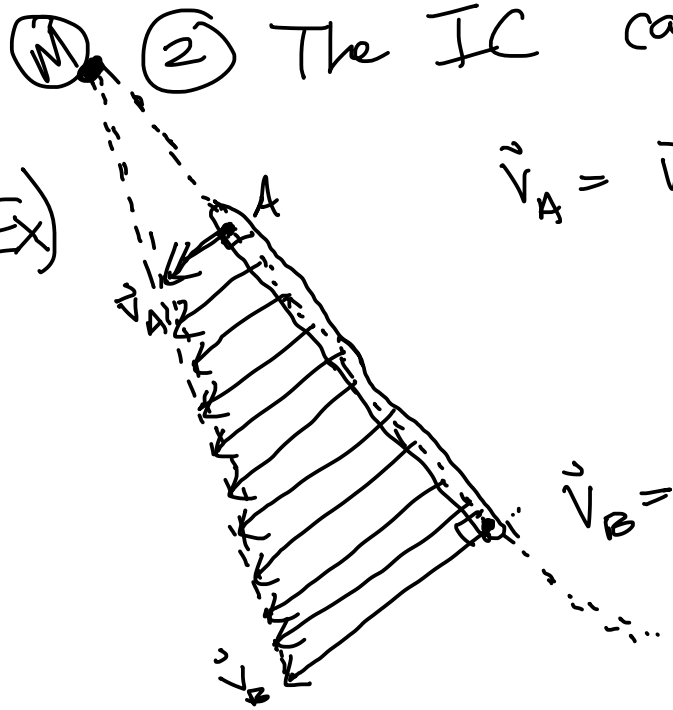
TAM 212 Class 24 : Rigid Bodies in Contact

COMING UP
* Midterm 2 Apr 9th (Thurs)
* Final May 13th (W) 1:30 – 4:30 pm

Review: Instantaneous center of velocity (M) of a R.B. is the point the R.B. is rotating about at that instant.

(1) The IC can be on or off the R.B itself
(2) The IC can vary during the motion (not nec. constant)

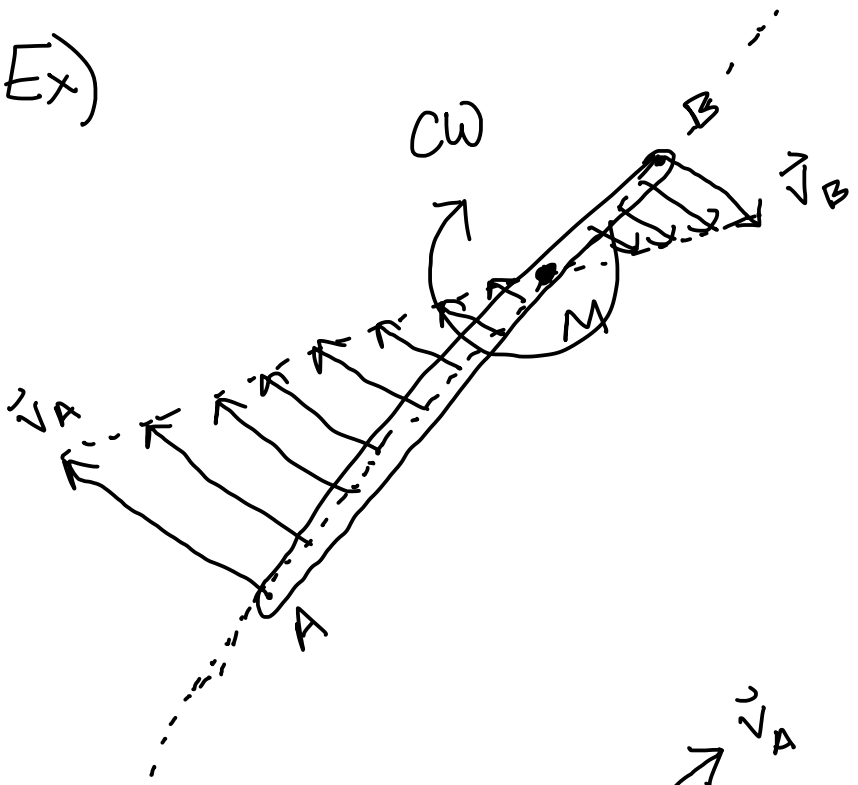
Ex)



$\vec{v}_A = \vec{\omega} \times \vec{r}_{MA}$ $\quad \vec{v}_O = \vec{\omega} \times \vec{r}_{MO}$

