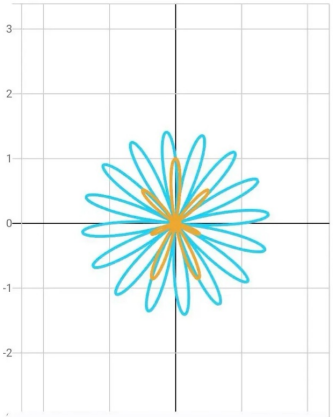
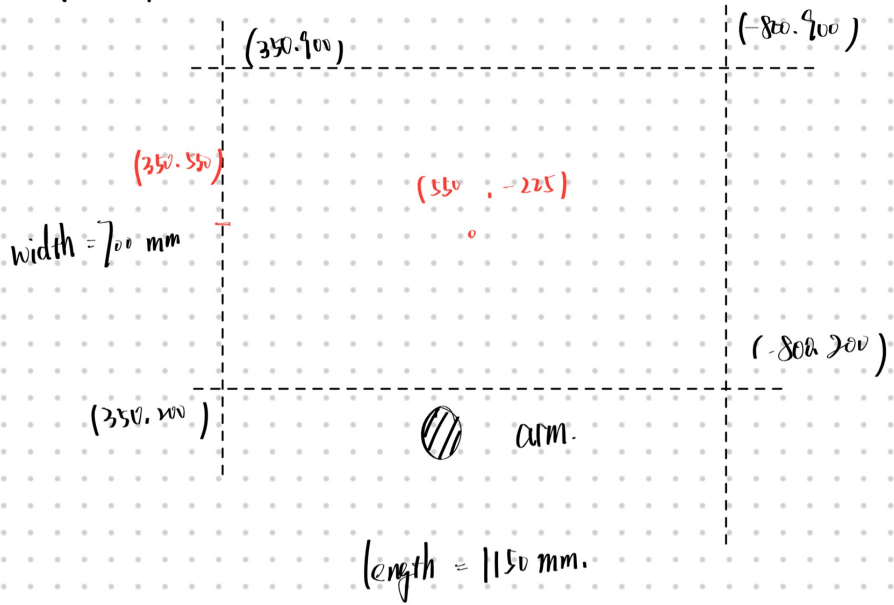
Trigonometric Function Demo.



Can't use (0,0) as orginal point

⇒ shift, use the previous range.

⇒ original point is (-225, 550), unit is mm.



Need scaling and translation. to fit it into the range

For function $r(\theta) = \sin(8\theta) + \cos(8\theta)$

$$x(\theta) = r(\theta) \cdot \cos\theta \quad , \quad y(\theta) = r(\theta) \cdot \sin\theta$$

move the starting point to $(550, -225)$ (Translation)

$$\Rightarrow \begin{cases} x(\theta) = 550 + r(\theta) \cdot \cos\theta \\ y(\theta) = -225 + r(\theta) \cdot \sin\theta \end{cases}$$

Highest point has $y = 650$ (Scaling)

$$\Rightarrow \max. \ y(\theta) = 650$$

$$\Rightarrow \max\left[-225 + S \cdot r(\theta) \cdot \sin\theta\right] = 650$$

$$\Rightarrow \max\left[-225 + S \cdot \left[\sin(8\theta) + \cos(8\theta)\right] \cdot \sin\theta\right] = 650$$

same

$$\Rightarrow -225 + S \cdot \max\left[\sin(8\theta) + \cos(8\theta)\right] \cdot \sin\theta] = 650$$

$$S = \frac{650 + 225}{\max\left\{\left[\sin(8\theta) + \cos(8\theta)\right] \sin\theta\right\}} = 875$$

[3]:
```
import numpy as np

theta = np.linspace(0, 2*np.pi, 1_000_000)
y = (np.sin(8*theta) + np.cos(8*theta)) * np.sin(theta)

print(np.max(y))
```

```
1.4075087431413424
```

pick a million sample. calculate its y value. and find biggest, which is 1.4

$$\Rightarrow S = \frac{875}{1.4} = 625$$

$\Rightarrow$ New function that fit the correct range.

$$\begin{cases} x(\theta) = 550 + 625 \cdot r(\theta) \cdot \cos\theta \\ y(\theta) = -225 + 625 \cdot r(\theta) \cdot \sin\theta \end{cases}$$

where $r(\theta) = \sin(8\theta) + \cos(8\theta)$

How to make the robot arm run the trajectory of the function ?

Sample a lot of points. Let the tool tip go to each point linearly.