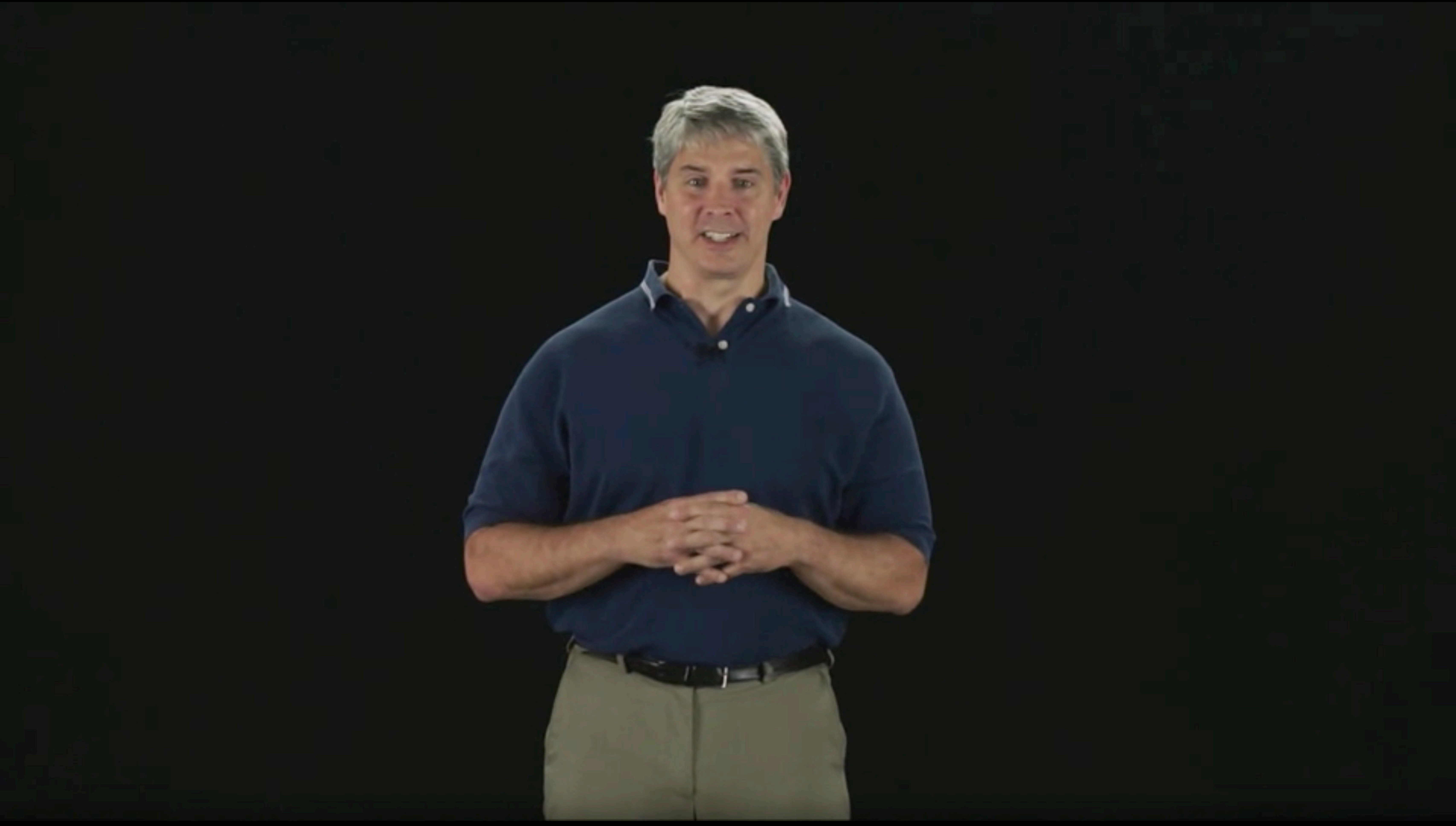