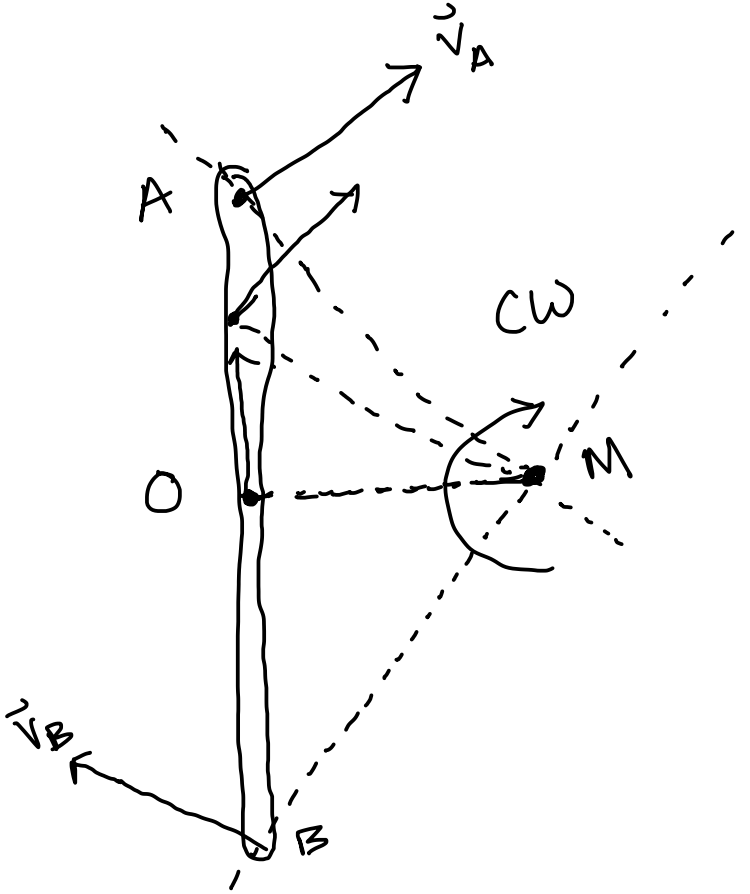
$\vec{v}_B = \vec{\omega} \times \vec{r}_{MB}$

Ex)



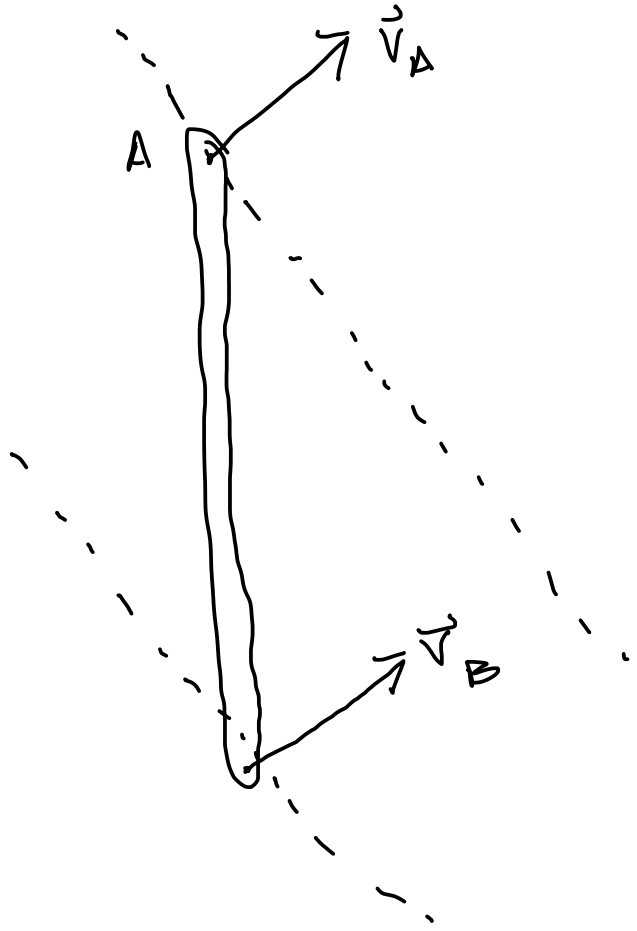
$$\vec{v}_O = \vec{\omega} \times \vec{r}_{MO}$$

Ex)



$$\vec{v}_O = \vec{\omega} \times \vec{r}_{MO}.$$

Ex)

