Real-time simulations

CS-116B: Computer Graphics Algorithms
Spring 2018

Real-time simulations

Euler integration formula:
$v(t + \Delta t) = v(t) + (\Delta t) * v'(t)$

Problem:
Truncation error due to absence of higher order terms (i.e. approximation).

Source: *Physics for Game Developers*, p. 146

Real-time simulations

Improved Euler method:
$y(t + \Delta t) = y(t) + \frac{1}{2} * (k_1 + k_2)$

By including one more Taylor expansion term beyond basic Euler method, this reduces the truncation error on order of $(\Delta t)^3$ compared to $(\Delta t)^2$.

Source: *Physics for Game Developers*, p. 155

Real-time simulations: Runge-Kutta method

Yet another improvement: Runge-Kutta method:

We can further improve Euler's method by adding addition Taylor expansion terms. This further reduces truncation error on the order of $(\Delta t)^5$

Runge-Kutta method is "a popular general-purpose numerical integration scheme."

Source: *Physics for Game Developers*, pp. 155-158