作业5 简单物理

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1. 单摆模拟

1.1 数学原理

1.1.1 局部阶段误差(local truncation error)

假设 $$ y_i = y(x_i) $$

$$y_i = y(x_i)$$

并且认为第 *i* 步计算是精确的，那么局部截断误差为

$$\theta_{n+1} = \theta_n - \omega_n \Delta t$$
$$\omega_{n+1} = \omega_n + \frac{g}{l} sin\theta \Delta t$$

- explicit Euler

$$\theta_{n+1} = \theta_n - \omega_n \Delta t$$
$$\omega_{n+1} = \omega_n + \frac{g}{l} sin\theta_n \Delta t$$

- Midpoint

$$\theta_{n+1} = \theta_n - (\omega_n + \frac{\Delta t}{2}\omega_n)\Delta t$$
$$\omega_{n+1} = \omega_n + \Delta t(\frac{g}{l} sin\theta_n + \frac{\Delta t}{2}\frac{g}{l} sin\theta_n)$$

- Trapezoid

$$\theta_{n+1} = \theta_n - \Delta t \frac{\omega_n + \omega_{n+1}}{2}$$