Sled-Based Force Measurement System for Football Players

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Figure 16. Prototype of the Force Measurement System

INTRODUCTION

The objective of this project is to design a sled-based force measurement system for football players. In the sport of football, a major component of a player's repertoire is his ability to block and tackle an opponent. While devices to test this exist, none is capable of producing a set of quantitative data to be used for rehabilitation progress purposes or general training enrichment. In order to acquire this valuable data, the designed device consists of a stationary football blocking sled outfitted with a series of sensors to capture every linkage's movement throughout the progression of a football player's hit. This data is then compiled and used to generate a force component profile of the user's hit over a predetermined time interval. In order to determine the location and minimal amount of sensors needed to optimize both efficiency and accuracy, a detailed dynamic and kinematic analysis was performed. After optimizing the sensors' locations, the best method of securing the device to minimize vibration while remaining structurally sound was implemented. Using a computer program unique to the device, an operator will be able to analyze all force components of a player's hit to aid in tracking progress during sports rehabilitation as well as for performance optimization.

SUMMARY OF IMPACT

The force-measuring football sled has an impact in the field of rehabilitation study and football performance evaluation. The device will be used in the study of shoulder injuries to understand the force experienced in the shoulder during a block as well as the muscles involved in the block. Utilizing this data, researchers will be able to come up with preventative measures and training which focus on the muscles involved in supporting injury prone areas such as the shoulder to prevent further injuries. The device will also be used during rehabilitation of an already injured athlete to monitor his strength recovery. For performance evaluation, this device can be used to quantitatively measure a linebacker's potential blocking force. No device on the market currently measures this force, and most athletes and coaches rely on indirect measures of strength and

speed that do not necessarily translate into a blocking force. With such a device, linebackers in football can be evaluated qualitatively in terms of their blocking power.

TECHNICAL DESCRIPTION

Using an array of force load cells, accelerometers, and gyroscopes, the modified stationary football sled is capable of reading the impact force of a football player. By modifying the base linkage of the football sled, a custom-made base structure was designed to be able to measure the reaction forces that the linkage undergoes during a user's hit. The designed base structure includes holes on the bottom to be secured to the floor, as well as tabs to allow the force load cells to be secured properly to the device.

The force and motion sensors for this device were chosen carefully to withstand high forces, measure forces both in tension and compression, and use with a standard data acquisition device. Due to this device being used by people of varying technical backgrounds, all sensors were chosen to be self-contained to prevent the need for any troubleshooting due to a bad electrical component such as a resistor, capacitor, etc.

To ensure the device's user-friendliness, the program used to acquire all data was designed in LabVIEW, with a front panel that can be operated by people of all technical backgrounds. Shown on this display is a real-time graphical display of each force component and the magnitude of the force. The program saves all acquired data to a file which can then be further analyzed.

The total cost of the parts and supplies for this project was about $6275.

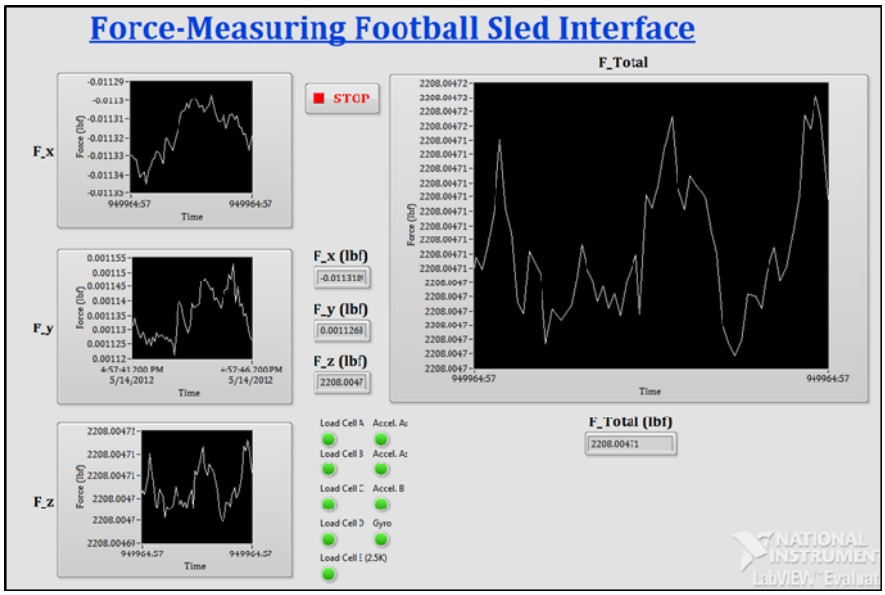

Figure 17. LabVIEW Interface in Use