Robot turning

Understanding how your robot is turning

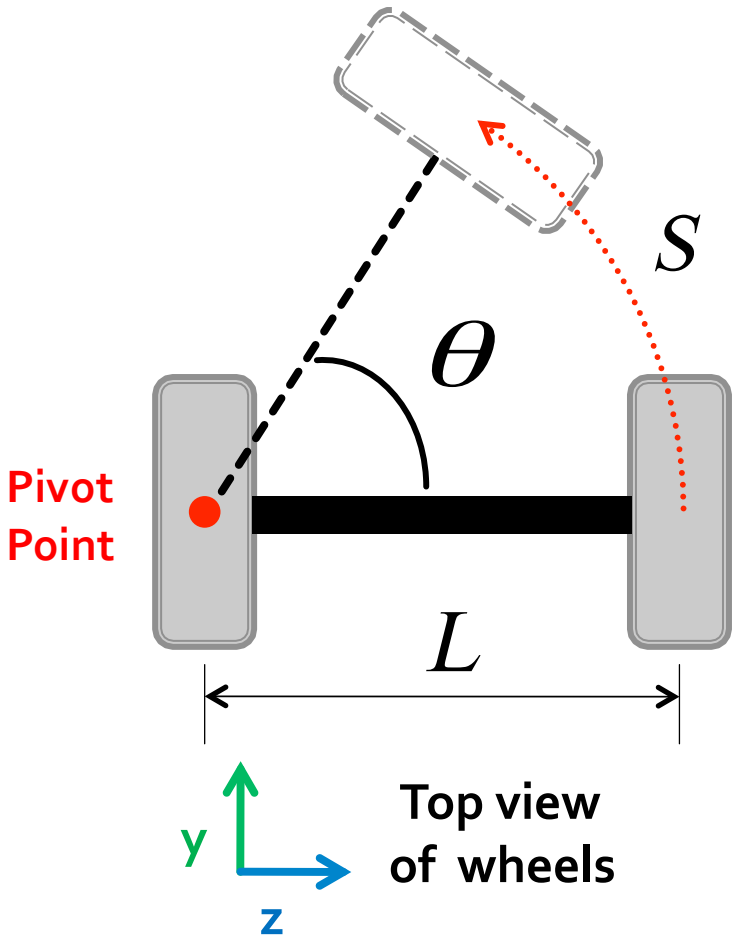
Background

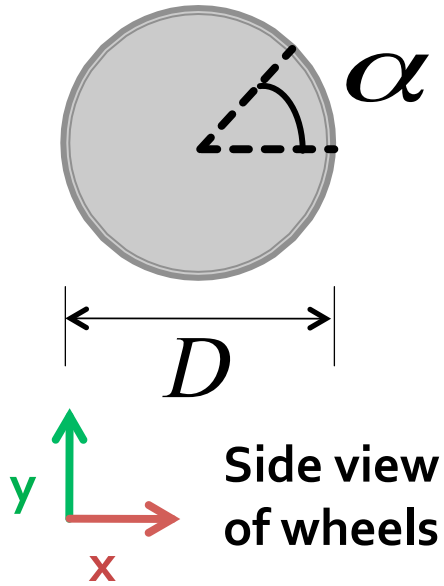
- In LEGO MINDSTORMS NXT software, we are able to control (input) the movement of the individual motor or wheel.
- How does it relate to movement of the Tribot when it is turning
- Most students do guess and check approach
- If one parameter change, need to redo guess and check
- Would like robot to pivot or do an arc turn to desire angle with less (or no) guessing

Types of Turns

- To pivot you could stop one wheel and continue to run the other but for how long?
- To do a arc turn you need to know how wide you want to go, what tire to slow down, what tire to speed up and the distance each should travel.
- How would you go about doing such a thing? Stay tuned to find out.

