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

$$egin{aligned} heta_{n+1} &= heta_n - \omega_n \Delta t \ \omega_{n+1} &= \omega_n + rac{g}{l} sin heta \Delta t \end{aligned}$$

• explicit Euler

$$egin{aligned} heta_{n+1} &= heta_n - \omega_n \Delta t \ \omega_{n+1} &= \omega_n + rac{g}{l} sin heta_n \Delta t \end{aligned}$$

• Midpoint

$$egin{aligned} heta_{n+1} &= heta_n - (\omega_n + rac{\Delta t}{2}\omega_n)\Delta t \ \ \omega_{n+1} &= \omega_n + \Delta t (rac{g}{l}sin heta_n + rac{\Delta t}{2}rac{g}{l}sin heta_n) \end{aligned}$$

• Trapezoid

$$heta_{n+1} = heta_n - \Delta t rac{\omega_n + \omega_{n+1}}{2}$$