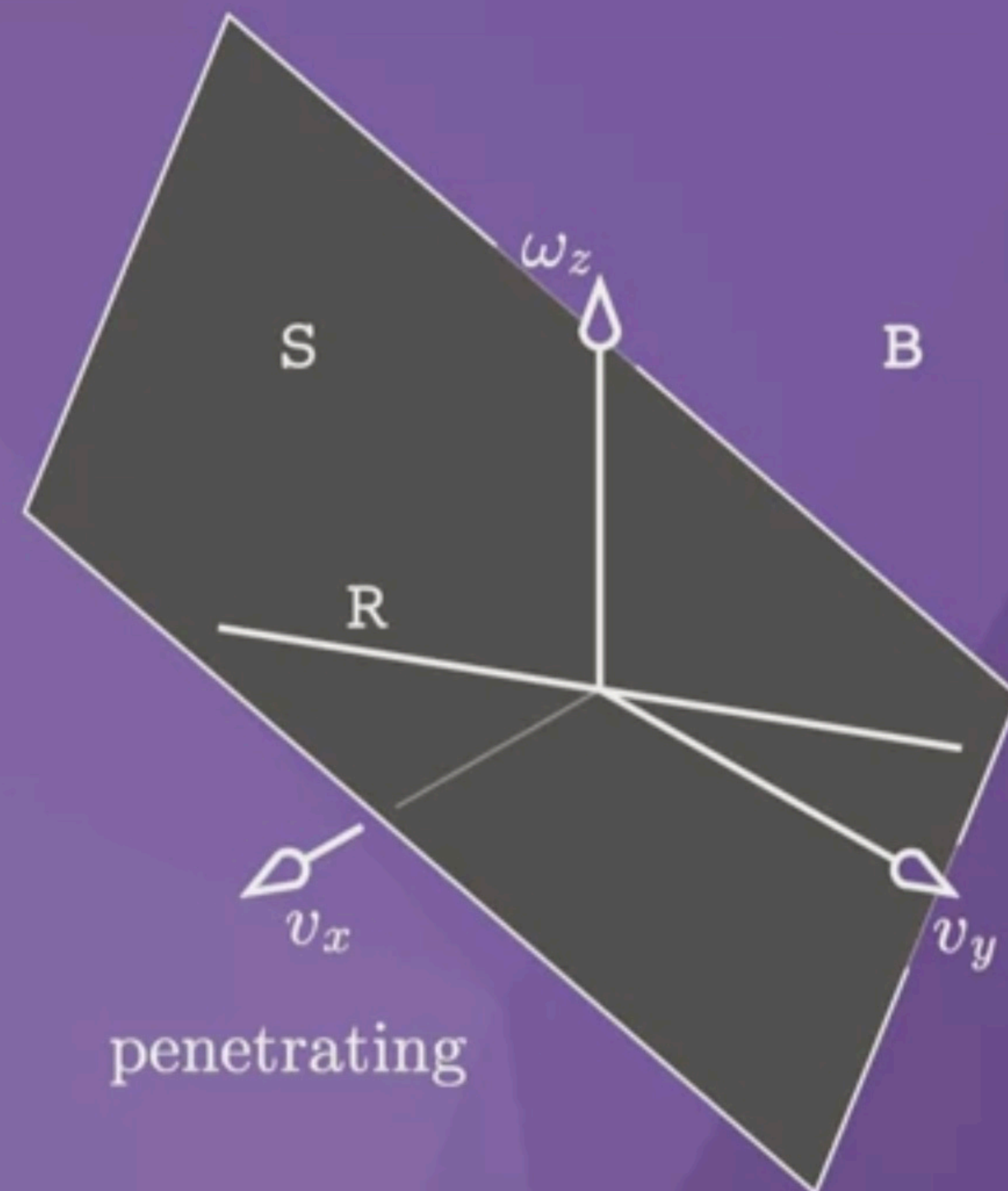


