

Plateau ovoïde de vélo

- I. Plateau ovale et comparaison
 - a) Quelques bases
 - b) Couple en sortie du pignon
 - c) Vitesse de rotation du plateau
- II. Mises en évidence expérimentales des différences
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 - b) Force maximale exercée
 - c) Vitesse de la manivelle
- III. Ajuster la position angulaire du plateau
 - a) Angle de la pédale
 - b) Force associée à l'angle de la manivelle
 - c) Force utile et position du plateau

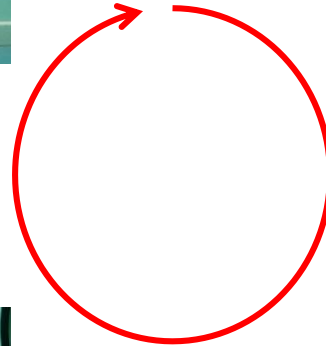


Cycle de pédalage

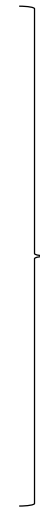
Point mort haut



Point mort bas



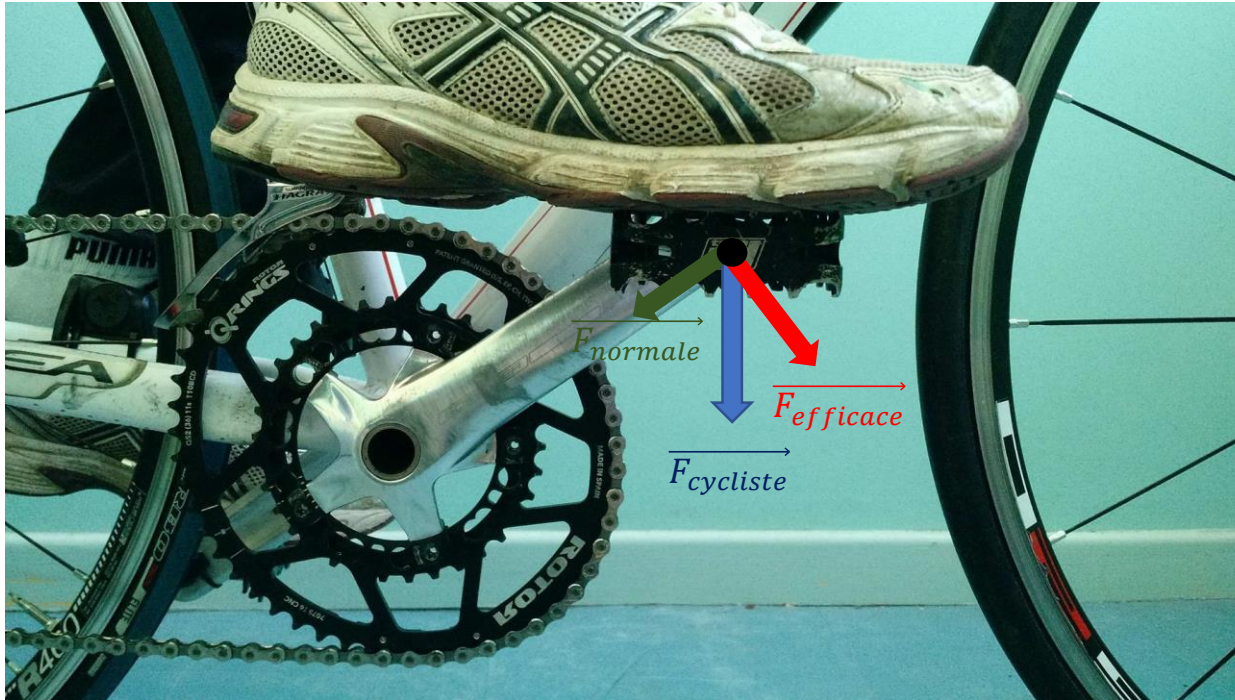
Phase de poussée



Phase de remontée



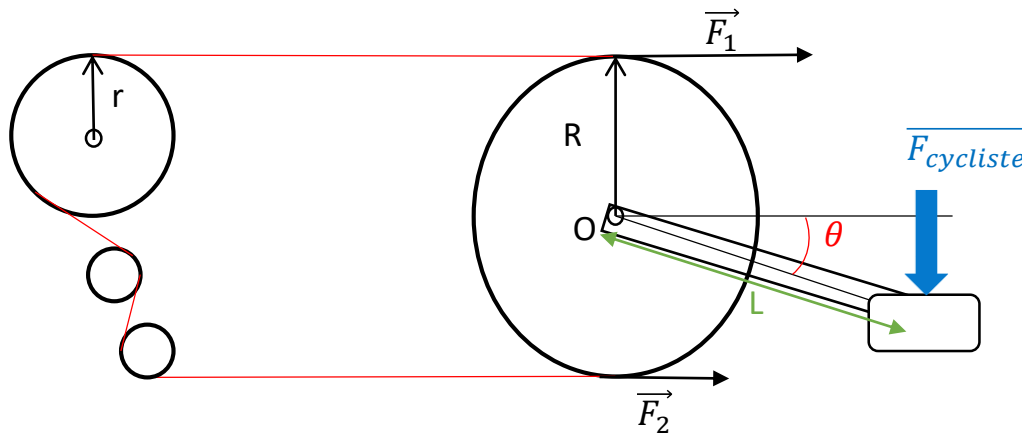
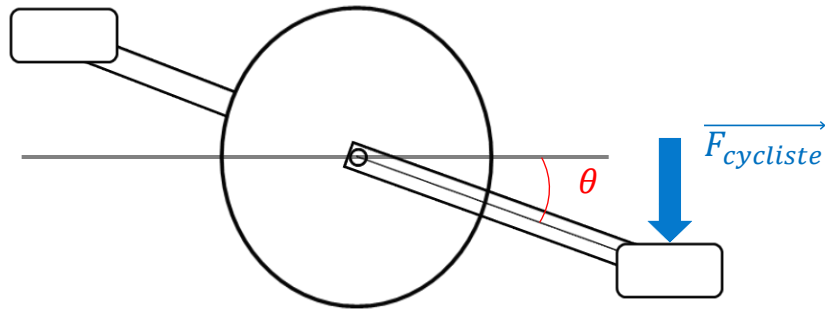
Force utile



Cas du plateau rond

Hypothèses:

- Force de poussée maximale pour $\theta=0^\circ$
- Force de traction nulle



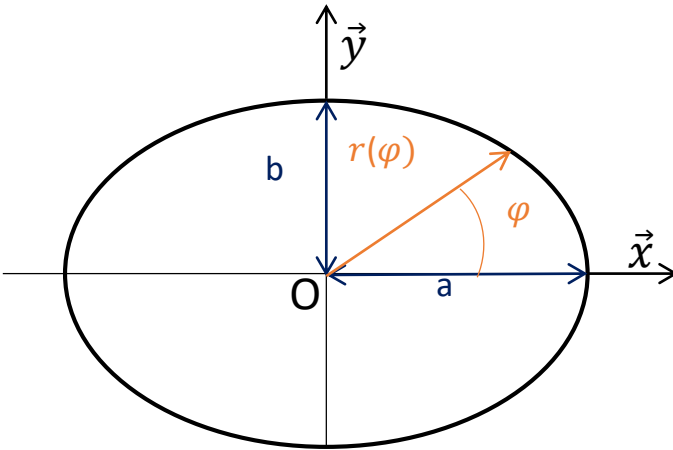
F_1/F_2 : force exercée par le plateau sur la chaîne

$$C_{manivelle} = F_{cycliste} \cdot L \cdot \cos(\theta)$$

Conservation de l'énergie mécanique :

$$C_{pignon} = F_{cycliste} \cdot L \cdot \cos(\theta) \cdot \frac{r}{R}$$

Propriétés d'une ellipse



Équation caractéristique d'une ellipse : $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

