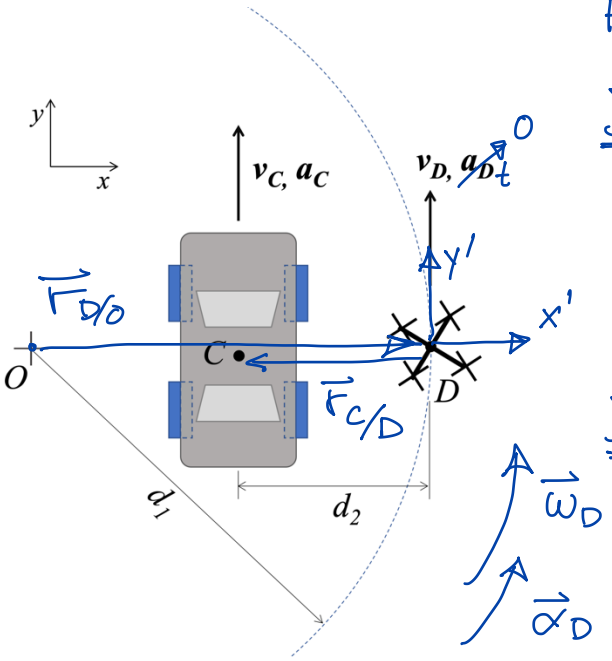
A camera drone, *D*, flies over a car race in a curved trajectory (centre *O*) with a constant ground-speed velocity of v_D = 9 m/s. At the moment shown, car *C* is travelling with velocity of v_C = 12 m/s and an acceleration of a_C = 2 m/s^2 as shown. Assume d_1 = 7.5 m, d_2 = 3 m.

a) Find the velocity of the car as observed by the camera on drone D at this instant.

b) Find the acceleration of the car as observed by the camera on drone D at this instant.



Find $(\vec{v}_{C/D})_{rel}$ & $(\vec{a}_{C/D})_{rel}$

$\vec{\Omega}$: $\vec{v}_D = \vec{v}_O + \vec{\omega}_D \times \vec{r}_{D/O}$

$v_D \hat{j} = \omega_D \hat{k} \times d_1 \hat{i}$

$v_D \hat{j} = \omega_D d_1 \hat{j} \Rightarrow \omega_D = \frac{v_D}{d_1} = \frac{9\,m/s}{7.5\,m}$

$\vec{\omega}_D = 1.2\,rad/s = \vec{\Omega}$

$\dot{\vec{\Omega}}$: $\vec{a}_D = \vec{a}_O + \vec{\alpha}_D \times \vec{r}_{D/O} - \omega_D^2 \vec{r}_{D/O}$

$\vec{a}_D = a_{Dx}\hat{i} + 0\hat{j}$ $(\vec{a}_{Dt} = 0)$

$\Rightarrow a_{Dx}\hat{i} = \underbrace{\alpha_D \hat{k} \times d_1 \hat{i}}_{\alpha_D d_1 \hat{j}} - \omega_D^2 d_1 \hat{i}$

$\hat{j}$: $0 = \alpha_D d_1 \Rightarrow \alpha_D = 0 = \dot{\Omega}$

$\vec{v}_C = \vec{v}_D + \vec{\Omega} \times \vec{r}_{C/D} + (\vec{v}_{C/D})_{rel}$

$v_C \hat{j} = v_D \hat{j} + \omega_D \hat{k} \times d_2(-\hat{i}) + (\vec{v}_{C/D})_{rel}$

$12\,m/s\,\hat{j} = 9\,m/s\,\hat{j} - (1.2\,rad/s)(3\,m)\hat{j} + (\vec{v}_{C/D})_{rel}$

$$(\vec{a}_{C/D})_{rel} = (22.32\hat{i} + 2\hat{j})\ m/s^2$$