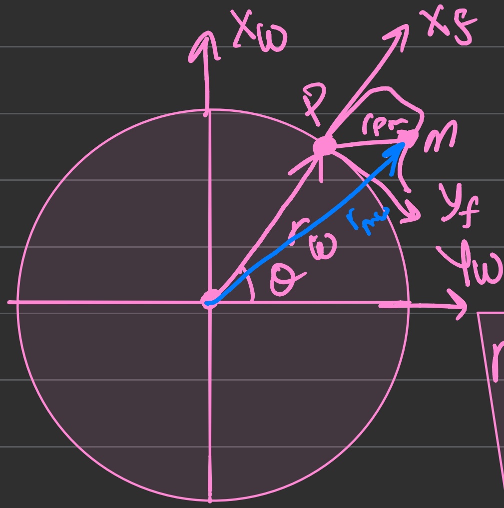
We will try to find the tooth profile of the Flex spline wrt ground frame of reference.

→ So first we will observe the FS wrt WG.

→

So fixing WG, this is the FS ~~tooth~~ curve, let m be a point on the




let the coordinates of $r_w$ be

$$\boxed{r_w = R(\theta)\cos\theta\,\hat{i} + R(\theta)\sin(\theta)\,\hat{j}}$$

since there is also radial displacement of the point

So it will be $s(\theta) = (R(\theta) - r_0)$

$r_0$ = radius of neutral circle of the flexspline.

This generates a radial velocity of the tooth like moving around the point P itself.

→ $\boxed{\dot{s}(\theta) = \dot{R}(\theta)}$

Since there is a motion around point P too, let the point m rotate by angle $\phi$, (oscillation angle).

→ So, $\theta_{f|w} = \theta_f - \theta_w = \theta + \phi$.

$$\omega_{f|w} = \frac{d\theta_{f|w}}{d\theta} = (1 + \dot{\phi})$$

$r_{m|w} = r_w + r_{pm}$ ( Vector addition).

For $r_p$ there is a rotation about P so we will use the transformation matrix to find out wrt to it.

$$r_{m|w} = r_w + \begin{bmatrix}\cos\theta_{fw} & -\sin\theta_{fw}\\ \sin\theta_{fw} & \cos\theta_{fw}\end{bmatrix} r_{pm}$$

For CS wrt WG,

→ Since the circular spline is fixed so wrt to WG is just having a pure rotation.

$$r_{c|w} = \begin{bmatrix}\cos\theta_{cw} & -\sin\theta_{cw}\\ \sin\theta_{cw} & \cos\theta_{cw}\end{bmatrix} r_c$$

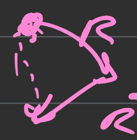
$\theta_{cw} = (R d\theta)$

Since the arc rotated by the FS =

$$\sigma = \int_0^\theta \sqrt{R^2 + \dot{R}^2}(d\theta).$$

∴ By theory of gearing, $D_{Co} = \dfrac{N_C}{N_F} D_{Fo}$

→ Here $R$ is the rotational displacement while the $\dot{R}$ is the radial displacement.



$$\boxed{\theta_{cw} = \frac{2NF}{D_{FO}N_C} \int_0^{\theta} \sqrt{R^2 + \dot{R}^2}\, d\theta}$$

→ Now from the ground respect the coordinate is again to be transformed.

$$\vec{r}_{new} = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} \left[ r_{m/w} \right]$$

This is the tooth profile with respect to ground.

Then again as we did the observation of CS wrt to WG, then we will do,

$$\boxed{\vec{r}_m = \begin{bmatrix} \cos\theta_\omega & -\sin\theta_\omega \\ \sin\theta_\omega & \cos\theta_\omega \end{bmatrix} \left[ r_{c/\omega} \right]}$$