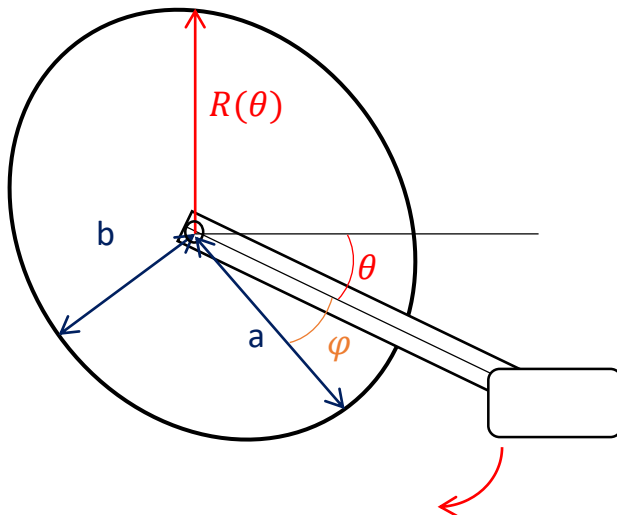
$$\left(\frac{r \times \cos(\varphi)}{a} \right)^2 + \left(\frac{r \times \sin(\varphi)}{b} \right)^2 = 1$$

$$r(\varphi) = \frac{b}{\sqrt{1 - \left(1 - \frac{b^2}{a^2}\right) \cdot \cos^2(\varphi)}}$$

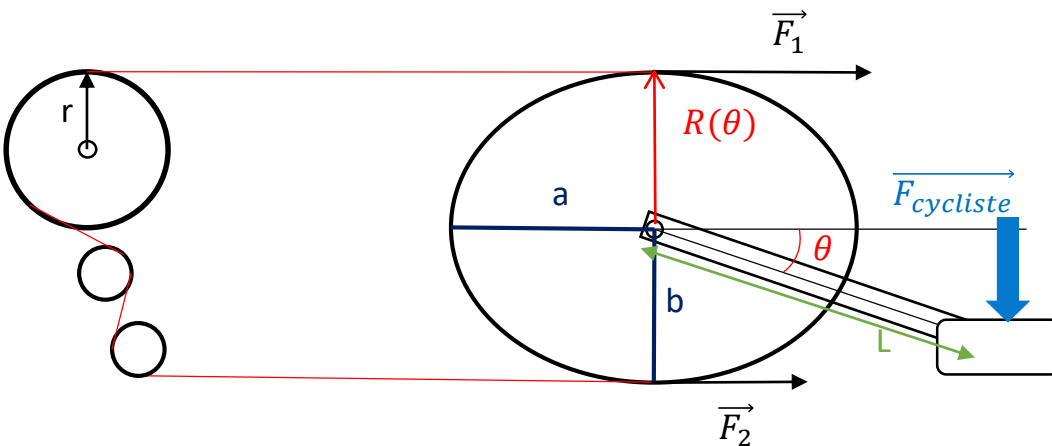
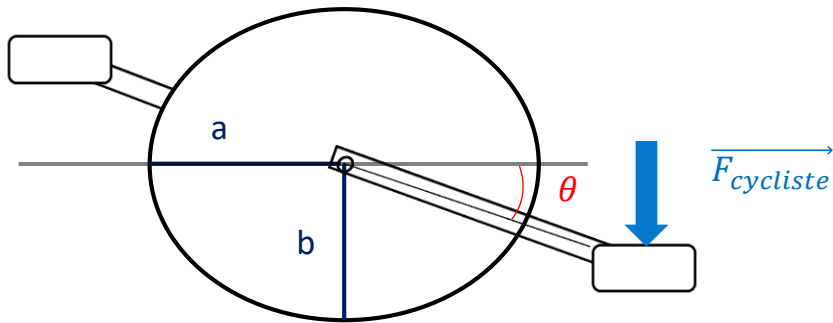
Cas du plateau ovale

Rayon du plateau au point d'ancrage de la chaîne:

