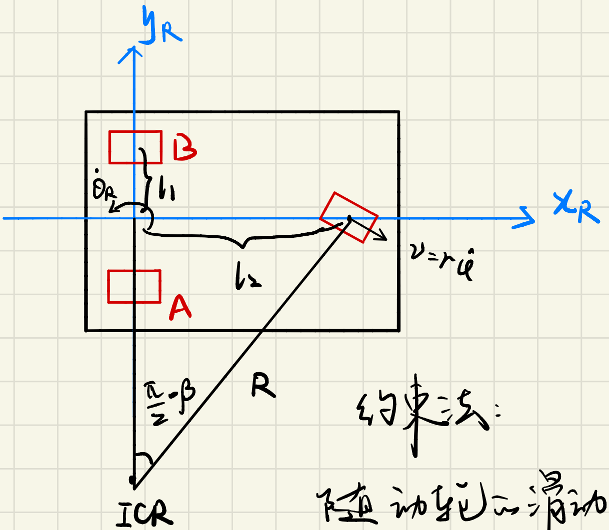
梁栩程 SZ170410221

ICR法：



由于小车可视为刚体,各点角速度相同

故有 $-R\dot{\theta}_R = v = r\dot{\varphi}$ ，又 $R\cos\beta = 2$

$$\dot{x}_R = v\sin\beta$$

$$\dot{y}_R = 0$$ （固定标准轮无法侧滑）

故有 $$\begin{bmatrix}\dot{x}_R \\ \dot{y}_R \\ \dot{\theta}_R\end{bmatrix} = \begin{bmatrix} r\dot{\varphi}\sin\beta \\ 0 \\ -\frac{r\dot{\varphi}\cos\beta}{2}\end{bmatrix}$$

约束法：

随动轮的滑动约束 $\begin{bmatrix}0 & 1 & 0\end{bmatrix} R_\theta \dot{\xi}_I = 0$

$$\Downarrow$$

$$\dot{y}_R = 0$$

主动轮的滚动约束和滑动约束分别为

$$\begin{cases}\begin{bmatrix}\sin(\alpha+\beta) & -\cos(\alpha+\beta) & -2\cos\beta\end{bmatrix} R_\theta \dot{\xi}_I = r\dot{\varphi} \\ \begin{bmatrix}\cos(\alpha+\beta) & \sin(\alpha+\beta) & 2\sin\beta\end{bmatrix} R_\theta \dot{\xi}_I = 0\end{cases}$$

∵ 主动轮 $\alpha = 0$，代入 $\alpha = 0$，$\dot{y}_R = 0$

$$\Downarrow$$

$$\begin{cases}\dot{x}_R\sin\beta - 2\dot{\theta}_R\cos\beta = r\dot{\varphi} \\ \dot{x}_R\cos\beta + 2\dot{\theta}_R\sin\beta = 0\end{cases} \Rightarrow \begin{cases}\dot{x}_R = r\dot{\varphi}\sin\beta \\ \dot{\theta}_R = -\frac{1}{2}r\dot{\varphi}\cos\beta\end{cases}$$

$$\therefore \dot{\xi}_R = \begin{bmatrix} r\dot{\varphi}\sin\beta \\ 0 \\ -\frac{1}{2}r\dot{\varphi}\cos\beta\end{bmatrix}$$