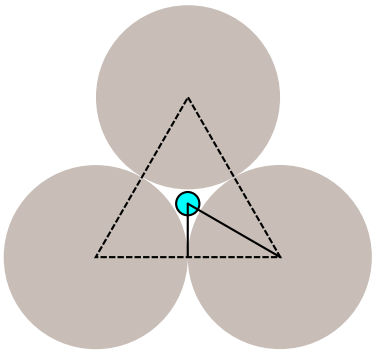
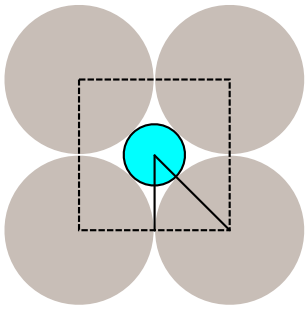
Determination of Maximum Gear Ratio for a Planetary Stage

Based on minimum possible sun gear diameter (limited by interference fo planet gears)

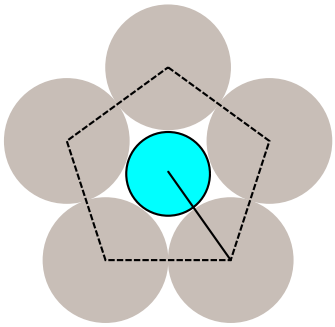
3 Planet Gears (N=3)



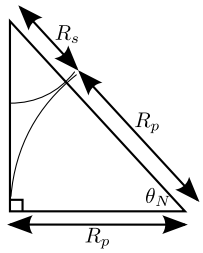
4 Planet Gears (N=4)



5 Planet Gears (N=5)



Calculation of sun gear radius based on number and size of planet gears



$$\theta_N = 90^0 - \frac{180^0}{N}$$

$$\begin{aligned} R_s &= R_p\left(\frac{1}{\cos(\theta_N)} - 1\right) \\ &= R_p\left(\frac{1}{\sin(\frac{\pi}{N})} - 1\right) \end{aligned}$$

$$GR = \frac{2(R_s + R_p)}{R_s}$$

$$\begin{aligned} GR_{max} &= \frac{2\left[R_p\left(\frac{1}{\sin(\frac{\pi}{N})} - 1\right) + R_p\right]}{R_p\left(\frac{1}{\sin(\frac{\pi}{N})} - 1\right)} \\ &= \frac{2\frac{1}{\sin(\frac{\pi}{N})}}{\frac{1}{\sin(\frac{\pi}{N})} - 1} \\ &= \frac{2}{1 - \sin(\frac{\pi}{N})} \end{aligned}$$

N	GR_max
3	14.93
4	6.83
5	4.85
6	4