

Gaming Control Armband for Amputees

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Project Motivation

There were 1.6 million amputations in 2005, and this is projected to double in 2050.

80% of amputations are due to traumatic injury.

Gaming has mental health and therapeutic benefits for people who have gone through a traumatic injury.



EMGs in Prosthetics

EMG control is by far the most common user interface for powered prosthetic devices. This lets patients use other muscles in their body to control their prosthetic limb.



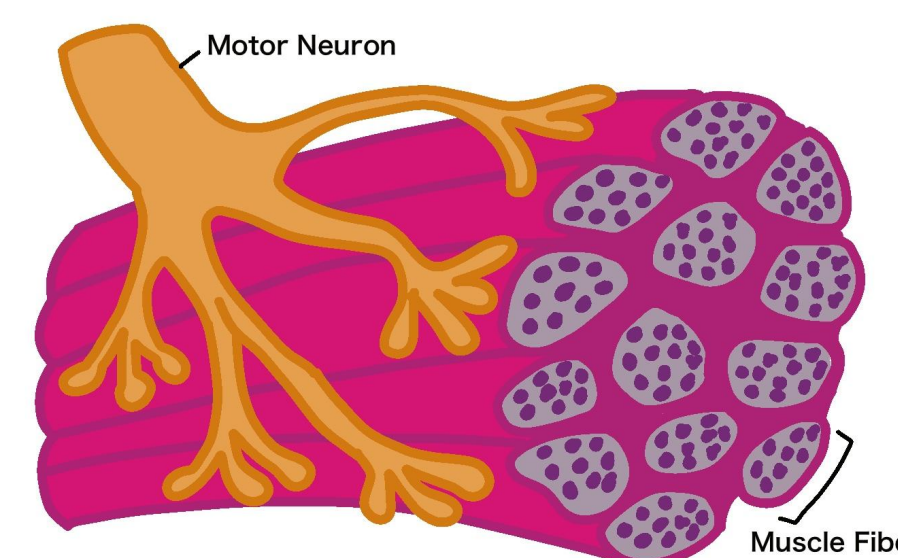
Psyonic bionic hand

For upper limb amputees, gaming can improve motivation and outcome of physical training for precise EMG control.

EMG Signals

Electromyography (EMG) is the detection of electrical signals from skeletal muscles.

- Motor units consist of motor neurons and muscle fibers
- The brain sends a signal to the muscles through the motor neurons, generating an action potential

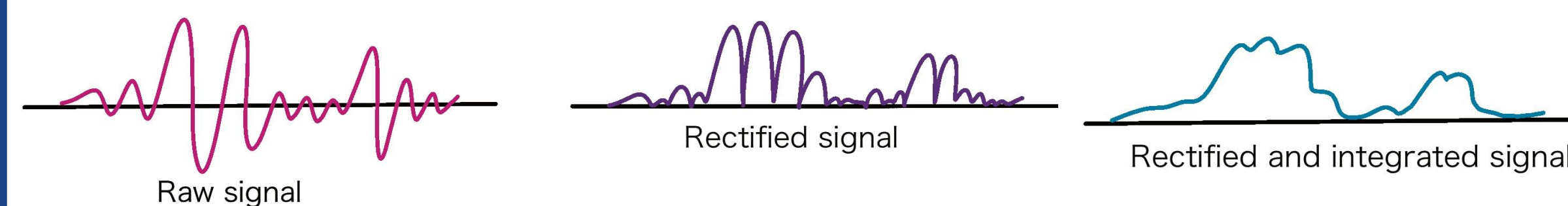


Motor Unit Diagram

- Action potentials of all the stimulated motor units combine to make an action potential train, which is an electrical signal we can detect
- Electrodes are placed across the muscle to report the electrical signal to our device

Raw EMG data is very messy, so it needs to be cleaned up before use:

The Myoware EMG sensor gives us the rectified and integrated signal.

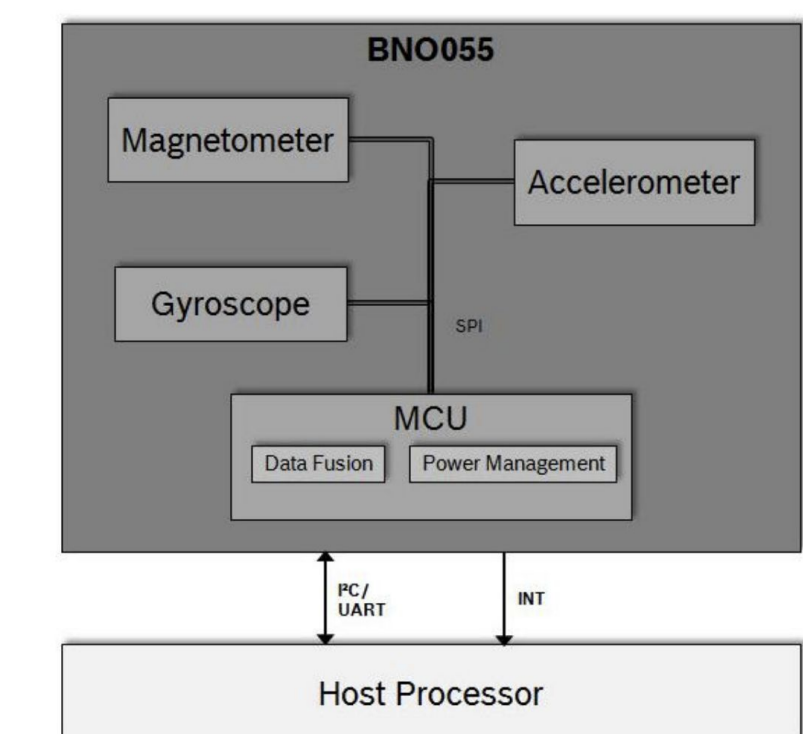


The rectified and integrated signal gives us information about the relative force the muscle is producing. This signal can be further processed to remove more of the noise by the addition of digital filters.

