Duayenler Ltd. Şti.
Members :
Enes Taştan, 2068989, 0543 683 4336
Halil Temurtaş, 2094522, 0531 632 2194
Sarper Sertel, 2094449, 0542 515 6039
Erdem Tuna, 2167419, 0535 256 3320
İlker Sağlık, 2094423, 0541 722 9573

April 09, 2019

April 02 - April 08 Weekly Report

1 Progress

- Step response of the car is tried to be obtained to find the model of the vehicle.

2 Plans

- Further PID controller design parameter tuning for controller subsystem with varying base speed.

Appendices

where

- v_r is current position linear velocity
- w_r is current angular velocity
- v_R and right wheel linear velocity
- v_L and left wheel linear velocity
- $w_R = \frac{v_R}{r}$ and right wheel angular velocity
- $w_L = \frac{v_L}{r}$ and left wheel angular velocity

and their relation between linear speed and angular velocity of the vehicle with respect to right and left wheel are as follows [1] [2]

$$v_{vehicle} = \frac{v_R + v_L}{2}$$

$$w_{vehicle} = \frac{v_R - v_L}{r}$$

In our case we could you constant base speed $V = \frac{v_R + v_L}{2}$ and $\Delta V = v_R - v_L$. Thus,

$$v_R = V + \Delta V/2$$

$$v_L = V - \Delta V/2$$

$$\dot{q_r} = \begin{bmatrix} \dot{x_r} \\ \dot{y_r} \\ \dot{\theta_r} \end{bmatrix} = \begin{bmatrix} \cos(\theta_r) & 0 \\ \sin(\theta_r) & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} v_r \\ w_r \end{bmatrix}$$

$$\dot{q_d} = \begin{bmatrix} \dot{x_d} \\ \dot{y_d} \\ \dot{\theta_d} \end{bmatrix} = \begin{bmatrix} \cos(\theta_d) & 0 \\ \sin(\theta_d) & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} v_d \\ w_d \end{bmatrix}$$

$$q = q_r - q_d$$

where $v = v_r - v_d$ and $w = w_r - w_d$

[1] https://www.researchgate.net/publication/252016633_Trajectory-tracking_and_discrete-time_sliding-mode_control_of_wheeled_mobile_robots

[2] https://www.dis.uniroma1.it/ labrob/pub/papers/Ramsete01.pdf

Enes Taştan, 2068989, 0543 683 4336
Halil Temurtaş, 2094522, 0531 632 2194
Sarper Sertel, 2094449, 0542 515 6039
Erdem Tuna, 2167419, 0535 256 3320
İlker Sağlık, 2094423, 0541 722 9573

$$\dot{q} = \begin{bmatrix} \dot{x_r} - \dot{x_d} \\ \dot{y_r} - \dot{y_d} \\ \dot{\theta}_r - \dot{\theta}_d \end{bmatrix} = \begin{bmatrix} 0 & 0 & -v_d \sin(\theta_d) \\ 0 & 0 & +v_d \cos(\theta_d) \\ 0 & 0 & 0 \end{bmatrix} q + \begin{bmatrix} \cos(\theta_d) & 0 \\ \sin(\theta_d) & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} v \\ w \end{bmatrix}$$

through a rotation matrix

$$q_R = \begin{bmatrix} \cos(\theta_d) & \sin(\theta_d) & 0 \\ -\sin(\theta_d) & \cos(\theta_d) & 0 \\ 0 & 0 & 1 \end{bmatrix} q$$

$$\dot{q_R} = \begin{bmatrix} 0 & w_d & 0 \\ -w_d & 0 & +v_d \\ 0 & 0 & 0 \end{bmatrix} q_R + \begin{bmatrix} 1 & 0 \\ 0 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} v \\ w \end{bmatrix}$$

