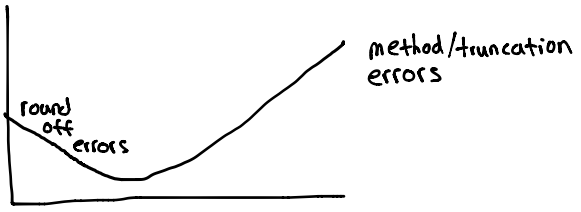
Particle Dynamics

Error in ODE solution (soln)



Back to particle dynamics

General Problem: $\vec{F} = \vec{F}(\vec{r}, \vec{v}, t)$

Example: gravity $\vec{F} = \begin{bmatrix} -mg\hat{j} \\ -\frac{MmG}{r^2}\hat{r} \end{bmatrix}$ near earth, big G

spring: $\vec{F} = K(|\vec{r}| - l_0)\frac{\vec{r}}{|\vec{r}|}$

drag: $\vec{F} = \begin{bmatrix} -c\vec{v} \\ -c|\vec{v}|\vec{v} \end{bmatrix}$ linear viscous, quadratic drag

You know the particles mass, position, velocity, time $K \rightarrow \vec{F}(\vec{r}, \vec{v}, t)$

$\vec{F} = m\vec{a}$ $\quad \vec{a} = \frac{\vec{F}}{m}$

$\dot{\vec{r}} = \vec{v}$

$\dot{\vec{v}} = \vec{a} = \frac{\vec{F}}{m}$

$\dot{z} = f(z,t)$ $\quad z = \begin{bmatrix} z_1 \\ z_2 \\ z_3 \dots \end{bmatrix} = \begin{bmatrix} r_x \\ r_y \\ v_x \\ v_y \end{bmatrix}$

Ballistics Problem

$\vec{F} = -c|\vec{v}|\vec{v} + -mg\hat{j}$ $\qquad c = C_D * \rho_{air} * A_{cross}(ball)$

LMB: $\vec{F} = m\vec{a}$

$= -c|\vec{v}|\vec{v} - mg\hat{j} = m\vec{a}$

$= -\frac{c}{m}|\vec{v}|\vec{v} - g\hat{j} = \vec{a}$

$\dot{\vec{r}} = \vec{v}$

$\dot{\vec{v}} = \vec{a} = -\frac{c}{m}|\vec{v}|\vec{v} - g\hat{j}$] 4 ODE's

$\Delta r \approx \dot{\vec{r}}\,\Delta t$

$\Delta v \approx \dot{\vec{v}}\,\Delta t$] Euler's method

Set this up in the computer