$$R(\theta) = r\left(\varphi + \theta + \frac{\pi}{2}\right)$$



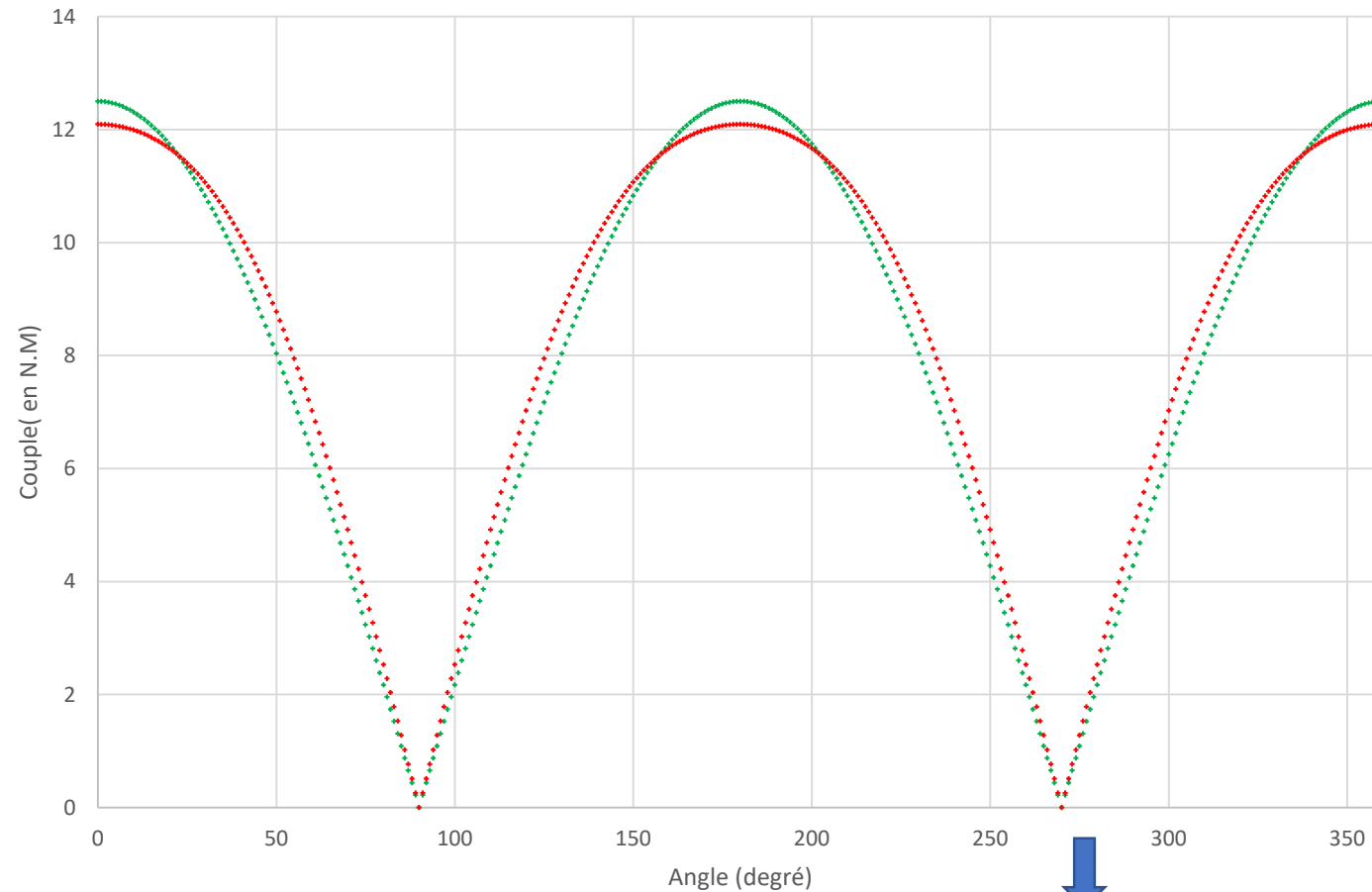
Cas du plateau ovale



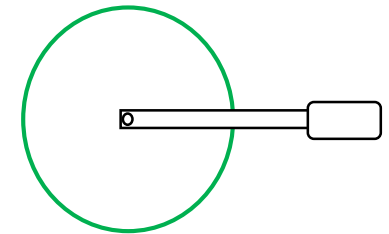
$$\text{Rappel : Couple}_{\text{pignon}} = \frac{F.L.\cos(\theta).r}{R(\theta)}$$

$$\text{Couple}_{\text{pignon}} = \frac{F.L.\cos(\theta).r.\sqrt{1 - \left(1 - \frac{b^2}{a^2}\right).\cos^2\left(\theta + \varphi + \frac{\pi}{2}\right)}}{b}$$

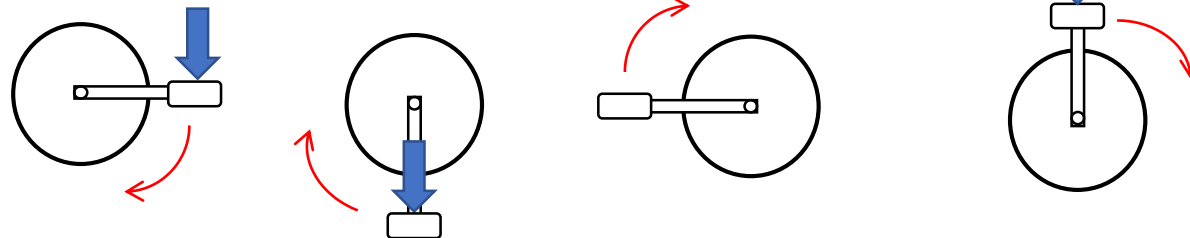
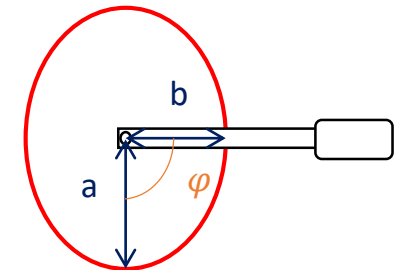
Comparaison des couples



Plateau circulaire

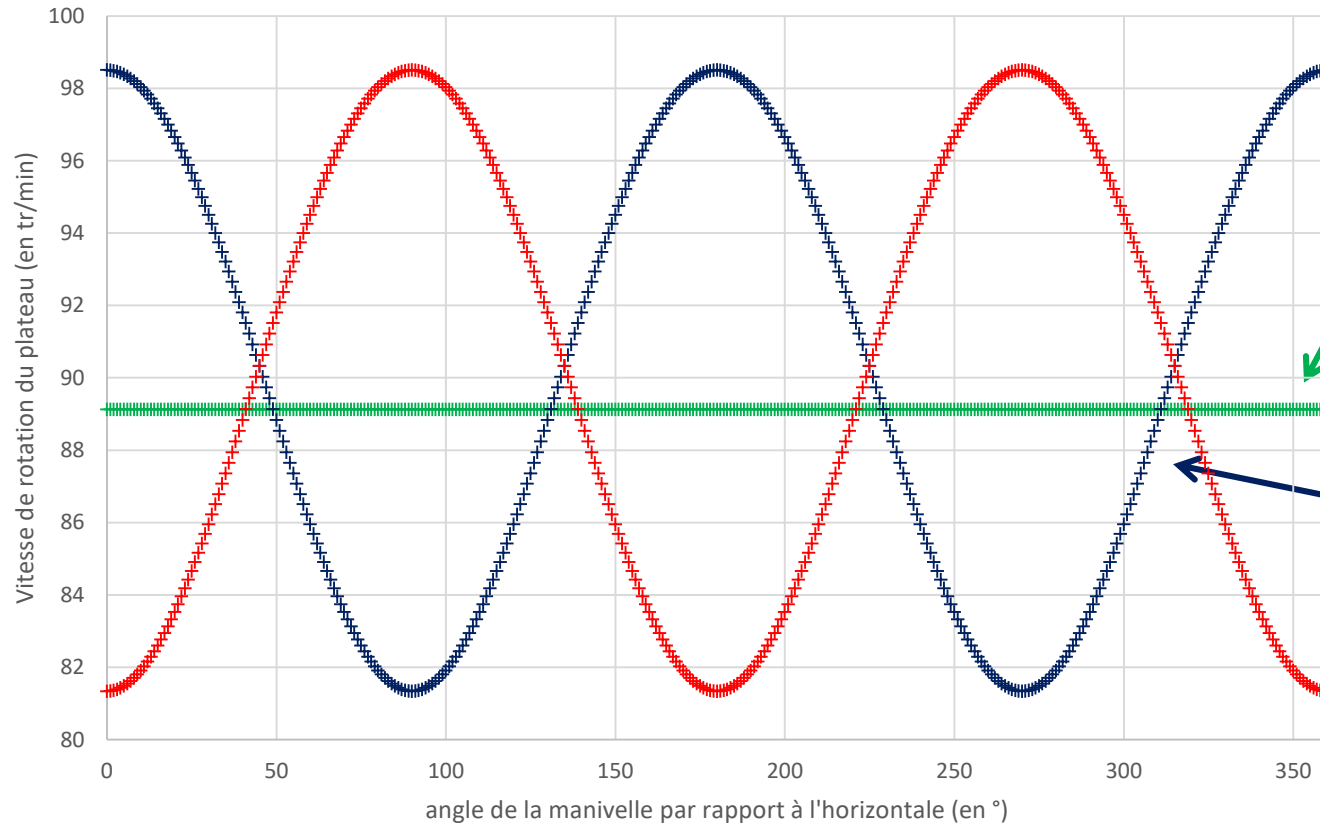


Plateau ovale - $\varphi=90^\circ$

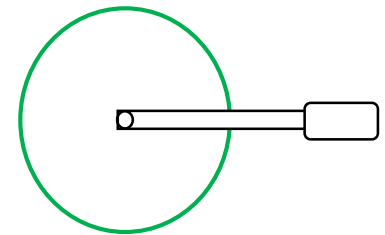


Vitesse de rotation du plateau théorique

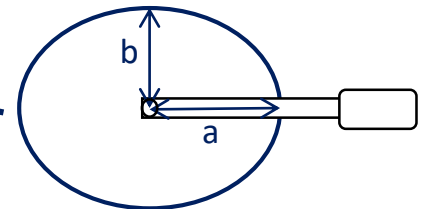
Rapport de transmission plateau/pignon: $\omega_{plateau} = \frac{r}{R} \omega_{pignon}$