$X_A, X_B \in SE(2)$

Relative twist $\mathcal{V}_A - \mathcal{V}_B$: $\begin{bmatrix} \omega_x \\ \omega_y \\ \boxed{\begin{matrix} \omega_z \\ v_x \\ v_y \end{matrix}} \\ v_z \end{bmatrix}$



$X_A, X_B \in SE(3)$

Relative twist $\mathcal{V}_A - \mathcal{V}_B$: $\begin{bmatrix} \omega_x \\ \omega_y \\ \omega_z \\ v_x \\ v_y \\ v_z \end{bmatrix}$

For a rolling (R) contact (3 constraints):

The relative twist must lie on a 3-dimensional hyperplane of the 6-dimensional relative twist space.

4:58 / 5:41

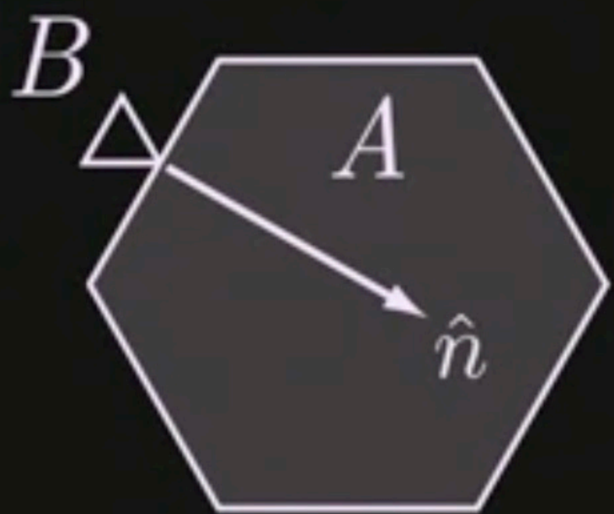
$X_A, X_B \in SE(3)$

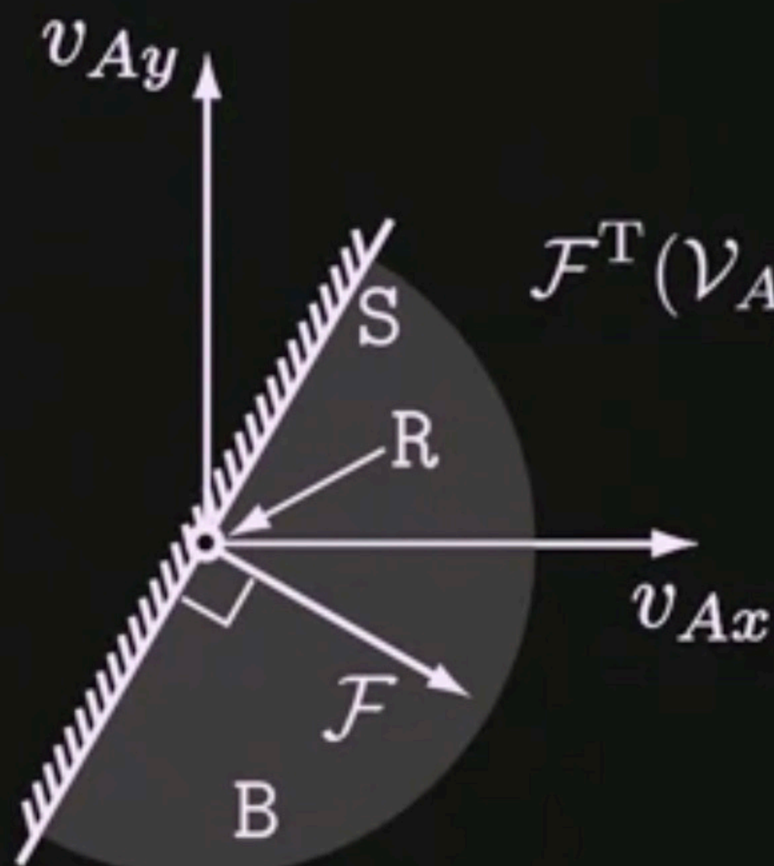
Relative twist $\mathcal{V}_A - \mathcal{V}_B$: $\begin{bmatrix} \omega_x \\ \omega_y \\ \omega_z \\ v_x \\ v_y \\ v_z \end{bmatrix}$

For a sliding (**S**) contact (1 constraint):

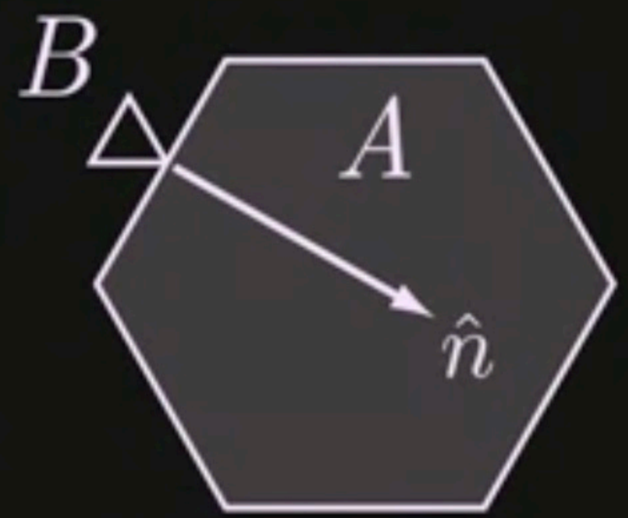
$\boxed{\text{The relative twist must lie on a 5-dimensional hyperplane of the 6-dimensional relative twist space.}}$

