# MJLS Vehicle Platooning: double integrators

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$$\boxed{\begin{aligned}\dot{x} &= v \\ \dot{v} &= u\end{aligned}}$$

$u = L(r - x) - Lv$ $\leftarrow$ Protocol

$$\boxed{\begin{aligned}\dot{x} &= v \\ \dot{v} &= -Lx - Lv + Lr\end{aligned}}$$

With ZOH exact discretization,

$$x_{k+1} = \begin{bmatrix} I & T \cdot I \\ 0 & I \end{bmatrix} x_k + \begin{bmatrix} \frac{T^2}{2} \cdot I \\ T \cdot I \end{bmatrix} u_k \qquad x_k = \begin{bmatrix} x_k^1 \\ x_k^2 \end{bmatrix} \begin{matrix} \leftarrow \text{pos} \\ \leftarrow \text{vel} \end{matrix}$$

$$\boxed{u_k = k_p L (r_k - x_k^1) - k_d \cdot L x_k^2}$$

$$\underbrace{x_{k+1} = \left[\begin{array}{c|c} I - \frac{k_p \cdot T^2}{2} L_k & T \cdot I - \frac{k_d \cdot T^2}{2} L_k \\ \hline -k_p \cdot T \cdot L_k & I - k_d \cdot T \cdot L_k \end{array}\right] x_k + \begin{bmatrix} \frac{k_p \cdot T^2}{2} \cdot L_k \\ T \cdot k_p \cdot L_k \end{bmatrix} r_k}_{}$$

MJLS for analysis & simulation