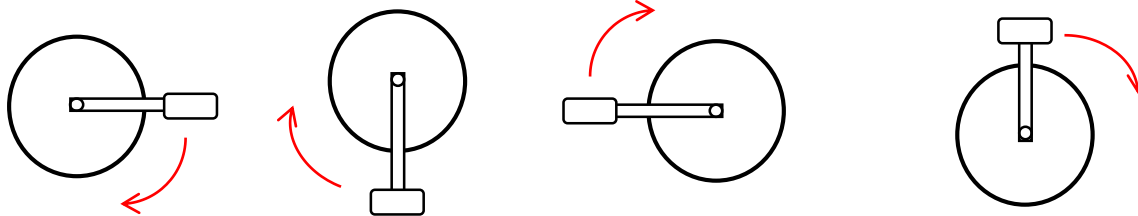
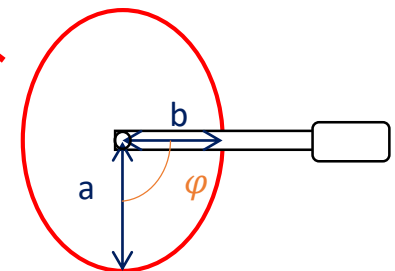
Plateau circulaire



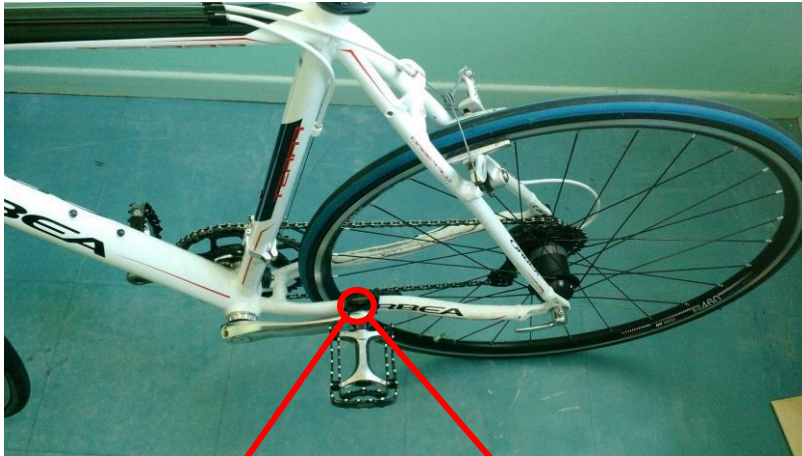
Plateau ovale - $\varphi=0^\circ$



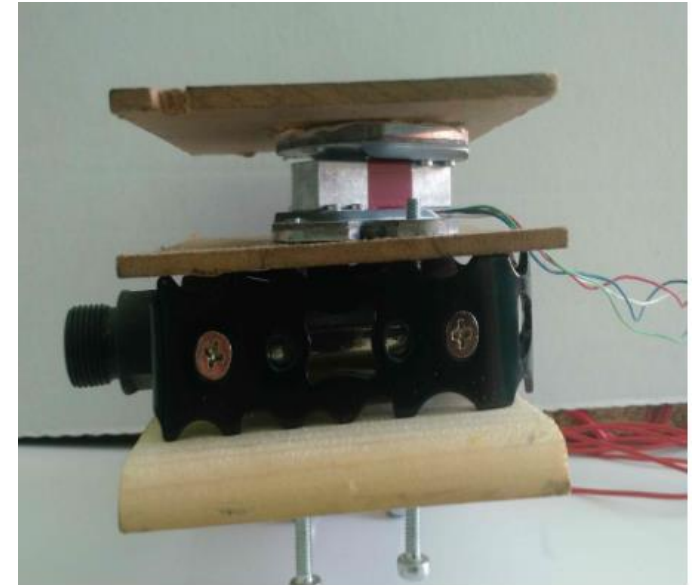
Plateau ovale - $\varphi=90^\circ$



Les capteurs

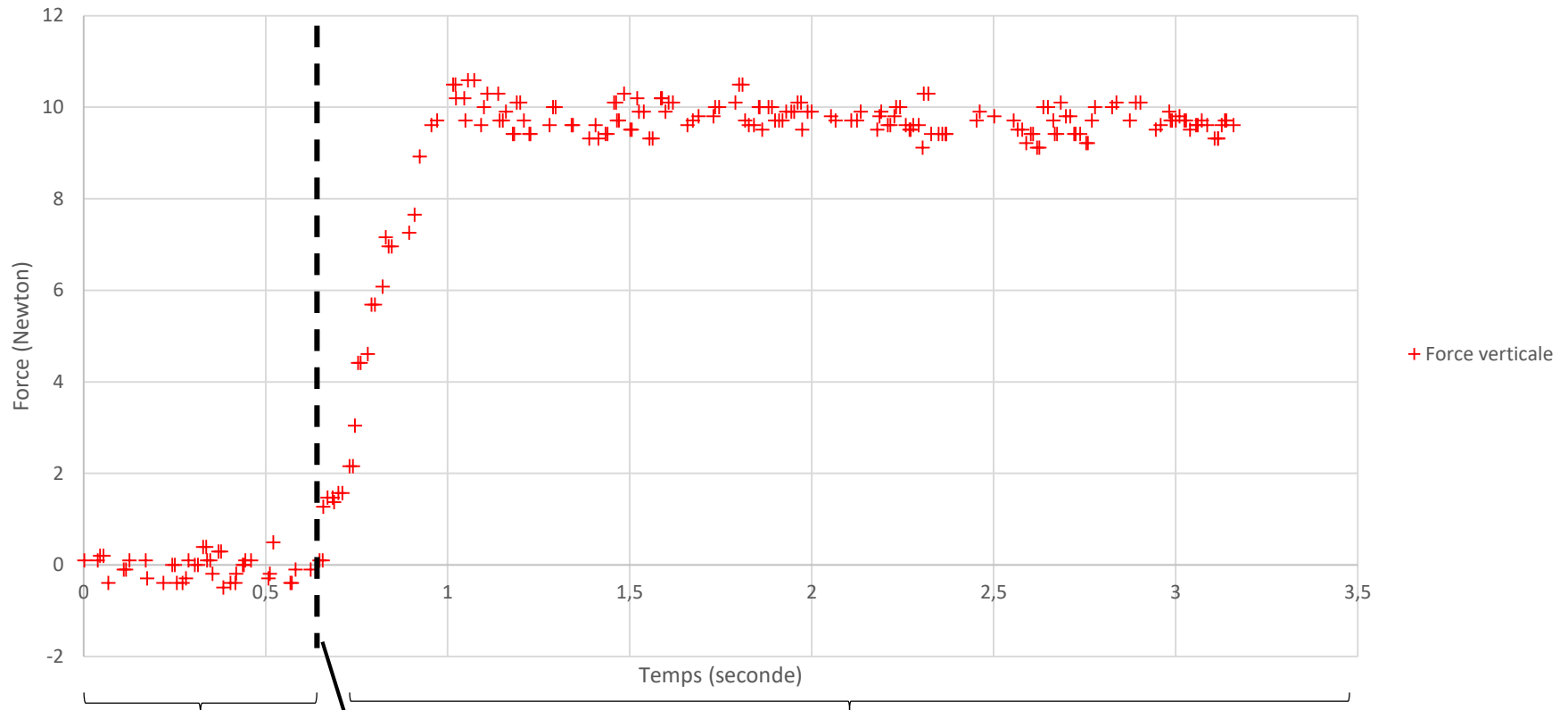


Capteurs de fréquence de pédalage et de vitesse



Capteur à jauge de contrainte

Acquisition de la force