4:48 / 5:41

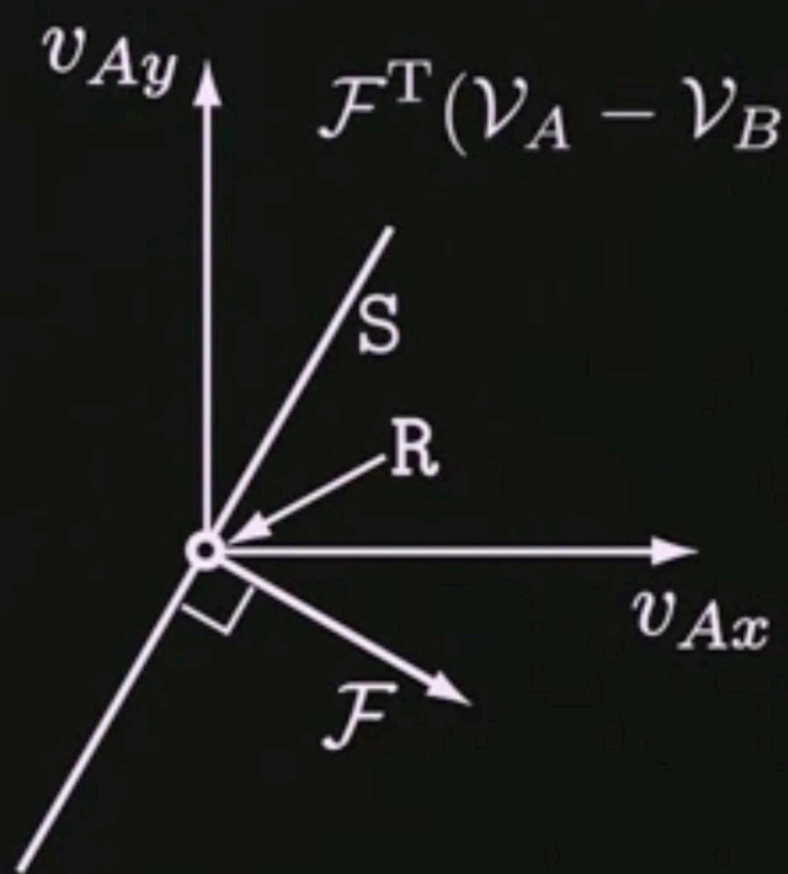


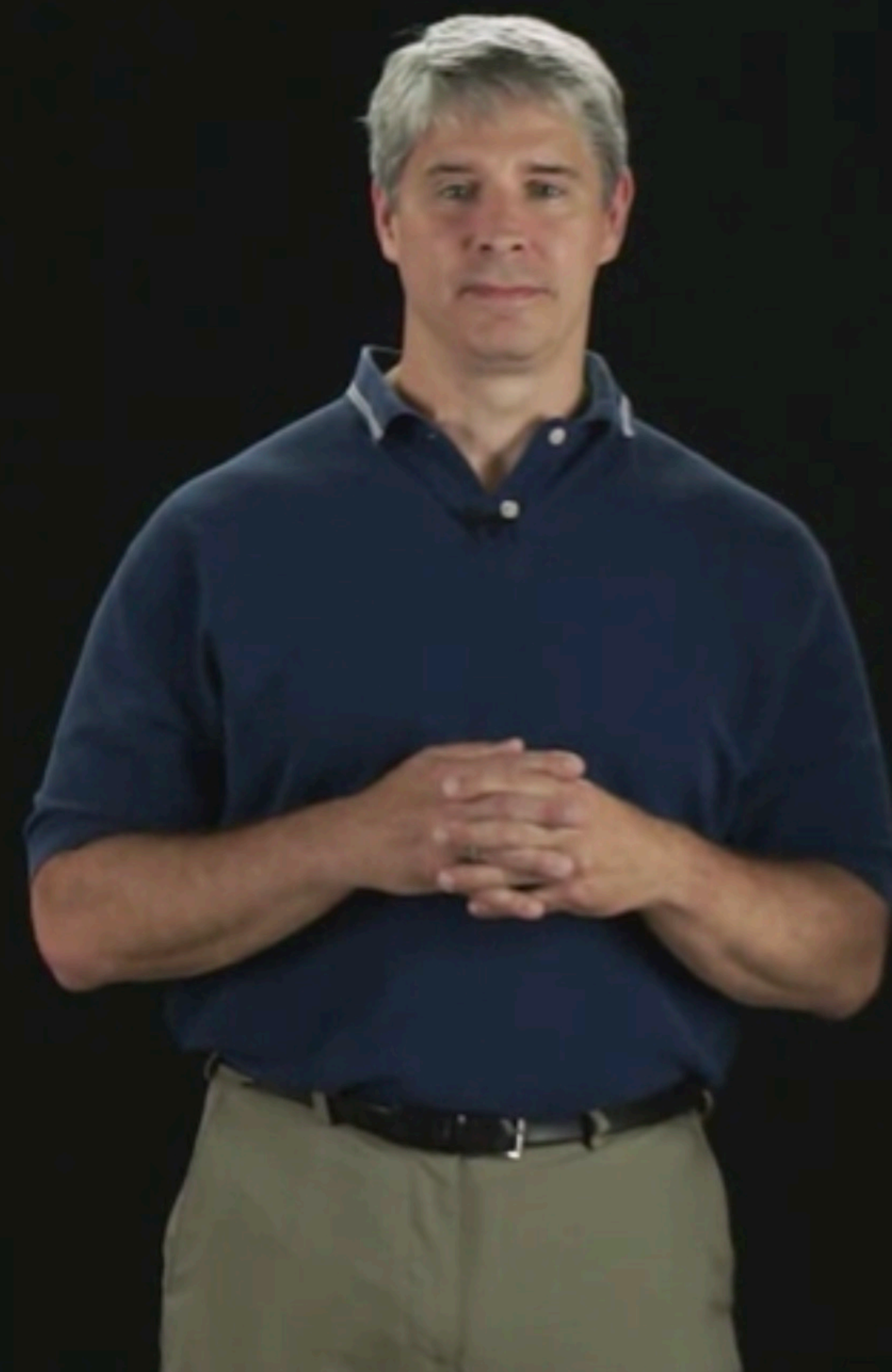


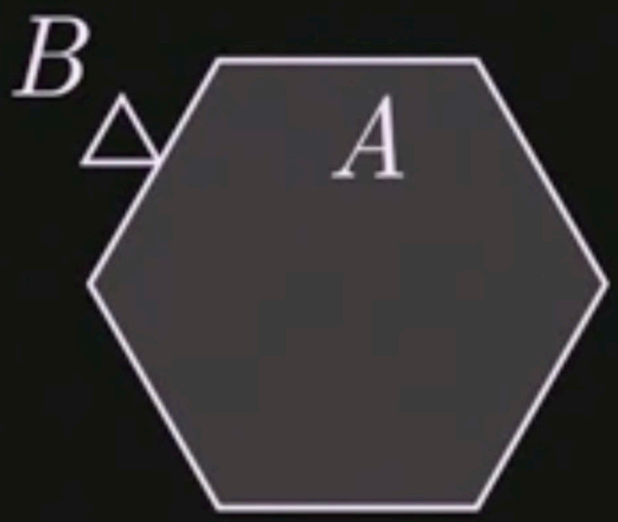
$$\mathcal{F}^{\mathrm{T}}(\mathcal{V}_A - \mathcal{V}_B) > 0$$

