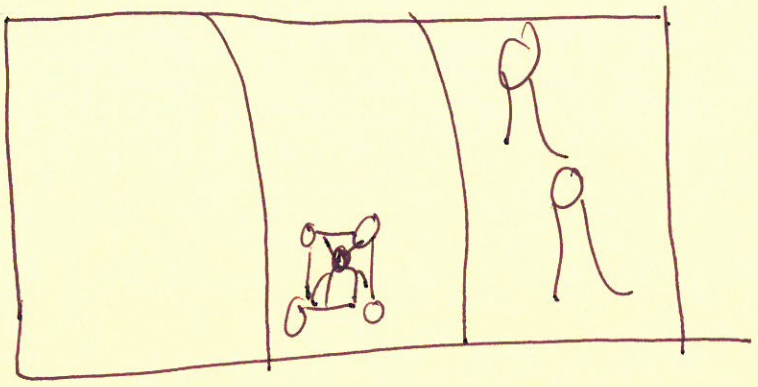
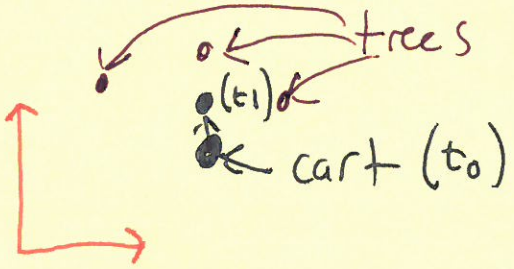
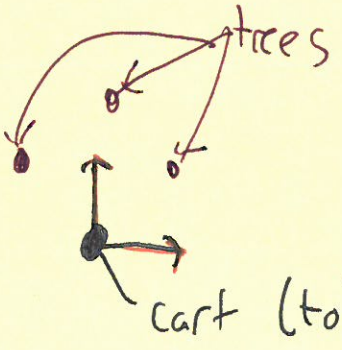
coordinate transforms

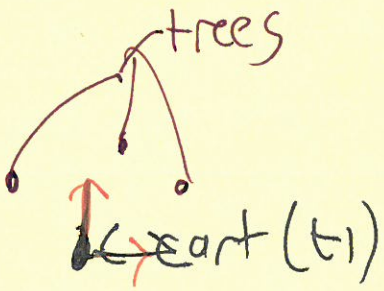


Moving between coordinate systems

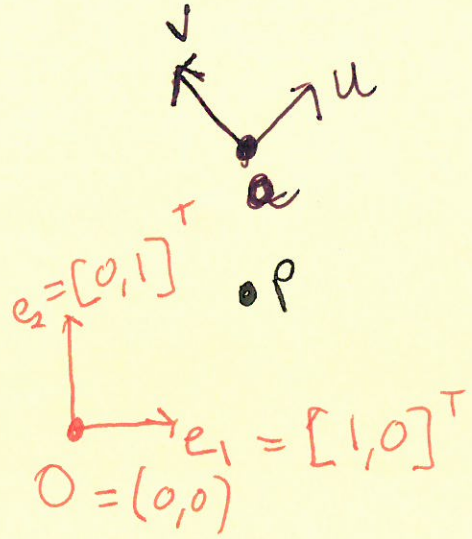




⇒ tire



(7, 5) in cartesian coordinates?



$$p = O + p_x e_1 + p_y e_2$$

$$p = a + p_u u + p_v v$$

Frame-to-cannonical

$$\begin{bmatrix} p_x \\ p_y \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & a_x \\ 0 & 1 & a_y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} u_x & v_x & 0 \\ u_y & v_y & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} p_u \\ p_v \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} u_x & v_x & a_x \\ u_y & v_y & a_y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} p_u \\ p_v \\ 1 \end{bmatrix}$$

M

Cannonical to frame

apply M^{-1}

$$\begin{bmatrix} p_u \\ p_v \\ 1 \end{bmatrix} = \begin{bmatrix} u_x & u_y & 0 \\ v_x & v_y & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & -a_x \\ 0 & 1 & -a_y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} p_x \\ p_y \\ 1 \end{bmatrix}$$

$$= M^{-1} \begin{bmatrix} p_x \\ p_y \\ 1 \end{bmatrix}$$