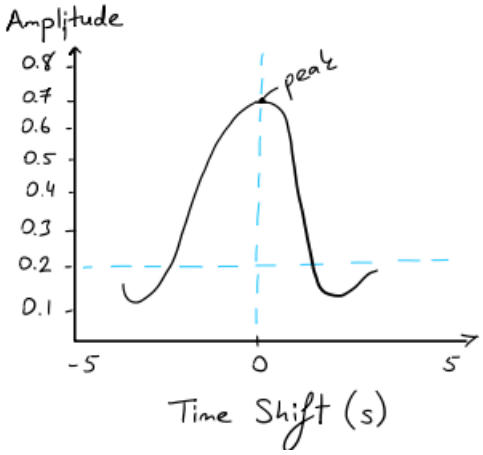
BME331: Physiological Control Systems

Lab 3 – Prelab

1. **If neural impulses could be converted to muscle contractions and produce joint torques instantaneously, sketch what the cross-correlation plot would look like between the EMG and force plate data.**



2. **Is an EMG signal produced by the action potentials in the muscle, or in the nerves controlling the muscle?**
   EMG refers to the collective electric signal from muscles, which is controlled by the nervous system and produced during muscle contraction. An EMG signal is the electrical activity of a muscle's motor units.

3. **Why is it important that the EMG and force plates be synchronized in this particular experiment?**
   For this experiment we are measuring commands to the muscle controlling ankle joint using EMG data and the angle of the body sway using force plate data to be able to observe the correlation of these measures for the ankle joint movement. In order to maintain balance, the data from the EMG and the force plates must be synchronized to be able to control the ankle movement according to the body positioning.

4. **In your Simulink model, do you think that the body parameters (height and weight) that you enter may affect the choice of gains? Why or why not?**
   Depending on the body parameters (weight and height) of the subject, some gain combinations may cause numerical instabilities in Simulink, therefore it may affect the choice of gains. In our Simulink model we have functions that are defined in a certain range, such as the sin function. Certain height and weight combinations may result in invalid inputs for certain blocks, which would result in a Simulink error.

5. **Very briefly explain how the visual, proprioceptive, and vestibular pathways all contribute to maintaining balance.**
   Maintaining balance depends on the sensory information received by the brain from the eyes (visual system), muscles, tendons, and joints (proprioceptive input) and vestibular organs in the inner ear (vestibular system). Visual system helps to sense head and body location and motion in relation to the outside world. Proprioceptive pathways are sensitive to stretch or pressure and informs the brain about the location of the feet and legs in addition to positioning of the head compared to chest and shoulders. Vestibular organs in the inner ear senses the movements and positioning of the head. The brain stem uses the collection of these sensory information along with cerebellum and cerebral cortex to control the balance.