

# LAB2

## EL2700 - Model Predictive Control

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### 1 Vehicle model

The first step of designing a good MPC is to obtain a good model of the system which is to be controlled.

#### 1.1 Continuous time system

The bicycle model in continuous time

$$\begin{bmatrix} \dot{x}(t) \\ \dot{y}(t) \\ \dot{v}(t) \\ \dot{\psi}(t) \end{bmatrix} = \begin{bmatrix} v(t) \cos(\psi(t) + \beta(t)) \\ v(t) \sin(\psi(t) + \beta(t)) \\ a(t) \\ \frac{v(t)}{l_r} \sin(\beta(t)) \end{bmatrix} \quad (1)$$

#### 1.2 Discrete time system

In order to implement the MPC the model needs to be discretized. This is here done by the explicit Euler method, which yields the system:

$$\mathbf{z}(k+1) = \mathbf{z}(k) + T_s f(\mathbf{z}, \mathbf{u}) \quad (2)$$