exceeds 2100 Newtons. The Knee Motion Sensor (KMS) was designed to provide situational awareness for athletes during game time and practice environments by alerting the user when the TSF approaches 2100 Newtons. Using the TSF equation, the KMS converts an array of digital sensory inputs into usable data to estimate the TSF. To facilitate these calculations, the microcontroller incorporates 2 pressure sensors accurate to 86.0% within the range of 20 to 120 kg, 2 angle sensors accurate to 94.8% within 35 to 180°, and a three-axis accelerometer with an accuracy of 98.2%. Preliminary validation testing has demonstrated the KMS's potential to mitigate ACL injuries by providing real-time situational awareness and post-game analysis for today's athletes.

Keywords: ACL injuries, Knee, Knee motion sensor, post-game analysis