**Objectives**

- Development of Droid MoCap System
  - Mobile Motion Capture System for capturing human motor behavior with the wireless sensors
  - Tablet based interface S/W for easy use

- Biomechanical Model Development and Implementation
  - Forward and Inverse Kinematics module
  - Inverse dynamics module for joint torque computation
  - Muscle force estimation from EMG signals based on the physiological model on the skeletal muscles

**Hill-based Muscle Force Model**

- Hill-based muscle model development (in progress)
  - Modified Hill-based model from the system engineering perspective
  - For the selected muscles (i.e. biceps brachii, triceps longhead, anterior and posterior deltoids), find the physiological properties (e.g. physiological cross-sectional area, muscle slack length or percentage of fast fiber)

- Adaptation mechanism for each subject (in progress)
  - For each individual, physiological parameters can be adapted via optimization algorithm (e.g. Genetic Algorithm)

**EMG Processing Module**

- Signal conditioning
  - High pass filter (4-th order Butterworth) with 20 Hz corner frequency
  - (Optional) Notch filter (4-th order Butterworth) on 60 Hz frequency
  - Full rectification
  - Low pass filter (4-th order Butterworth) with 5Hz corner frequency

- EMG feature extraction (i.e. neural activation value)
  - RMS (root mean square), MAV (mean absolute value) and MA (moving average) were compared to the same raw data
  - Nonlinear scaling function is adopted for finalizing the neural activation value as an input for the Hill-based muscle model

**Biomechanical Model of Human Arm**

- Inverse kinematics module
  - IMU sensor values (i.e. limb positions) are converted into the joint kinematics (i.e. joint angles)
  - Joint kinematics can be an input for moment arm computation and inverse dynamics module

- Inverse dynamics module (in progress)
  - Based on the rigid dynamics, required joint torque amount can be estimated from the measured motion kinematics
  - This estimated joint torques can be converted into muscular forces
  - Muscular forces estimated from the body dynamics can be a reference signal for the adaptation mechanism

- Varying moment arm computation module (in progress)
  - In the musculoskeletal system, muscle tensions drive the joint motions and multiple skeletal muscles are involved in each joint DOF (degrees of freedom) maneuver
  - From the geometry of muscle – joint connections, moment arms are computed

**Droid MoCap System**

- Wireless sensor modules
  - Bluetooth integrated IMU (inertial measurement unit) sensors measure the limb kinematics (i.e. three linear accelerations and three angular velocities)
  - Bluetooth integrated EMG (electromyography) sensors measure the muscle activations during the motion

- Android tablet interface
  - Nexus 7 tablet works as a host PC
  - Application software for capturing and recording the sensor measurement

- Dead reckoning algorithm (in progress)
  - Converting the sensor values into 3-dimensional positions and orientation values by integration method
  - Drift error compensation algorithm is also required