VehicleProject

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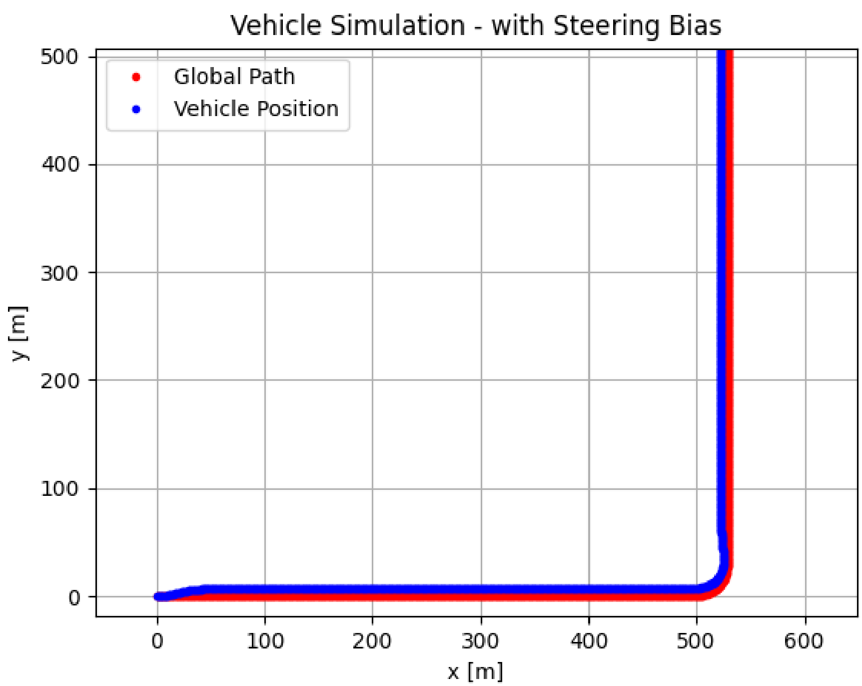
Theoretical Questions Answers:

1. In case of a bias in the steering system, we will get a lateral error from the reference path. Showing a simulation result plot for 5 [deg] bias:



   We get ~ 7 [m] bias from the path.

2. In case of velocities faster than $\sim 5\left[\frac{\text{m}}{\text{s}}\right]$, dynamics effects are more dominant and should be taken into account. Therefore, we will calculate the accelerations - linear and angular - from the forces and torques that applying on the vehicle. Forces and torques that can be take into account in faster speeds - drag and slippage friction.

3. the integration method based on the limis definition:

$$\frac{\mathrm{d}f}{\mathrm{d}t} = \lim_{\Delta t \to 0} \frac{f(t+\Delta t) - f(t)}{\Delta t}$$

Therefore, i chose an integration method of:

$$x(k+1) = x(k) + \dot{x}(k) \cdot \Delta t$$

I chose an integration step of $\Delta t = 1 \times 10^{-}3$ [s] for accurate enough calculations.

Extra: Steering Step Response:

As suggested, i modeled the steering systems dynamics with 2nd order system + 200 ms delay:

$$\frac{\delta(s)}{\delta_{\text{cmd}}(s)} = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2} \cdot e^{-0.2s}$$

Where,

$$\omega_n = 2\pi \cdot 10 \left[\frac{\text{rad}}{\text{s}}\right] \quad , \quad \zeta = 1$$

As well as saturation on the velocity and the angle where modeled as requested. The step response of the Steering system: