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Problem 1.

Question 1.1

$$\dot{z}(t) = A(\theta(t))u$$

$$\dot{z} = \begin{bmatrix} \text{speed\_linear} \cdot \cos(\theta) \\ \text{speed\_linear} \cdot \sin(\theta) \\ \text{speed\_angular} \end{bmatrix} \begin{matrix} (1) \\ (2) \\ (3) \end{matrix} \qquad A(\theta(t)) = \frac{k}{2}\begin{bmatrix} \cos(\theta(t)) & \cos(\theta(t)) \\ \sin(\theta(t)) & \sin(\theta(t)) \\ -\frac{1}{d} & \frac{1}{d} \end{bmatrix} \qquad u = \begin{bmatrix} u_{LW} \\ u_{RW} \end{bmatrix}$$

obtain u_{LW} and u_{RW} as a function of speed_linear, speed_angular, k, and d

$$(1) \quad \text{speed\_linear} \cdot \cancel{\cos(\theta)} = \frac{k}{2}\cancel{\cos(\theta(t))} \cdot u_{LW} + \frac{k}{2}\cancel{\cos(\theta(t))} \cdot u_{RW}$$

$$\left[\text{speed\_linear} = \frac{k}{2} u_{LW} + \frac{k}{2} u_{RW}\right] \frac{2}{k}$$

$$\frac{2}{k} \cdot \text{speed\_linear} = u_{LW} + u_{RW}$$

Same!

$$(2) \quad \text{speed\_linear} \cdot \cancel{\sin(\theta)} = \frac{k}{2}\cancel{\sin(\theta(t))} \cdot u_{LW} + \frac{k}{2}\cancel{\sin(\theta(t))} \cdot u_{RW}$$

$$\frac{2}{k} \text{speed\_linear} = u_{LW} + u_{RW}$$

$$(3) \quad \left[\text{speed\_angular} = \frac{k}{2} \cdot \frac{-1}{d} \cdot u_{LW} + \frac{k}{2} \cdot \frac{1}{d} \cdot u_{RW}\right] \frac{2d}{k}$$

$$\frac{2d}{k} \cdot \text{speed\_angular} = -u_{LW} + u_{RW} = u_{RW} - u_{LW}$$

effects:

$$\left.\begin{matrix} k\downarrow, d\downarrow: \text{speed\_linear} \uparrow, \\ k\downarrow, d\uparrow: \text{speed\_linear} \uparrow, \\ k\uparrow, d\downarrow: \text{speed\_linear} \downarrow, \\ k\uparrow, d\uparrow: \text{speed\_linear} \downarrow, \end{matrix}\right\} \text{speed\_angular} \downarrow \text{ if } \frac{2d}{k} < 1, \ \uparrow \text{ if } \frac{2d}{k} > 1$$