CS 633 3D Computer Animation

Homework Assignment 3 (40 points)

Due: 2/8/08

1. If we want the user to have an impression that the object is moving in constant speed, we need to parametrize the path curve by arc length. For a B-spline curve, how should the re-parametrization process be done? Note that a B-spline curve usually has several segments and each segment is defined differently.

2. Prove the third equation on page 104 of the textbook, i.e.,

$$s_3(t) = \frac{v_0 t_1}{2} + v_0(t_2 - t_1) + [v_0 - \frac{v_0(t - t_2)}{2(1 - t_2)}](t - t_2)$$

when $t_2 < t < 1$. To prove the above equation, you need to show the following equation first.

$$v_3(t) = - \frac{v_0}{1 - t_2} (t - t_2) + v_0.$$

(10 points)

3. There are two approaches to define a *spherical linear interpolation* (see page 111 for the definition of this term) between two unit quaternions. In the second approach, $slerp(q_1, q_2; u)$ is defined as follows:

$$slerp(q_1, q_2; u) = \frac{\sin((1 - u)\theta)}{\sin \theta} q_1 + \frac{\sin(u\theta)}{\sin \theta} q_2$$

Prove that when $u = 1/2$ the above definition indeed gives the mid-point of the arc between q_1 and q_2. (10 points)

4. Prove the second approach generates the same curve as the first approach. (10 points)