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***Why planetary gears for servo applications ?***



## Planetary Gearhead Basics

? WHY use Gearheads with servo motors ??

**Servo Motors have high Power Density, along with high speeds** 😊

power density Watts / Volume (or W/kg) = Power density increasing proportionally with speed

**...but Servo Motors have LOW Torque Density** 😞

torque density (Nm/volume (or Nm /kg)

**Gearbox :**

**Boosting the torque by** -  $i$

**Reducing the reflected inertia by** -  $J_{load} / i^2$

**Reducing the speed by** -  $1/i$

Motor accel. Torque requirement  $T_{motor\ accel} = J_{load} / i^2$



Servo motor with Gearbox :

Reduced load inertia, boosted torque → lower motor acceleration torque required → smaller motor, lower current rating less costly driver

→ **smaller, more compact, more economical overall drive pack**





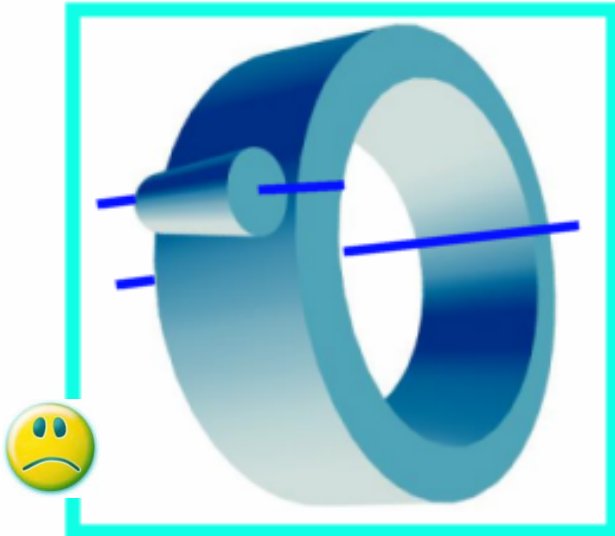
## Desired properties of Servo Gearheads

*WHAT properties are desired for a Servo-Gearhead ?*

- ***High Torque density (Compact)***
- ***High Stiffness =>Low Lost Motion***
- ***Low Backlash***
- ***High efficiency***
- ***Suitable for high input speeds***
- ***Low maintenance, Long reliable Life***
- ***Flexible Motor Mounting***
- ***Low Inertia***
- ***Low noise***

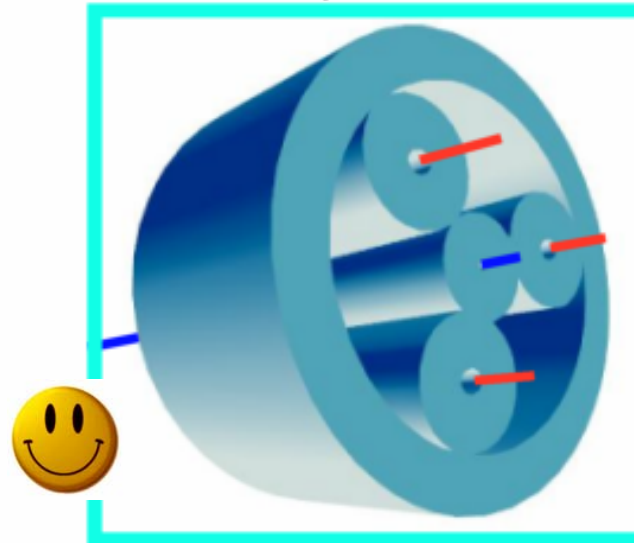
# Desired properties of Servo Gearheads

Volume =1, Torque =1, Stiffness=1



**Fixed Axis Gear System**

Volume =1, Torque =3, Stiffness=3



**Planetary Gear System**

- *High Torque density (Compact)*
- *High Stiffness =>Low Lost Motion*
- *Suitable for high input speeds*
- *Low Backlash*
- *High efficiency*
- *Low maintenance, Long reliable Life*
- *Low noise*
- *Low Inertia*
- *Flexible Motor Mounting*

**Approximately same ratio and same volume, the planetary has 3 x higher torque density and about 3 x higher stiffness, due to the increased number of gear contacts**

— **Moving Axis** —      — **Fix Axis** —