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

\[
u_{\text{new}} = u_{\text{current}} + (\Delta t) \frac{\sqrt{2g(h_{\text{max}} - h)}}{\| dp/du \|}\]

where \( \Delta t \) is the time step,
\( g \) is the gravity constant,
\( h_{\text{max}} \) 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 \( u = u_{\text{current}} \) (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 \( u = u_{\text{current}} \). Also, \( \| dp/du \| \) is the magnitude (i.e. \( \text{mag} = \sqrt{x^2 + y^2 + z^2} \)) of the vector \( \frac{dp}{du} \).