

## CSCI 420 Compute Graphics Programming Assignment 2 Simulating a Roller Coaster

For every time step of your simulation, the curve parameter  $u$  can be updated using the following equation:

$$u_{new} = u_{current} + (\Delta t) \frac{\sqrt{2g(h_{max} - h)}}{\left\| \frac{dp}{du} \right\|}$$

where  $\Delta t$  is the time step,

$g$  is the gravity constant,

$h_{max}$  is the maximum height of the track,

$h$  is the current height of the roller coaster,

$p$  is a function of  $u$  (i.e.  $p(u)$ ) that computes

the position (in 3D) of the roller coaster at  $u = u_{current}$  (see

p.628 of the textbook “Interactive Computer Graphics: A Top-Down Approach Using OpenGL” for the exact equation of  $p(u)$ ).

Note that  $\frac{dp}{du}$  is the derivative of  $p(u)$  with respect to  $u$ , and

the derivative is evaluated at  $u = u_{current}$ . Also,  $\left\| \frac{dp}{du} \right\|$  is the magnitude

(i.e.  $mag = \sqrt{x^2 + y^2 + z^2}$ ) of the vector  $\frac{dp}{du}$ .