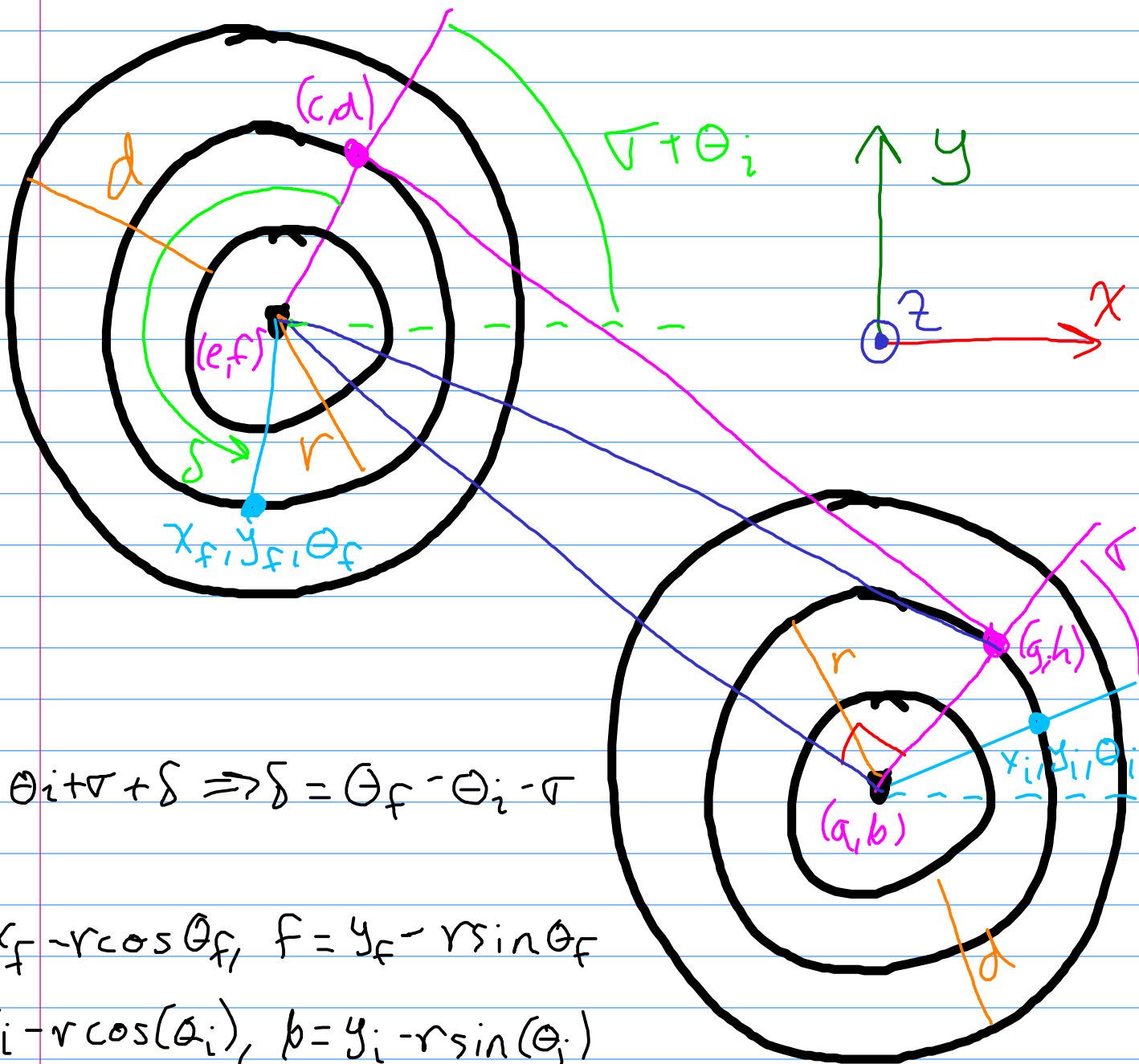


known: $x_i, y_i, \theta_i, x_f, y_f, \theta_f, r$
 find: σ, δ



$$\theta_f = \theta_i + \sigma + \delta \Rightarrow \delta = \theta_f - \theta_i - \sigma$$

$$e = x_f - r \cos \theta_f, \quad f = y_f - r \sin \theta_f$$

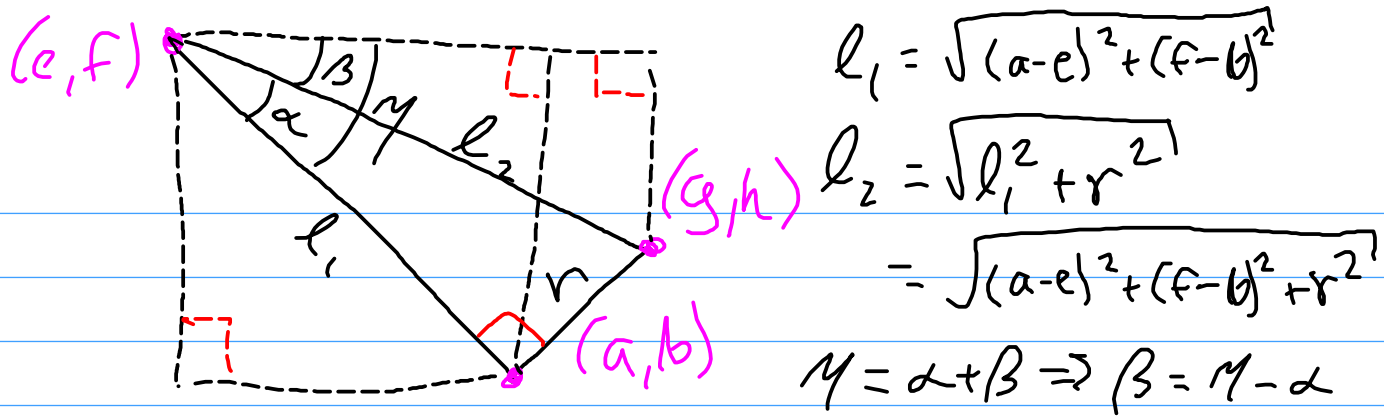
$$a = x_i - r \cos(\theta_i), \quad b = y_i - r \sin(\theta_i)$$