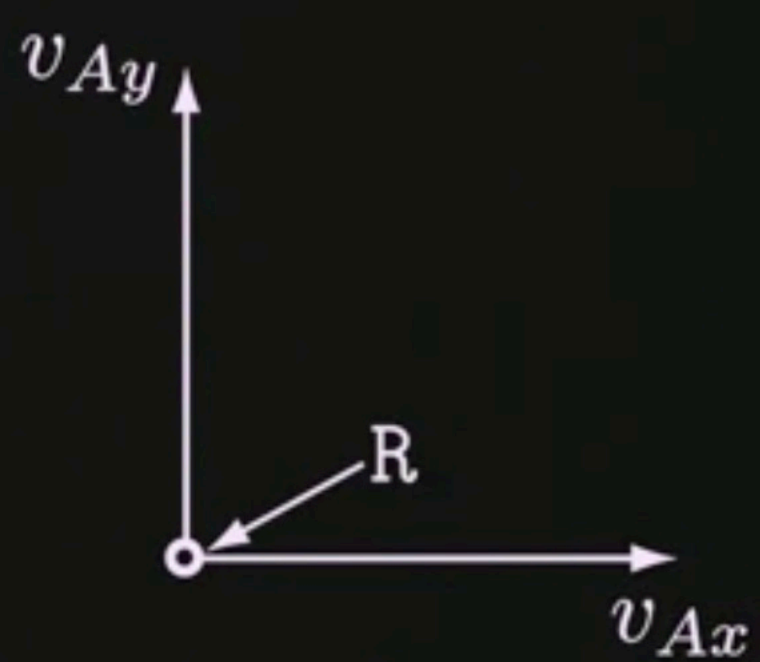


$$\mathcal{F}^{\mathrm{T}}(\mathcal{V}_A - \mathcal{V}_B) = 0$$

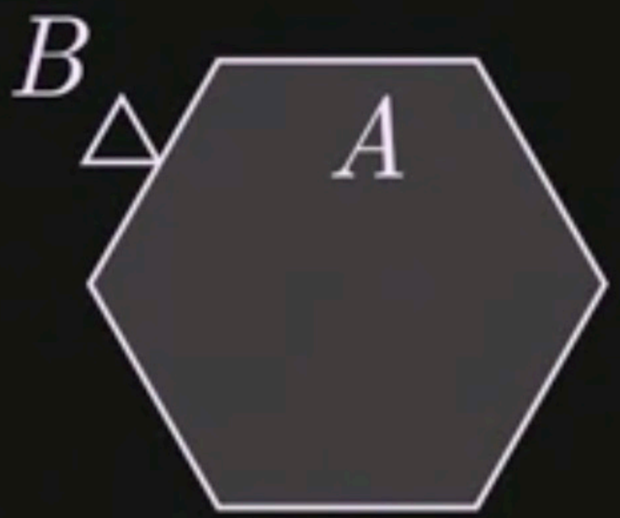


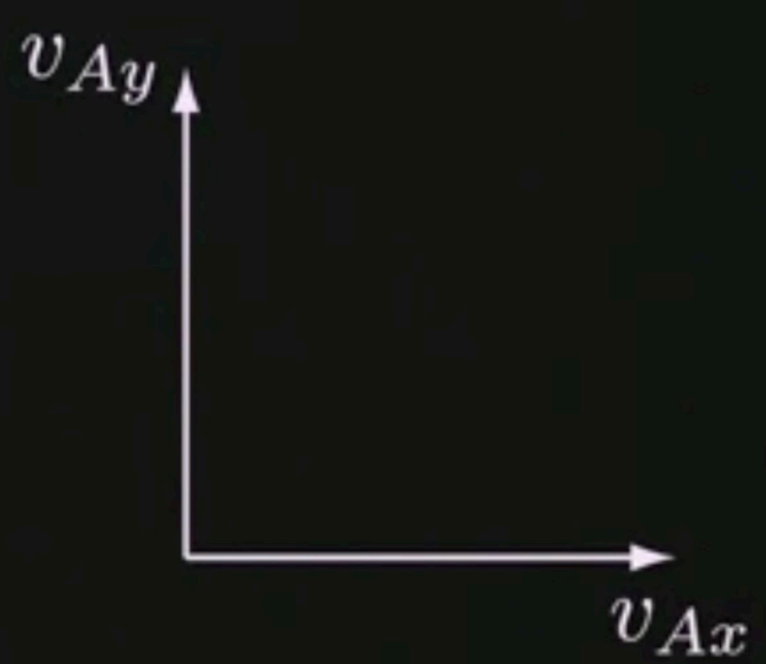






$$\dot{p}_A - \dot{p}_B = 0$$





Assuming B is stationary and A can only translate