Development of technique for measuring muscle activity and knee motion in children with CP

Cerebral is caused by brain injury occurring before the age of two and has impact on muscles and mobility of the growing child. There are no medicines for CP, but there are treatments and exercises that can relieve the symptoms.
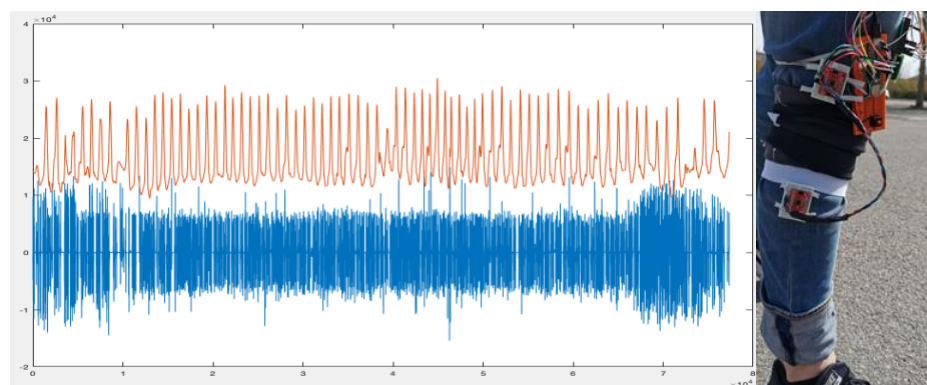
The aim for this project was to develop a method to measure the knee angle and muscle activity around the knee of children with CP during normal daily living for longer time periods. This can help physicians and physiotherapists to find better treatments for these children. Using IMU (Inertial measurement unit) to measure knee motion combined with measuring muscle activity with surface EMG, might be a solution.

An IMU can measure position and velocity and other variables by combining the triple-axis gyro, magnetometer, and accelerometer. Accelerometer detects linear acceleration and measures motion in X, Y, and Z direction. The gyroscope measures the angular velocities around three axis. The magnetometer makes it possible to calculate the direction of the sensor by cognizance direction towards the magnetic north.

An ADS1299 has been used to develop the EMG recording in this project. In order to analyse the data it needs to be converted to digital format. Then an analog to digital converter (ADC) was used.

Two IMUs sensors BNO080 placed one on the upper limb and one on the lower, have been used to measure the knee angle. The ADS1299 connected to surface electrodes were attached a procedure for recording EMG signals from some selected leg muscles around the knee. The implementation was done on a Teensy board.

The attachments of the BNO080 sensors on the leg give a accurate value of the knee angle. EMG recordings showed an excellent value that synchronized with measurements from the knee angle. The recording can be done with or without simultaneous recording of the knee angle. Further, the combination of knee angle measurements with EMG recordings of selected muscles gives exciting results.

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