Twin motors for one extruder: Is it reasonable to have a moving and a stationary stepper motor controlling a Bowden cable system?

Assume a viscous load on the extruder:

Assume that the small motor is coupled directly (or by a gear train)

And the large motor is coupled by a spring

Assume that the extruder follows a path which requires an arbitrary velocity profile. Let’s say at time t=0, a small velocity step function is required.

With no secondary motor the required behaviour of the primary motor is

This instantaneous jump requires infinite motor torque; it’s not possible. So even intelligent control cannot exactly solve this system.

What if at time t=0 a velocity ramp function is required.

Again assuming no secondary motor,

What if a poor control system is used?

It clearly makes sense to combine the damping and stiffness into a single parameter, which is a time constant.

If a second motor is introduced, would it be able to “take up the slack”? And if so, what’s the minimum torque it would need to do so?

As long as , x=0 and error=0. But this will not remain the case for long because is small. But what we obtain is a ‘zone of safety’ around the ideal control algorithm, with a zero error condition. That zone looks like this:

depends somewhat on the transmission. An ideal transmission would sustain a maximum power at all speeds but here we only have space for a single ratio. One suggestion for this would be to set the speed at which the maximum force from both motors equals the viscous force from the extruder.

We can also determine the ‘number of steps’ in the safety zone. That is, the number of steps that the primary motor can advance ahead of the secondary motor without exceeding the secondary’s braking force or, equivalently, the number of steps that the primary motor can lag behind. If the speed is v, and step advances by a distance delta,

At there is the ideal condition and the secondary motor will not need to do any work. However the error can be as high as .

Once you exceed the error boundary