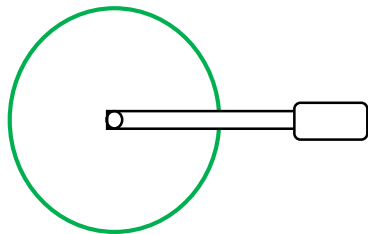
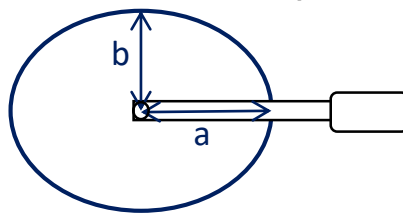
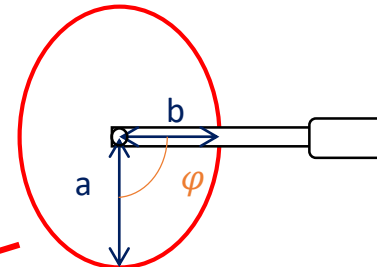


Ajout d'une
masse de 1kg



Force maximale au cours du pédalage

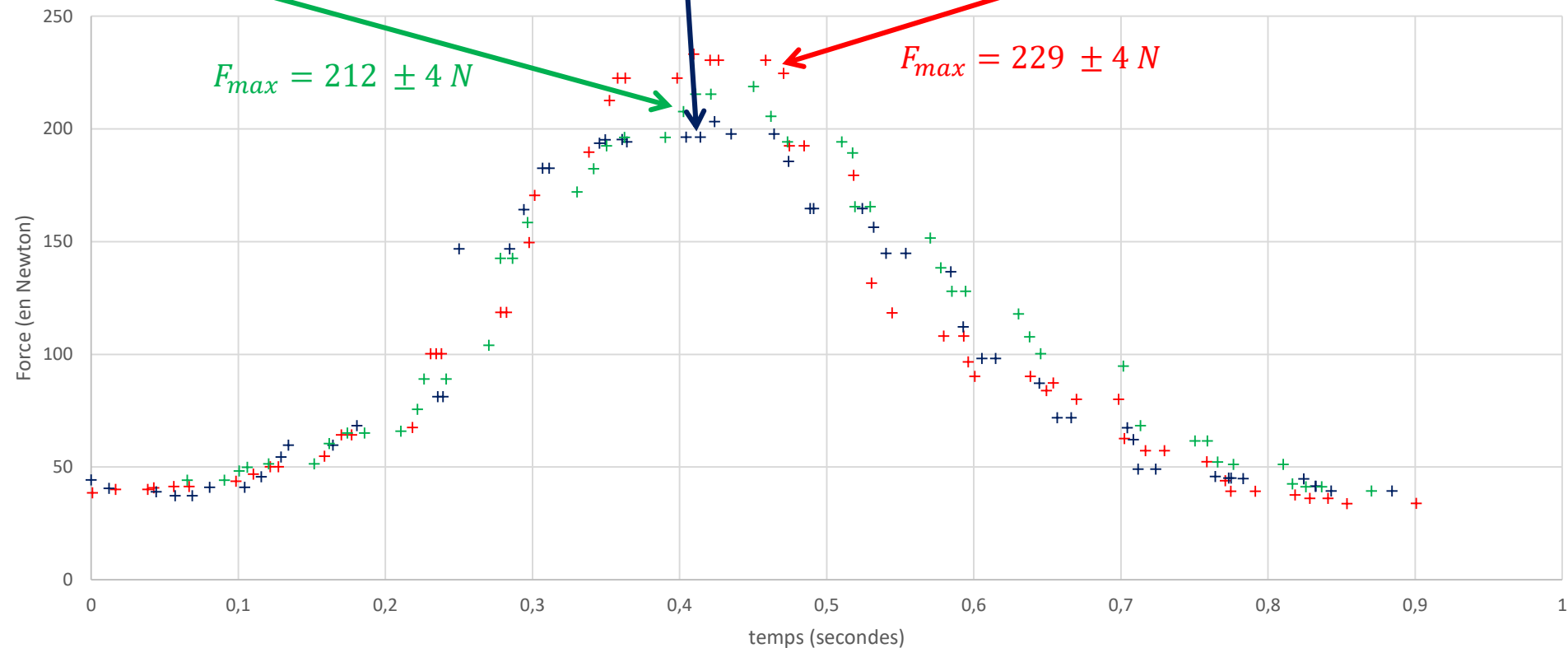
Plateau circulaire

Plateau ovale - $\varphi=0^\circ$ Plateau ovale - $\varphi=90^\circ$ 

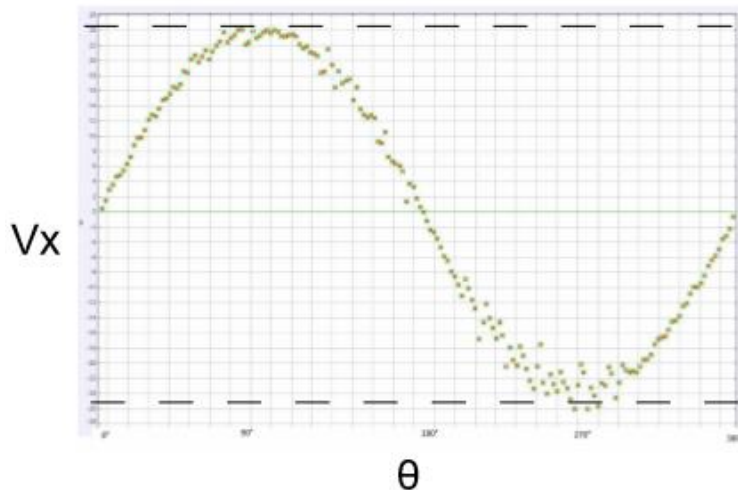
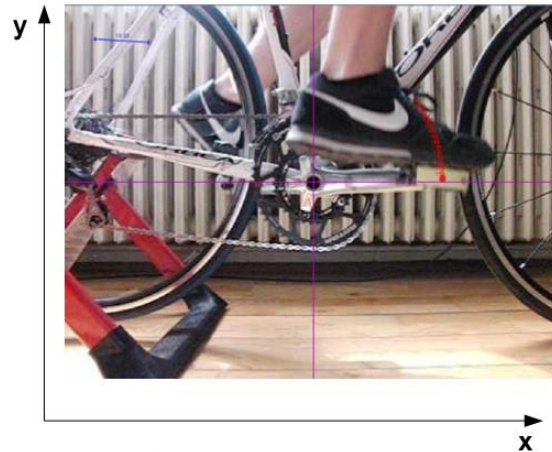
$$F_{max} = 202 \pm 3 \text{ N}$$