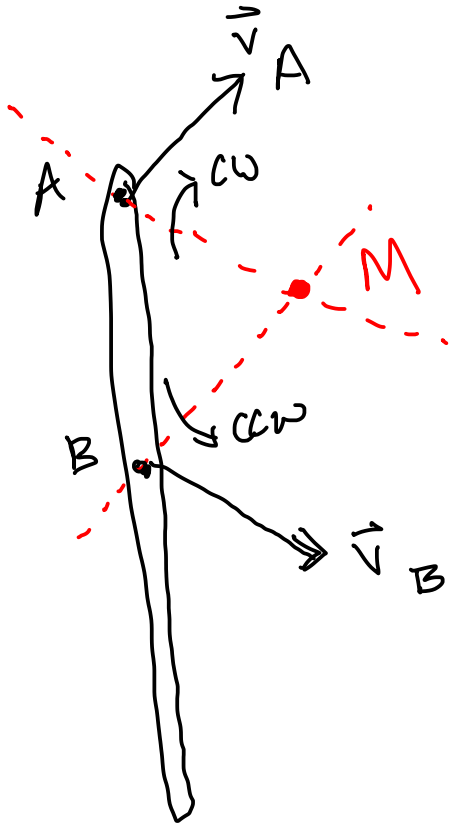


$\vec{v}_A = \vec{v}_B$

$\vec{\omega} = 0\,\hat{k}$ rad/sec

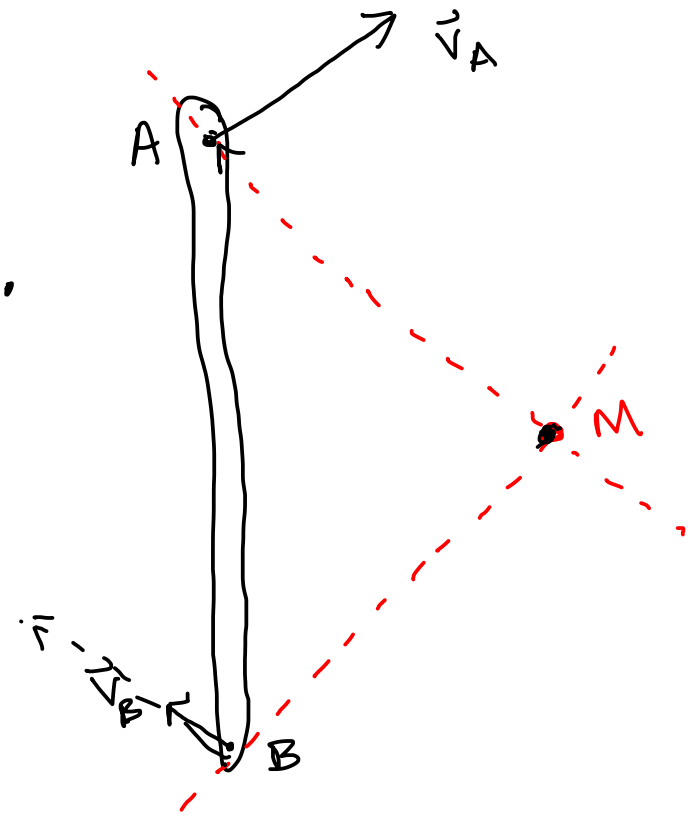
Ex)

Not possible!



There is no possible $\vec{\omega}$ that is consistent with $\vec{v}_A$, $\vec{v}_B$

Ex)



Not possible!

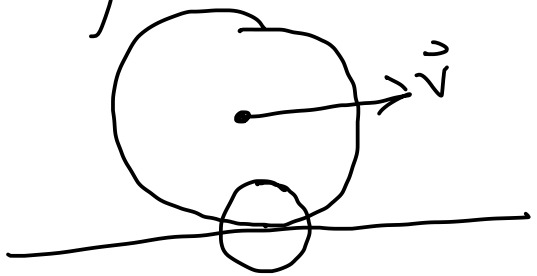
$$\vec{v}_A = \vec{\omega} \times \vec{r}_{MA}$$

$$\vec{v}_B = \vec{\omega} \times \vec{r}_{MB}$$

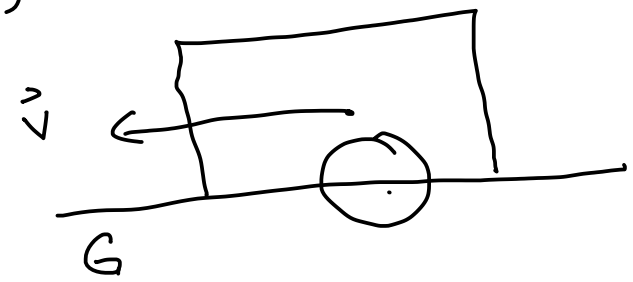
There is not one $\vec{\omega}$ that satisfies both equations

