Trade Publication

Enhanced Elevator Drive Software Improves Ride Quality, Eases Setup

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Today's high-performance elevator drives incorporate software which enhances overall ride quality and system performance and at the same time facilitates installation, setup, maintenance and testing.

Advanced software functions, including feedback loops and control algorithms pre-programmed into drive software, provide increased operating efficiency while allowing the drive to easily adapt to rigorous elevator performance requirements.

Software Delivers Optimum Performance

In order to provide optimum performance and premium ride quality, an elevator drive's speed regulation software must be created specifically for elevator applications.

For example, precise tracking of the elevator's speed reference during the "acceleration or deceleration" periods is less important than insuring overall ride quality and eliminating overshoot, which can adversely effect ride quality, at the end of acceleration and deceleration periods. This is in contrast to industrial drive applications where speed reference overshoots are less important than the precise tracking of the speed reference during the acceleration and deceleration periods.

To accomplish this, the drive's software must incorporate an advanced elevator application-specific speed regulator, which eliminates speed reference overshoot and helps to increase overall ride quality.

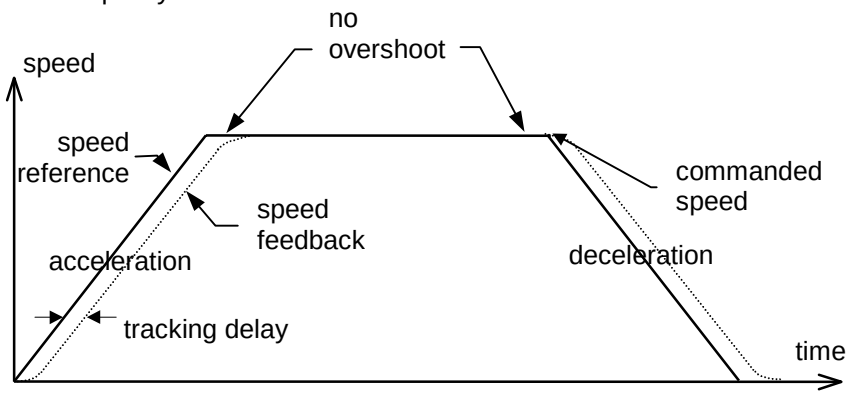

Figure 1 - Elevator Drive Speed Regulator Example

Advanced Drives Provide "Automatic Autotuning"

The most advanced elevator drives available today provide a valuable feature known as "Automatic Autotuning" This advanced feature provides the operator with enhanced software which can automatically determine and set basic operating settings.

Autotuning, utilizing data collected through feedback circuits, dramatically simplifies drive set-up and allows the drive to obtain the maximum performance from the motor, resulting in a more efficient application. Most significantly, however, it provides the ability to tune the drive without having to disconnecting the motor from the load.

No Need to Disconnect Motor From Load

The number one factor in easing the autotune process is the ability to auto-tune the drive without disconnecting the motor from the load, which saves both time and money. Set up is accomplished through the drive's ability to utilize feedback loops to automatically calculate important motor characteristics as well as the system inertia.

Important auto-tune drive values when using an AC motor are:

- Magnetizing current of the motor (percent no-load current)
- Slip frequency of the motor
- Elevator system inertia

When using a DC motor, important auto-tune drive values are:

- Total motor armature circuit resistance
- Total inductance as seen by the drive
- Inductance/Resistance time constant

Simple Overspeed Initiation/Cancellation

Most up-to-date elevator drives also provide simple initiation of overspeed test conditions for periodic elevator inspections. By easily initiating an overspeed test via an operator or logic input, both the speed command and overspeed limit are increased a defined level -- usually 125% -- for a single run.

An important feature found on top-of-the-line drives is this ability to initiate a single overspeed run, then automatically reset to normal operating parameters. This feature makes it unnecessary for the operator to reset to normal operating parameters following a test run.

Vibration Dampening Via Speed Regulator

Another aspect unique to high-performance elevator drives is the ability to limit car vibrations by varying the sensitivity of the speed regulator during the acceleration, cruise and deceleration periods.

The drive's speed regulator must be very sensitive when taking off from and leveling into a floor, both to reduce vibration and increase positioning accuracy. During the majority of the ride, however, the speed regulator needs to be suppressed in order to reduce resonant characteristics and spring action of the elevator ropes which can produce car vibration.

Therefore, speed regulator sensitivity control is required when the resonant nature of the elevator system interferes with the speed response of the drive.

