Derive the Steps that lead to physical realistic eq.

$$v\_new = v\_old + \frac{dt \sqrt{2g(h_{max}-h)}}{\left\| \frac{dk}{dv} \right\|}$$

For a falling body, Starting from rest ($V_{INITIAL} = 0$)

Distance $h_{max} - h$ travelled by body is

$$(h_{max} - h) = \frac{1}{2} g t^2 \quad \text{--- (1)}$$

h_{max} = final height
h = intial heigh
g = Acc. Gravity
t = time

D.W.r.t

$$\frac{d}{dt}(h_{max} - h) = gt.$$

$$v = gt. \quad \text{--- (2)}$$

v = Instantaneous velocity

From 1 & 2

$$v = g \sqrt{\frac{2(h_{max} - h)}{g}}$$

$$v = \sqrt{2g(h_{max} - h)}$$

distance travel in a single timestep

$$= \sqrt{2g(h_{max}-h)}\ dt.$$

Parametrizing using v linearly.

$$\frac{v_{new} - v_{old}}{1} = \frac{dt \cdot \sqrt{2g(h_{max}-h)}}{\left\| \frac{dp}{dv} \right\|}$$

Time taken to cover $v_{new} - v_{old}$ in steps of 1 is same as time taken to cover the distance $d(h_{max} - h)$ with parametrized speed of $\|dp/dv\|$.

$$v_{new} = v_{old} + \frac{\sqrt{2g(h_{max}-h)}}{\left\| \frac{dp}{dv} \right\|}\ dt$$

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