MCE 456
HW 5

$a = res = 4$ ticks/rev

$r = 0.03m$

$R = 20$

$d = 0.1m$

	Δt_1, 0-0.1s	Δt_2 0.1-0.2s
RT	12	8
LT	8	10

1;

	ω_{RM}	ω_R	V_R	ω_{LM}	ω_L	V_L	V	ω
Δt_1	188.5	9.4	.28	125.7	6.3	.14	.24	.93
Δt_2	125.7	6.3	.19	157.1	7.9	.24	.22	-.48

$\omega_M = \left(\frac{ticks}{a}\right) \cdot \frac{2\pi}{\Delta t}$ & $V_\theta = \omega_M r$

$\omega = \frac{\omega_M}{R}$

$V_{GA} = \frac{V_L + V_R}{2}$ & $\omega = \frac{1}{d}(\omega_R - \omega_L) \over 2$

2; Enter Forward: $\Delta x = \Delta t_i^{i} \cdot V_i \cos(\theta_{i-1})$

$\Delta y = \Delta t_i^{i} \cdot V_i \sin(\theta_{i-1})$

$\Delta\theta = \Delta t_i^{i-1} \omega_i$

→ Δt_1; $x = 1 + 0.1 \cdot .24 \cos(0) = 1.024$

$y = 2 + 0.1 \cdot .24 \sin(0) = 2$

$\theta = 0 + .43 \cdot 0.1 = 0.043$

→ Δt_2; $x = 1.024 + .22 \cdot 0.1 \cdot \cos(.043) = 1.046$

$y = 2 + 0.1 \cdot 0.22 \cdot \sin(.043) = 2.002$

$\theta = 0.043 + 0.1 \cdot -.48 = 0.045$

Runge-kutta:

$$\Delta x = \Delta t_i^{i-1} \cdot V_i \cos\left(\frac{\theta_i + \theta_{i-1}}{2}\right)$$

$$\Delta y = \Delta t_i^{i-1} \cdot V_i \sin\left(\frac{\theta_i + \theta_{i-1}}{2}\right)$$

$$\Delta \theta = \Delta t_i^{i-1} \cdot W_i$$

$\Rightarrow \Delta t_1 :\ X = 1 + 0.1 \cdot 0.24 \cdot \cos\left(\frac{0 + .093}{2}\right) = 1.024$

$\quad y = 2 + 0.1 \cdot 0.24 \cdot \sin\left(\frac{0 + .093}{2}\right) = 2.001$

$\quad \theta = 0.1 \cdot .93 = .093$

$\Delta t_2 :\ X = 1.024 + 0.1 \cdot 0.22 \cos\left(\frac{.093 + .045}{2}\right) = 1.046$

$\quad y = 2.001 + 0.1 \cdot 0.22 \sin\left(\frac{.093 + .045}{2}\right) = 2.003$

$\quad \theta = 0.093 + 0.1 \cdot -.48 = 0.045$

$3 :\ $ for $\dot{x} = f(x, u)$ $\quad X_i \approx \Delta t_i^{i-1} f(X_{i-1}, u_{i-1})$

~~$X_{i+1} \approx \Delta t f()$~~

$\rightarrow$ for $f(x, u) = x + 3u$

$$X_{t+1} \approx \Delta t \cdot \left(X_t + 3\left(\frac{u_t + u_{t+1}}{2}\right)\right)$$