$$F_{max} = 229 \pm 4 \text{ N}$$

$$F_{max} = 212 \pm 4 \text{ N}$$

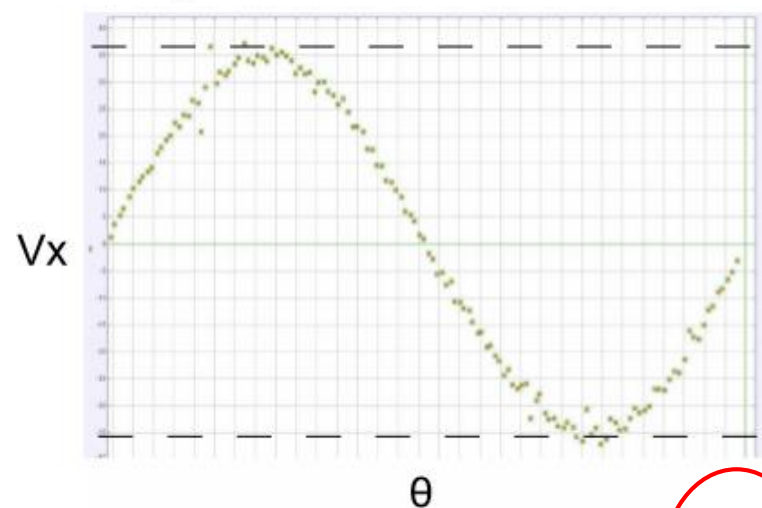
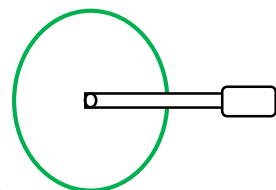


