

Abstract

The concept of a Portable Biomechanical Assessment Suite (PBAS) was proposed and developed by Dr. Frank L. Buczek Jr., Branch Chief HELD/ECTB, National Institute for Occupational Safety and Health (NIOSH), Morgantown, WV. This thesis documents a subset of the overall PBAS concept. PBAS is a suite of sensors to measure the kinematics and kinetics of the human body during lifting tasks. The suite is made up of ten inertial measurement units (IMUs) and the Novel Pedar pressure insoles. The IMUs are made up of an Xbee radio, a triple-axis accelerometer, a dual-axis gyroscope, and a single-axis gyroscope. The data are sent via the 802.15.4 wireless network protocol to a collection device connected to a computer and are stored in a binary data file that is then read and processed by a Matlab program. The output of the program is four data matrices: x-acceleration, y-acceleration, z-angular velocity, and the calculated angular position of each IMU. The pressure insoles are synchronized with the IMUs to measure the ground reaction forces.

An initial test was run to determine how battery life, the zero voltage level, and dropout rate change with data transmission time. The tests showed that the IMUs could easily run for five hours with no effect on the dropout rate. The accelerometer was found to have very little zero-drift while the gyroscopes do exhibit some zero drift. This will need to be taken into account for long tests.

Three pendulum tests were run to test the IMUs, all yielding good results. The first test used three preliminary IMUs made on breadboards to validate the circuit design and general concept. The next two tests used five final IMUs to measure the kinematics of the pendulum. One test had all IMUs measuring in the sagittal plane while the second test used three sagittal plane IMUs and two IMUs reprogrammed to measure the corresponding signals in the coronal plane. Both tests showed that the IMU signals matched what was expected and validated the network of IMUs for future use in biomechanical testing.

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