Pivot Turn Around One Wheel





$$S = \theta L = \alpha \frac{D}{2}$$

$$\theta = \frac{\alpha D}{2L}$$ Eq. (1)

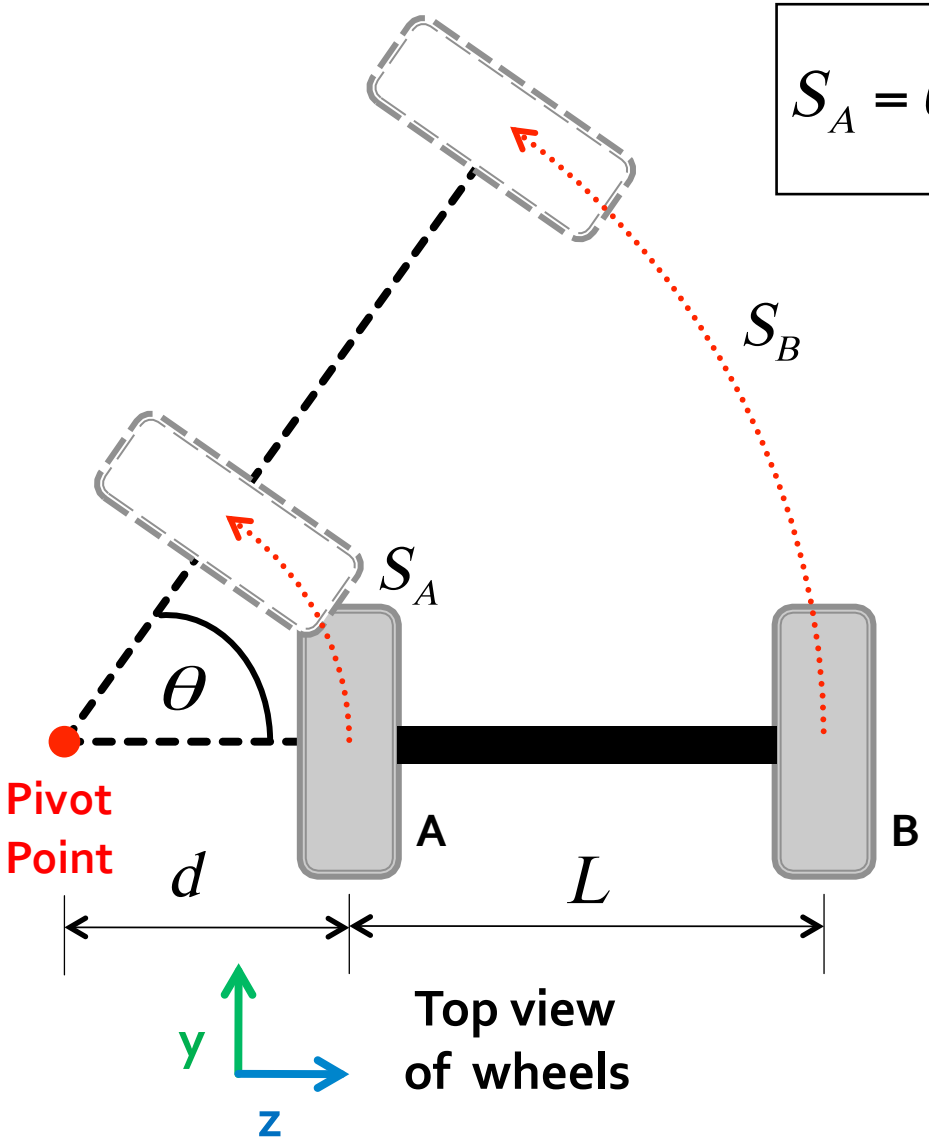
The ratio of diameter of the wheel over the distance between two wheels needs to be considered in the design

