**High end speed control applications**

Speed control requirements vary from process to another. ABB industrial drives offer numerous possibilities for high end speed controlling and access to those functions via standard analog interface, numerous field buses or through industrial PC interfaces.

Typical high end speed control applications:
- Test benches, the speed and torque control is essential
- Printing lines
- Converting lines
- Roll Mills
- Master-follower configurations
- General System Integration

**Torque control features**

The performance of speed controller is highly dependent on torque control performance. For ABB industrial drives with Direct Torque Control:

- Torque control cycle time: 25µs
- Torque risetime: 1-2 ms measured from current rise, dependent on motor characteristics.

**Speed control features**

PID speed control loop at 1 ms time level to adjust speed behaviour in case speed reference changed:
- Separated speed reference ramping for acceleration and deceleration and shape function for jerkless change of speed
- Set point weighting of gain - enables high gain and fast response without overshoot
- Adaptation of gain and integration time in function of speed and in function of load - useful when compensating unlinearity in load characteristics

Speed regulator control features:

Impact drop for nominal load step:
- 0.3 - 0.4% without encoder feedback
- 0.1 - 0.2% with encoder feedback

Impact drop describes the maximum speed change in respect to time when stepwise nominal load step is given. Impact drop is dependent on speed control tuning.

Static speed accuracy

- 10% of motor slip without encoder feedback
- e.g. typically < 0.1 Hz electrical speed
- 0.01% of nominal speed with encoder feedback
**Advanced speed and torque control features**

There are over 60 parameters to receive desired coordination of speed and torque. As example these functions are:

- Basic PID controller
- User parametrised over speed protection
- User parametrised torque limitation
- Bumpless transfer from speed reference to torque reference control and vice versa
- Speed limitation in torque control mode
- Window control: drive follows torque reference when shaft speed inside given limits. If limits exceeded the speed controller activates and takes over control
- Mechanical oscillation damping algorithm to cut off undesired oscillation in mechanics to proceed through speed controller
- Feedforward
- Inertia compensation
- Ramp hold function
- Two memorised inching speed references e.g. for having slow machine operation for operator via digital inputs

**Speed reference chain**

![Speed reference chain diagram](image)

Speed reference chain including torque selector for user-given torque reference. Principal block diagram.

**Torque selector**

Torque selector enables on line pick up of desired torque reference and bumpless transfer from different reference source to another:

- Output of speed controller: torque reference
- User given torque reference
- Sum of speed controller’s torque reference and user given torque reference. Used in follower drive in combination with speed window function allowing constant free torque reference control within specified speed window
- Min/Max selection. Drive selects and switches in bumpless manner between speed controller's torque reference according to given speed reference and signs of torque requested

**Torque reference chain**

![Torque reference chain diagram](image)

Torque reference chain including optional filter for mechanical oscillation damping. Principal block diagram.

Example of impact drop measurement. In this case the impact drop is about 0.32 %. A nominal load step was applied to a 4-pole AC motor shaft.