

# Notes on Cycloidal Drives

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## 1 Design of Cycloidal Disc

### 1.1 Cycloidal Disc

- Cycloidal shape obtained by rolling circle that rolls around a base circle
- Cycloid corresponds to path described by a point at the circumference of the rolling circle (ordinary cycloid)
- Diameter of fixed pins will correspond w/ diameter of drawing circle used to actually make cycloid
- Will likely want contracted cycloid to decrease eccentricity and unbalanced forces at high speeds ( $r < R$ )
- Due to symmetrical load distribution, two cycloidal discs are often used and offset by  $180^\circ$

### 1.2 Transmission Ratio

$$TransmissionRatio = i = \frac{n}{N - n} \quad (1)$$

$$where, N = 1 + n \quad (2)$$

- $n$  = # of rotor teeth
- $N$  = # of rollers

$$i = \frac{d}{\delta} \quad (3)$$

$$\delta = \frac{D}{N} \quad (4)$$

$$d = \frac{i}{N} D \quad (5)$$

- $\delta$  is the diameter of the rolling circle
- $d$  is base circle diameter
- $D$  is the pitch circle of the fixed diameter pins
- $N$  is the # of fixed pins

### 1.3 Eccentricity

$$e \leq \frac{\delta}{2} \quad (6)$$

- If  $e$  is too small, the shape of the cycloid will become too soft and get close to a circle
- This can cause increasing backlash

## 1.4 Hole diameter of the cycloidal disc

$$d_h = d_r + 2e \quad (7)$$

- $d_h$  is the diameter of holes in the cycloidal disc
- $d_r$  is the diameter of the roller pins

## 2 Epitrochoid

An epitrochoid is a roulette traced by a pt attached to a circle of radius  $r$  rolling around the outside of a fixed circle of radius  $R$ . The point is at a distance  $d$  from the center of the exterior circle. The parametric equations are as follows:

$$x(\theta) = (R + r) \cos \theta - d \cos\left(\frac{R + r}{r} \theta\right) \quad (8)$$

$$y(\theta) = (R + r) \sin \theta - d \sin\left(\frac{R + r}{r} \theta\right) \quad (9)$$

## 3 References

1. Construction of Cycloidal Disc
2. Thesis involoving cycloidal drives
3. Thesis with Dual Stage cycloidal drive
4. Cycloidal drive design and printing
5. Cycloidal drive in Solidworks
6. stepbystep-robotics guide
7. Useful cycloid github
8. Wiki page on Epitrochoid
9. Wiki page on epicycloid