$$c = e + r \cos(\sigma + \theta_i) = x_f - r \cos(\theta_f) + r \cos(\sigma + \theta_i)$$

$$d = f + r \sin(\sigma + \theta_i) = y_f - r \sin(\theta_f) + r \sin(\sigma + \theta_i)$$

$$g = a + r \cos(\sigma + \theta_i) = x_i - r \cos(\theta_i) + r \cos(\sigma + \theta_i)$$

$$h = b + r \sin(\sigma + \theta_i) = y_i - r \sin(\theta_i) + r \sin(\sigma + \theta_i)$$



$$\alpha = -\arctan(r/l_1), \gamma = \arctan2(f-b, a-e)$$

$$\Rightarrow \beta = \arctan2(f-b, a-e) + \arctan(r/l_1)$$

$$\cos\beta = \frac{g-e}{l_2} \Rightarrow g = e + l_2 \cos\beta$$

$$\Rightarrow g = x_f - r \cos(\theta_f) + l_2 \cos(\beta)$$

From before: $g = x_i - r \cos\theta_i + r \cos(\sigma + \theta_i)$

$$\Rightarrow x_i - r \cos(\theta_i) + r \cos(\sigma + \theta_i) = x_f - r \cos(\theta_f) + l_2 \cos(\beta)$$

$$\Rightarrow \cos(\sigma + \theta_i) = \frac{1}{r} [x_f - x_i + r \cos(\theta_i) - r \cos(\theta_f) + l_2 \cos(\beta)]$$

$$= \frac{x_f - x_i + l_2 \cos(\beta)}{r} + \cos(\theta_i) - \cos(\theta_f)$$

$$\Rightarrow \sigma + \theta_i = \cos^{-1} \left(\frac{x_f - x_i + l_2 \cos(\beta)}{r} + \cos(\theta_i) - \cos(\theta_f) \right)$$

$$\Rightarrow \sigma = \cos^{-1} \left(\frac{x_f - x_i + l_2 \cos(\beta)}{r} + \cos(\theta_i) - \cos(\theta_f) \right) - \theta_i$$

$$\Rightarrow \delta = \theta_f - \theta_i - \sigma$$

Known: $r, d, R_w, \dot{\omega}_0, \nabla, \delta, l,$

Assumption: Outside wheels (the ones that will be rotating the fastest) have $\dot{\omega}_0 = \dot{\omega}_{\max}$

Find: * Δt for both turns and linear move

* Angular velocity of inside wheels for both turns

Let S be the arc length traveled during a turn.

$$S_{\text{oft}} = (r+d)\nabla, \quad S_{\text{oft}} = R_w \Delta\omega_{\text{oft}}$$

$$\Delta\omega_{\text{oft}} = \dot{\omega}_{\text{oft}} \Delta t_{\text{ft}} \text{ with } \dot{\omega}_{\text{oft}} = \dot{\omega}_0$$

$$\Rightarrow \Delta t_{\text{ft}} = \Delta\omega_{\text{oft}} / \dot{\omega}_0, \quad \Delta\omega_{\text{oft}} = S_{\text{oft}} / R_w$$

$$\Rightarrow \Delta t_{\text{ft}} = S_{\text{oft}} / \dot{\omega}_0 \cdot R_w$$

$$S_{\text{ift}} = r\nabla, \quad S_{\text{ift}} = R_w \Delta\omega_{\text{ift}}$$

$$\Delta\omega_{\text{ift}} = \dot{\omega}_{\text{ift}} \Delta t_{\text{ft}} \Rightarrow \dot{\omega}_{\text{ift}} = \Delta\omega_{\text{ift}} / \Delta t_{\text{ft}}$$

$$\Rightarrow \Delta\omega_{\text{ift}} = S_{\text{ift}} / R_w \Rightarrow \dot{\omega}_{\text{ift}} = S_{\text{ift}} / R_w \cdot \Delta t_{\text{ft}}$$

For the second turn, the calculations are the same, just that S_{ost} and S_{ist} are solved with an angular displacement of δ instead of ∇ .

For the linear movement from (g,h) to (c,d), all wheels can travel at the "outside" wheel speed.

$$l_1 = R_w \Delta \omega_m \Rightarrow \Delta \omega_m = l_1 / R_w$$

$$\Delta \omega_m = \dot{\omega}_m \Delta t_m \Rightarrow \Delta t_m = \Delta \omega_m / \dot{\omega}_m$$

$$\Rightarrow \Delta t_m = l_1 / R_w \cdot \dot{\omega}_m$$