Error for a position

$$\begin{bmatrix} x_e \\ y_e \\ \theta_e \end{bmatrix} = \begin{bmatrix} \cos(\theta_d) & \sin(\theta_d) & 0 \\ -\sin(\theta_d) & \cos(\theta_d) & 0 \\ 0 & 0 & -1 \end{bmatrix} \begin{bmatrix} x_d - x_r \\ y_d - y_r \\ \theta_d - \theta_r \end{bmatrix}$$

$$\begin{bmatrix} x_e \\ y_e \\ \theta_e \end{bmatrix} = \begin{bmatrix} y_1 \cos(\beta) \\ y_1 * \sin(\beta) + 50/\cos(\beta) \\ \beta \end{bmatrix}$$

where β and y_1 are measurable quantities

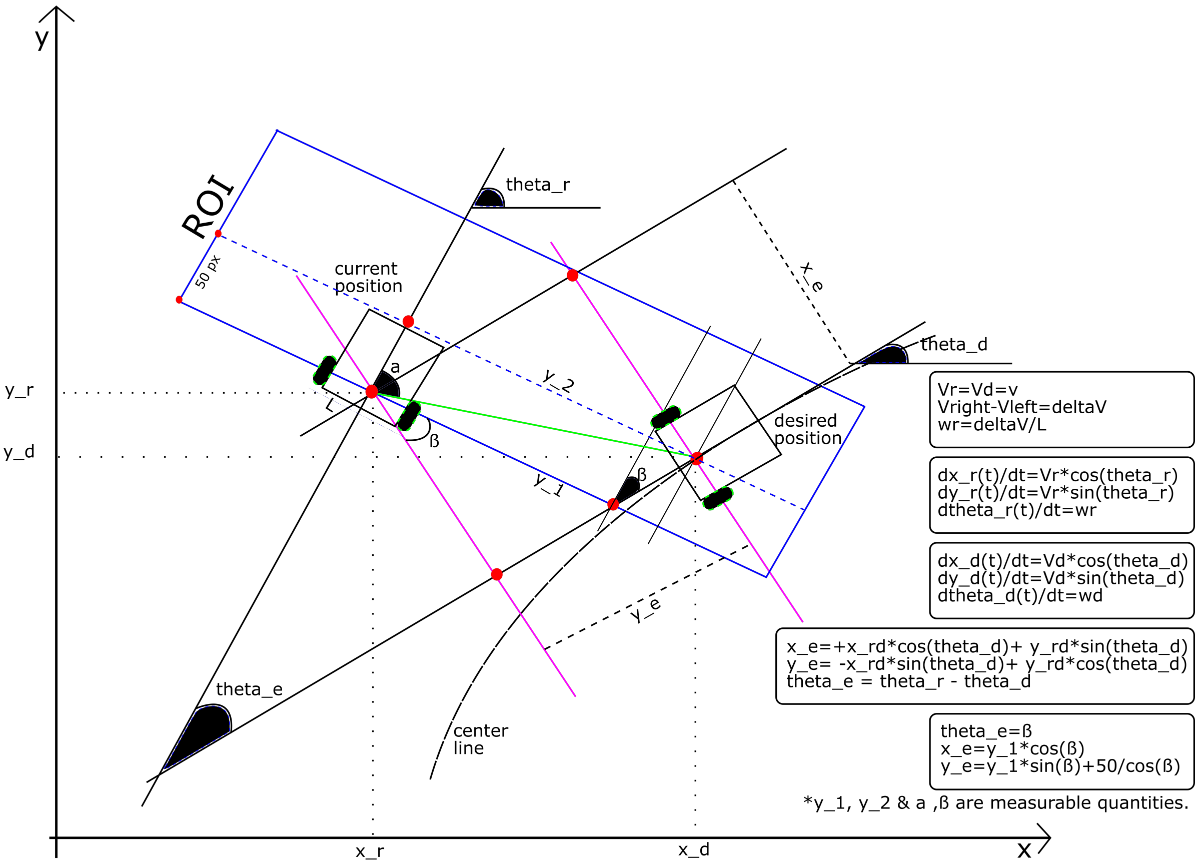

Figure 1: Inverse Kinematic Model for the Differential Drive Motor