Vitesse de la manivelle en fonction de θ



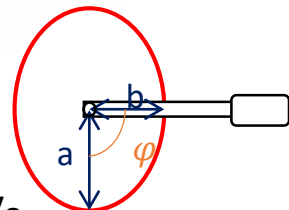
Plateau circulaire

Vitesse au point mort : 24cm/s



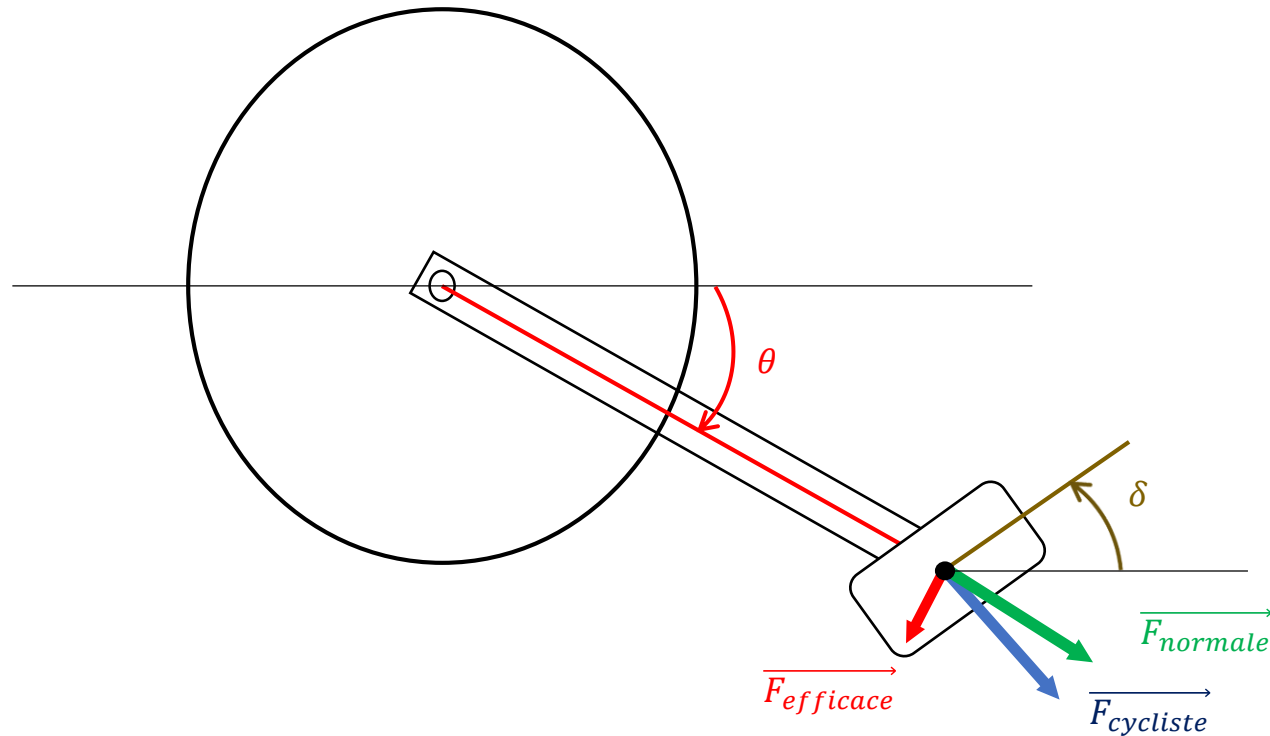
Plateau ovale – $\varphi=90^\circ$

Vitesse au point mort : 34cm/s



Angle de la pédale

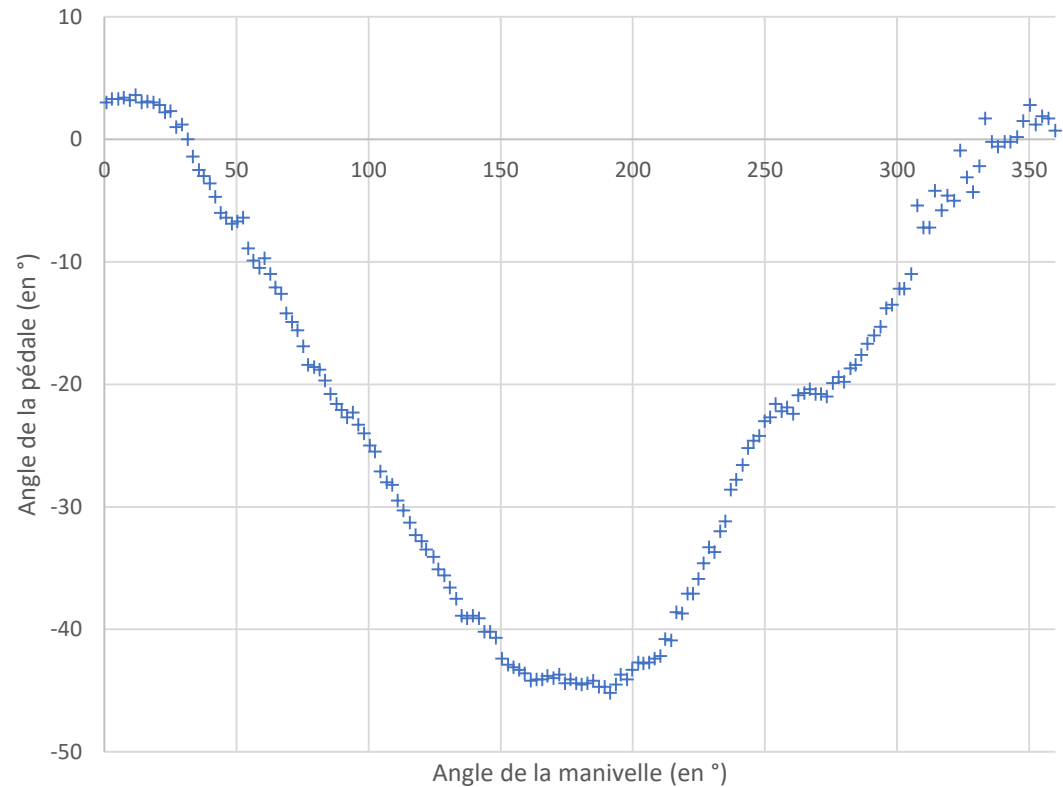
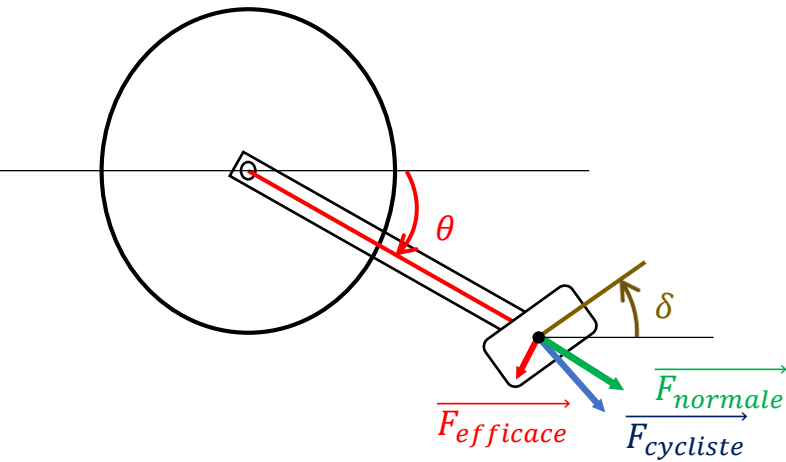
Objectif : adapter la position du plateau au cycliste



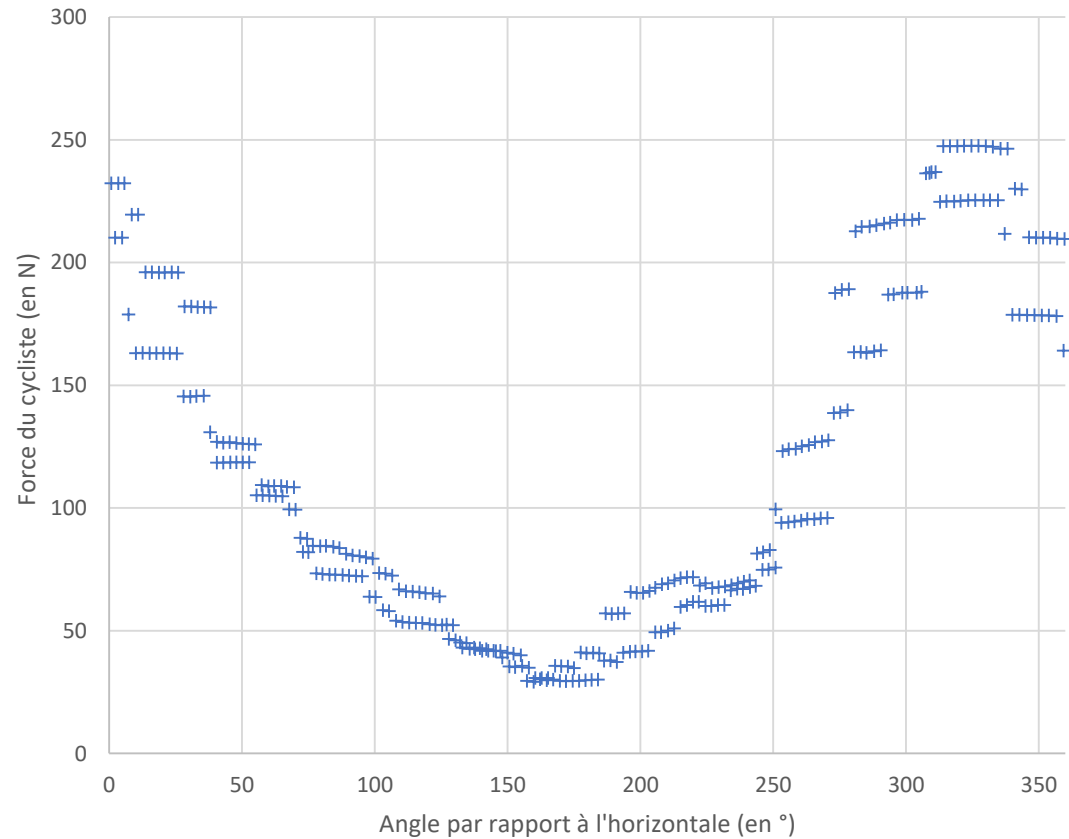
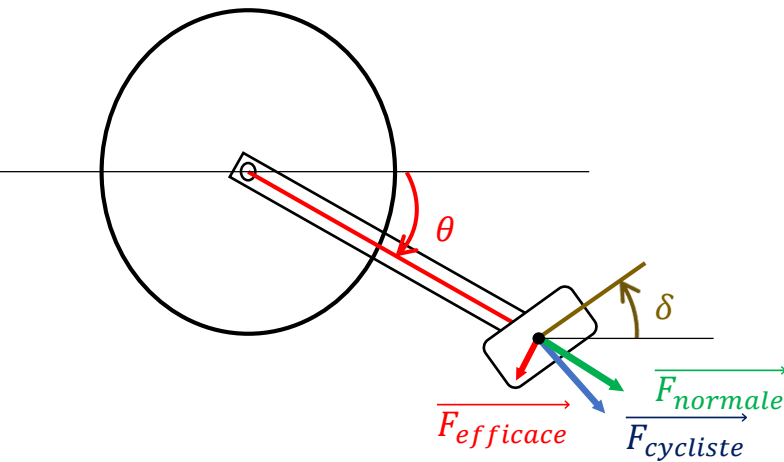
θ : angle entre la manivelle et l'horizontale