EMGs are used for a variety of applications, including prosthetics and medical diagnosis. EMG signals can be collected from many different muscles throughout the body.

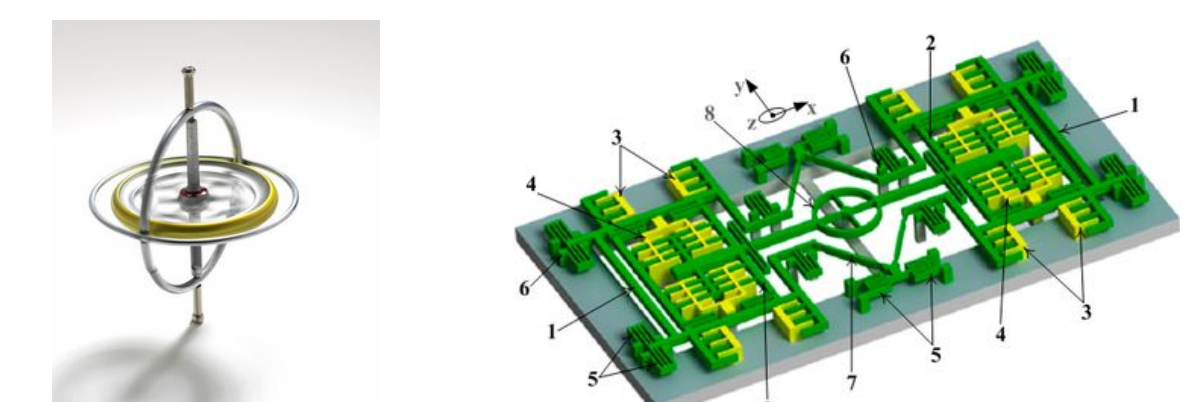
IMU Signals

Inertial measurement units (IMUs) use gyroscopes, accelerometers, and magnetometers to give information about the movement and orientation of the sensor. 3D movement can be seen from looking at the x, y, and z directions.

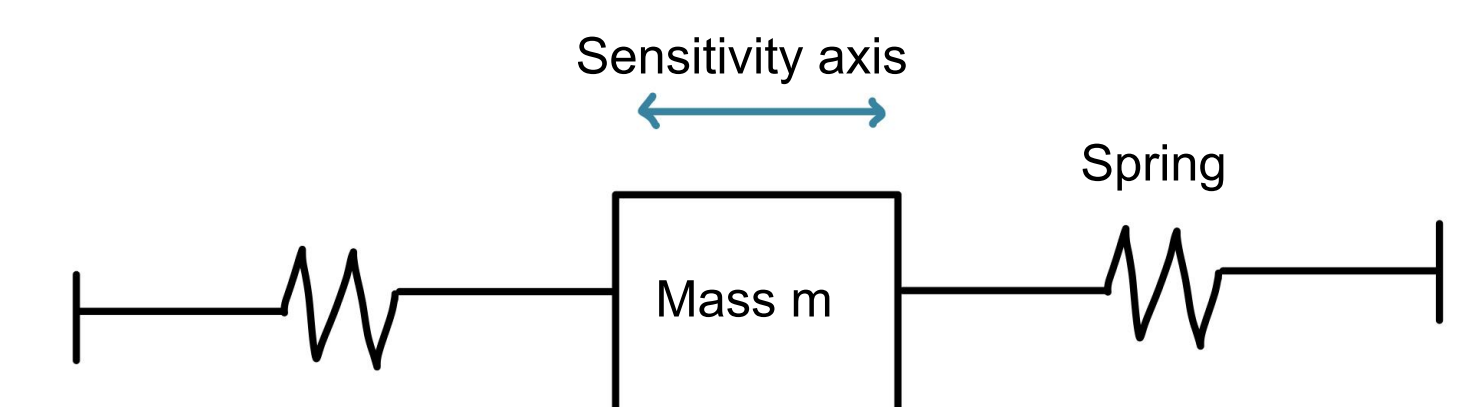


BNO055 IMU Sensor System Architecture

Gyroscopes are used to sense rotational motion. They can detect rotations of the sensor by maintaining their orientation when the sensor is rotated. There are different types of gyroscopes, including mechanical and vibrating structure gyroscopes.



Accelerometers are used to sense acceleration, which is the change in velocity over time. You can feel this when you're in a car that's speeding up or breaking. This can be done with different types of sensors. A MEMS accelerometer, for example, consists of a mass suspended by springs. The mass moves along the axis when there is an acceleration.



Accelerometer diagram