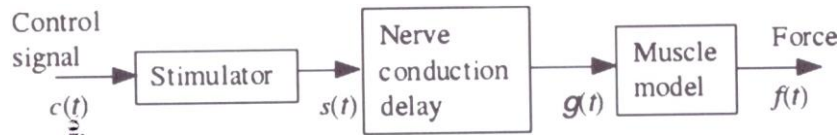


AM5510 : BIOMEDICAL SIGNALS & SYSTEMS

Programming Assignment #3: Simulating Skeletal Muscle Model

Please write your own code in Matlab. This assignment can be turned in as an e-mail attachment (PDF) along with the Matlab code with a filename indicating your unique identity 06/11/2023

A block diagram representation of the process to activate skeletal muscle by artificially stimulating the nerve is given below.



The control signal is a continuous signal that controls the frequency of the stimulator o/p. The stimulator o/p's a train of pulses with frequency proportional to the voltage i/p to it. But, the minimum and maximum frequency of the stimulator, $s(t)$, is only b/w 5Hz and 50Hz, respectively. $s(t)$ is related to $c(t)$ by a constant K_3 . The interpulse interval for p^{th} stimulus is

$$\tau_p - \tau_{p-1} = K_3/c(t),$$

where, $K_3 = 0.3 \text{ s-V}$,

$$s(t) = \sum_p \delta(t - \tau_p)$$

The nerve conduction delay introduces a constant delay of θ s:

$$g(t) = s(t - \theta),$$

where $\theta = 0.005 \text{ s}$. The muscle model is a model of the muscle twitch, with impulses as the i/p to the muscle. The o/p force for a single AP is

$$f_h(t) = G(e^{-at} - e^{-bt})u(t)$$

The unit of force is Newton; $a=5/s$, $b=20/s$, and $G= 30\text{N/Hz}$. The cumulative force is $f(t)=f_h(t)*g(t)$

Assignment

Write the discrete recursive equations for each block in the system so that the values at each point in time may be calculated. Use BL transform to obtain the Z-transform and then write the DT recursive equations.

Write a program to simulate the system. The force must be o/p for any arbitrary i/p signal from the recursive equation. Simulate the system using $t=n\Delta t$ with $\Delta t = 0.0001 \text{ s}$.

- Plot the o/p of the muscle block to a single impulse (twitch) and to two impulses 200 ms apart
- Simulate the O/P of this system under the following conditions :
 1. $c(t)$ is a rect function of amplitude 4 and duration 10 secs
 2. $c(t)$ is a rect function of amplitude 10 and duration 5 secs