δ : angle entre la pédale et l'horizontale

Evolution de l'angle de la pédale au cours d'un cycle de pédalage



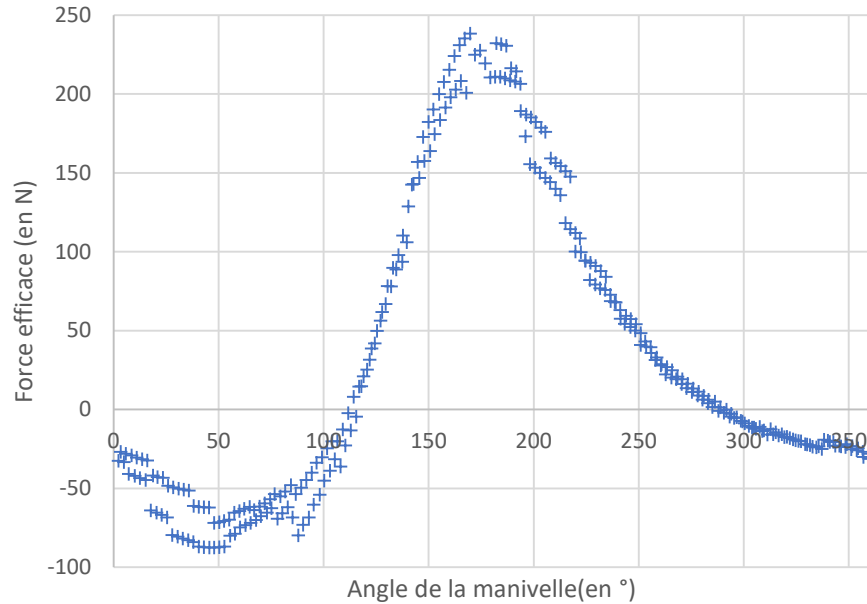
Force associée à l'angle de la manivelle



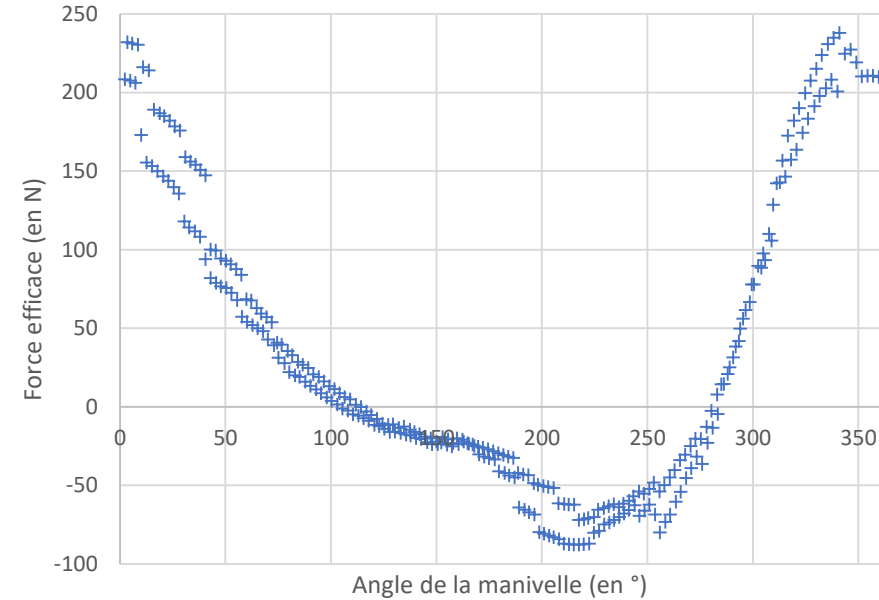
Déduction de la force efficace au cours du pédalage

Force efficace de pédalage

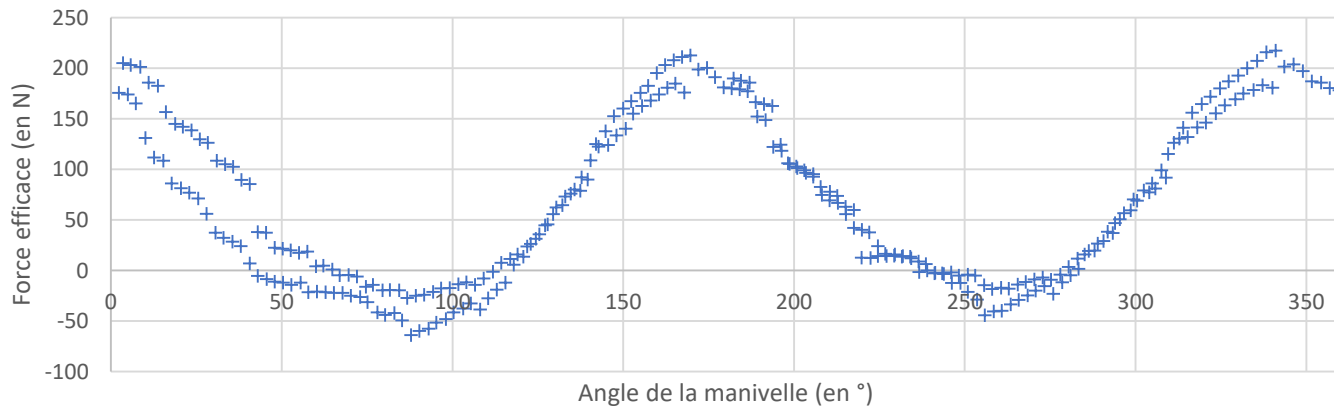
Pédale gauche



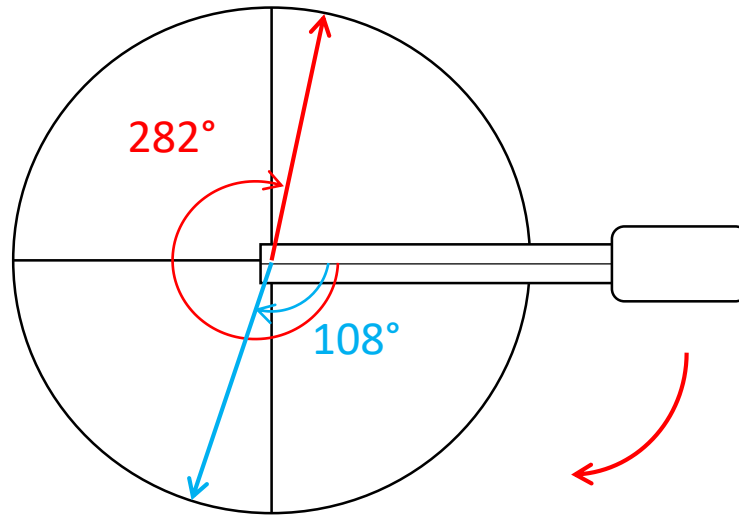
Pédale droite



Force efficace totale



Position du plateau



Points morts : - bas : $108 \pm 6^\circ$
- haut : $282 \pm 4^\circ$

Déduction de la position optimale
du plateau dans le cas d'étude :

$$\varphi = 71^\circ$$