General Arc Turn

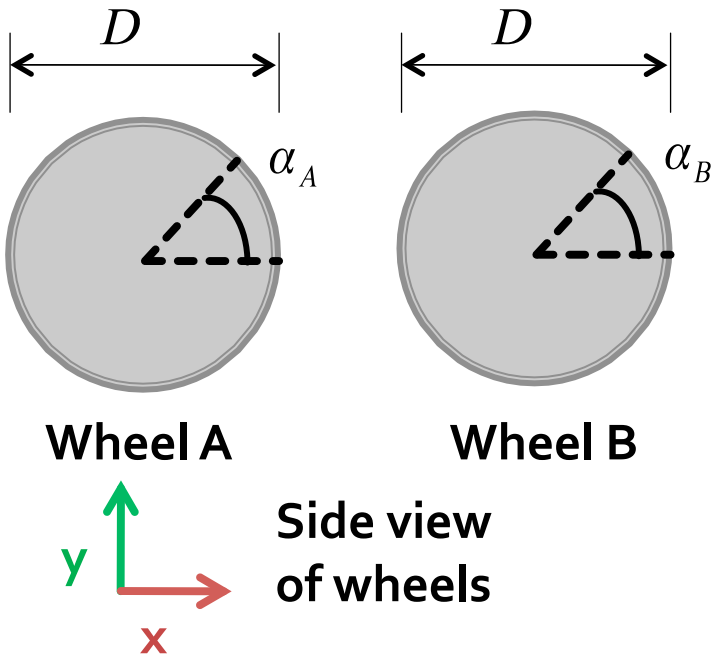
$$S_A = \theta d = \alpha_A \frac{D}{2}$$

$$S_B = \theta(d + L) = \alpha_B \frac{D}{2}$$

$$\theta = \frac{\alpha_B D}{2(d + L)} = \frac{\alpha_A D}{2d}$$ Eq. (2)



Top view of wheels

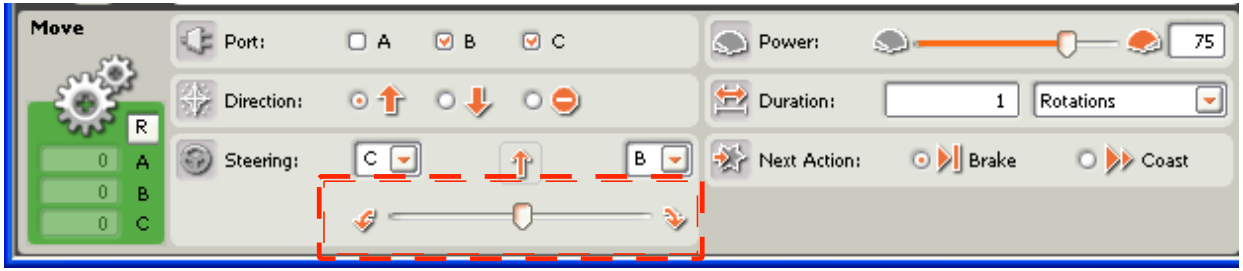


Side view of wheels

Rearranging terms give the following ratio

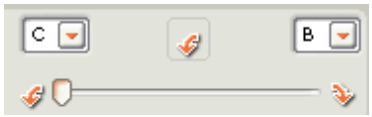
$$\frac{S_A}{S_B} = \frac{\alpha_A}{\alpha_B} = \frac{d}{(d+L)}$$

This ratio is the Turn Adjusting Bar (TAB), red dotted rectangle.



When $d = 0$ $\frac{\alpha_A}{\alpha_B} = 0$ recover pivot turn, Eq. (1) $\theta = \frac{\alpha D}{2L}$

TAB switch all the way left



When $d \rightarrow \infty$ Straight movement $\frac{\alpha_A}{\alpha_B} = 1$

TAB switch stay in the middle

The ratio $\frac{\alpha_A}{\alpha_B}$ is TAB from NXT software. There are 11 steps to one side of the TAB (total 21 steps - 10 steps to the right, 10 steps to the left and the middle one) and the ratio is from 0 to 1. Therefore, each step is the increment of 0.1. By using above equations, you can design you tribot turn more efficiently.

Ackowlegement

- Jasen Carroll, Jon Cuccinello and Henry Wong from Engr102-sec026-group 4 put this power point together