Did You Know?

DANAHER MOTION

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Did you know…..Danaher Motion DDR motors can run with inertia “mismatch” up to 1000:1 and above? Applications with conventional rotary servomotors using mechanical transmissions are limited to 5:1 or 10:1 at the highest. This inertia matching limit does not apply to DDR applications. Here’s why:

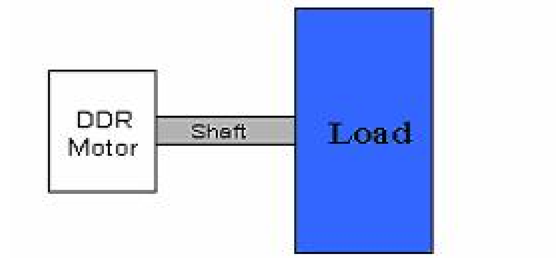
The reason for a mismatch limit with conventional rotary motors with mechanical transmissions is the backlash in the transmission. For very small movements of the motor, the load is uncoupled because of the backlash and the only inertia seen by the motor is the motor itself. For larger movements of the motor, it engages the load and now the motor sees the entire inertia of the load as well.

The problem is with the control loop. The control loop around the motor must provide stable performance with only the motor inertia for small movements and with the total inertia for larger movements. It is impossible for one control loop to provide stable performance with both the motor’s small inertia and the large total motor and load inertia when the load inertia is many times that of the motor.

When confronted with a conventional rotary application with a large inertia mismatch, designers have resorted to specifying a larger than required motor or adding a flywheel to the motor. They would upsize the motor or add a flywheel for the sole purpose to reduce the inertia mismatch.

Such antics are not required with DDR applications. With DDR motors, the load is directly coupled to the motor so there is no backlash between the motor and load. The backlash is eliminated and consequently the requirement for inertia matching is also eliminated.

There is a mechanical consideration with DDR motors driving large inertias and that is the mechanical resonance. In the simplified DDR model below, the motor is directly connected to the load through a shaft.



In this model, consider that the shaft has torsional compliance giving it the characteristic of a spring. The motor inertia coupled to the load inertia by a spring will give rise to a mechanical resonance. The goal of the DDR system designer is to make the resonate frequency as high as possible.

How does one increase the resonant frequency? Obviously, if the shaft can be made more rigid, then the resonant frequency is increased. Consequently the shaft should be as large a diameter as possible and as short axially as possible. Often in DDR applications, the load is bolted directly to the DDR motor which is optimal and gives a very high resonant frequency and a very high performance system.

Another way to increase the resonant frequency is less obvious and actually quite surprising for those used to sizing motors for inertia matching. The resonant frequency can be increased by REDUCING the inertia of the motor. This actually INCREASES the ratio of the load inertia to motor inertia, but it also increases the resonant frequency and results in a higher performance servo system.

DDR motors should be sized for torque and speed requirements of the application only and never sized for inertia matching. Very high performance DDR applications are possible with high load to motor inertia ratios. The situation which should be avoided is a high performance DDR application with a large load inertia coupled by a small diameter or long length shaft which will give rise to mechanical resonance.

Now you know…….