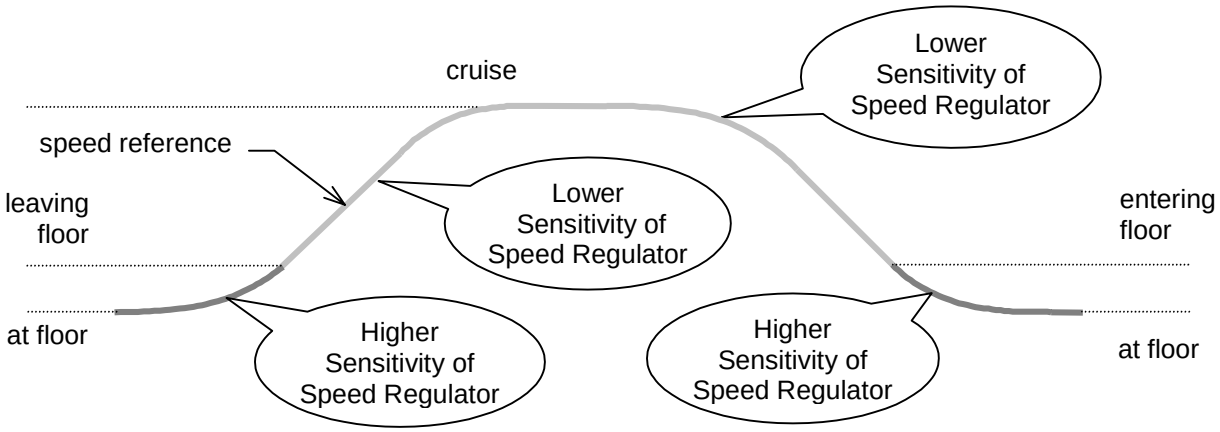

Figure 2 - Speed Regulator Sensitivity Example

Motor Torque Enhances Mechanical Braking Control

A braking characteristic unique to today's high-performance elevator drives involves a programmed interaction between motor torque and the mechanical brake. At the end of a run, the drive should provide an option of gradually reducing motor torque through a ramp-to-stop function. This can be accomplished by utilizing drive software to ramp the motor to zero torque once the brake is set. This function enhances ride quality, provides a smooth stop and minimizes brake slippage. Application of the function is greatly simplified in powerful new drives which are able to program this interaction between the drive and the mechanical brake.

Speed Reference Generation -- Providing For a Smooth Ride

A smooth ride during starts and stops is also dramatically helped by the drive's internal S-curve. This is accomplished through the drives ability to assign limits to acceleration and deceleration and to changes in rates of acceleration or deceleration (otherwise known as "jerk rates"). The S-curve function operates by generating a speed reference subject to the conditions that the maximum acceleration, deceleration and jerk rates not be exceeded.

In order to facilitate fine tuning, the S-curve function should have:

- Separate settings for acceleration and deceleration rates,
- Jerk rate settings partially split to allow for a separate setting of the leveling jerk rate (deceleration jerk out),
- Settings in engineering units (i.e., ft/s^2, m/s^2, ft/s^3 and m/s^3),
- The ability to externally select from several different S-curves

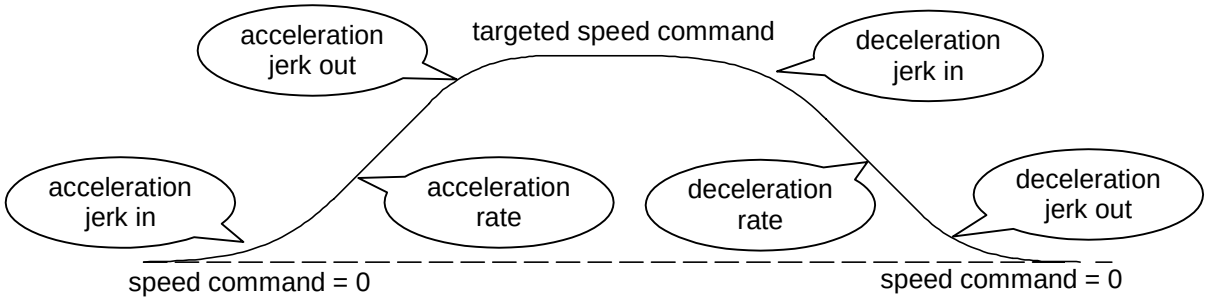

Figure 3 - S-curve Function Example

Conclusions

Today's high-performance elevator drives incorporate software features that greatly enhance the elevator system's performance:

- A speed regulator designed specifically for elevator applications, with the ability to eliminate overshoot at the end of acceleration and deceleration periods.
- The ability to control the sensitivity of the speed regulator during acceleration, cruise and deceleration periods, to minimize car vibration.
- The ability to gradually reduce motor torque as the brake is set for smooth stops and minimized brake slippage.
- The ability to limit acceleration, deceleration and jerk rates to insure a smooth ride during elevator starting and stopping.
- The ability to auto-tune the drive without having to disconnect the motor from the load.
- An overspeed test and reset capability

As more and more performance is demanded of the elevator system, the advantages will lie in development of even more advanced software, rather than expensive modifications to hardware and mechanical components.