Rigid Bodies in Contact

ex) rolling wheel

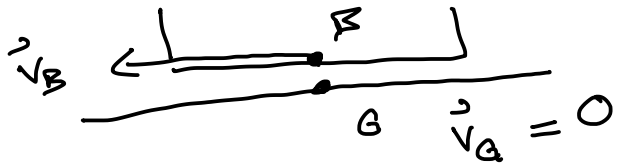


ex) SLIPPING sliding block

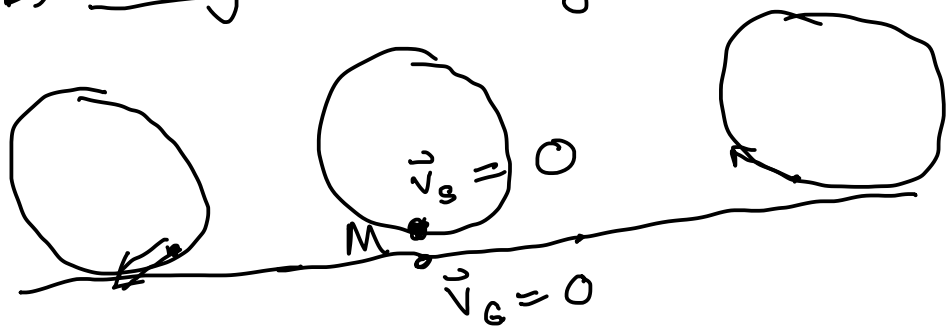


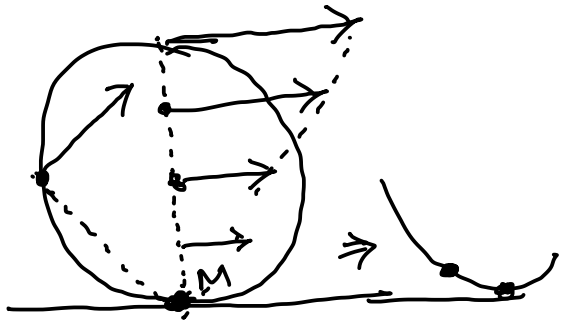
Generally two types of contact:

A) slipping: points in contact have different velocities

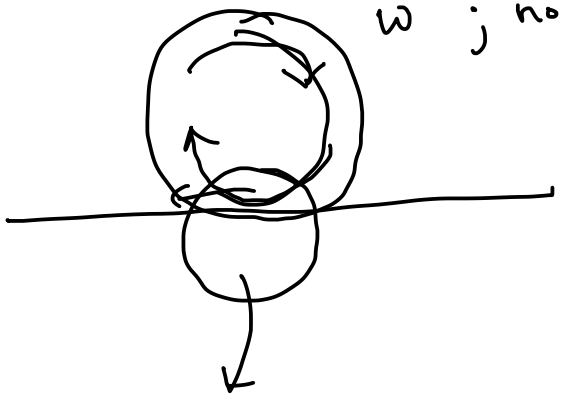


B) rolling without slipping: points in contact have the same velocity





Ex)

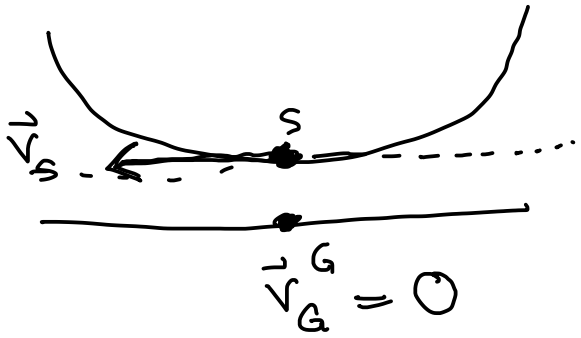


angular velocity $\vec{\omega}$; no forward progress

iclicker:

A) slipping

B) rolling without slipping



Notice that $\vec{v}_S \neq \vec{v}_G$ $\Rightarrow$ slipping

But

(1) Normal Components of $\vec{v}$ are the same. ↑

(2) Tangential components are different →

Ex) Wheel rolls w/o slipping?