**Tuning / Parameter Setting**

**Auto Tuning**

**Why Auto Tuning?**

All 3 control loops have to be adjusted for a proper operation of the servo system.

The adjustment depends mainly on:

a. Motor and Drive-combination
b. Design of the mechanical system
c. Mechanical load in comparison with the inertia of the motor requested dynamic (inertia mismatch)

The settings can be done manually from experts, an Autotuning guarantees a proper setting of all relevant control loop parameters without expert knowledge.

Auto Tuning is core function for Simplicity and Customer Satisfaction.
Tuning / Parameter Setting

Auto Tuning

Target of Auto Tuning:

• **Automated procedure** for setting the control parameter KPp, KFPp, KPn, TNn, TAUnref, TAUiref

• **Automated procedure** for setting additional filters Posicast (overshoot damping) and Notch (mechanical resonances)

• Support mechanical system with friction and constant load (Z-axis)

• Under all conditions, this parameter setting has to ensure a **stable system behaviour**
Tuning / Parameter Setting
Auto Tuning

Procedure of Auto Tuning:

- Determine mechanical resonance frequency and setting of the integrated filter for vibration suppression
- Determine friction and constant load by means of constant movements
- Determine inertia by means of acceleration
- Calculate optimal speed and position loop parameter (no current loop)
- Test parameter for stability
- Increase parameter values, evaluation of the result
Tuning / Parameter Setting

Auto Tuning

Controllers structure in view of Autotuning Lexium32
Auto Tuning

Autotuning can be executed with:

- Internal HMI
- External HMI
- Commissioning tool

Easy Tuning

Easy/Comfort Tuning
Easy tuning with just one button

Can be performed from the internal HMI, external key pad and commissioning tool.

Fitting for main applications in uncritical conditions (e.g., pick and place)

No knowledge about drives and servo technology necessary. A very basic knowledge on mechanics necessary

Set up one parameter: Direction to protect the mechanic

Global gain can be used.
Tuning / Parameter Setting
Auto Tuning / Comfort

Comfort Tuning

**Comfort tuning with mechanical settings**

Performed with the external HMI or commissioning tool

Control loop parameters depend on settings for the mechanical system

Two more parameters can be adjusted: mechanical coupling and the movement speed.
Best in class results can be achieved
Global gain can be used

Results are very hard to beat even for real experts!
Set Exclusive access „on“.

Switch to the operating mode Manual/Autotuning and start the Comfort Tuning.
Tuning / Parameter Setting

Auto Tuning / Comfort

Type of movement:
- AT_dr: Positive Negative Home
- AT_n_tolerance: 10 1/min
- AT_n_ref: 100 1/min
- AT_vel: 2.0 revolution
- AT_watt: 500 ms

Mechanical system:
- Direct Coupling
- Belt Asss
- Spindle Asss

Fine tuning:
- Global gain: 100.0 %

Summary

Schneider Electric – Machine Solutions – Closed Loop Technology Lexium32

Summary
# Tuning / Parameter Setting

## Auto Tuning / Comfort

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Info</th>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT_state</td>
<td>x</td>
<td></td>
<td>Autotuning status (auto_tune_err/end/process)</td>
</tr>
<tr>
<td>AT_dis</td>
<td>x</td>
<td></td>
<td>Movement range autotuning</td>
</tr>
<tr>
<td>AT_dir</td>
<td>x</td>
<td></td>
<td>Direction of rotation autotuning (e.g. pos-neg-home)</td>
</tr>
<tr>
<td>AT_n_ref</td>
<td>x</td>
<td></td>
<td>Speed jump for motor starting</td>
</tr>
<tr>
<td>AT_gain</td>
<td>x</td>
<td></td>
<td>Adapting controller parameters (tighter/looser)</td>
</tr>
<tr>
<td>AT_n_tol</td>
<td>X</td>
<td></td>
<td>Revolution tolerance by parameter definition</td>
</tr>
<tr>
<td>AT_mechanics</td>
<td>X</td>
<td></td>
<td>System coupling type (e.g. direct coupling, medium, soft)</td>
</tr>
</tbody>
</table>
“AT_dis” Movement range auto tuning

Range in which the automatic optimisation processes of the controller parameters are run. The range is input relative to the current position.

Caution with “movement in only one direction “parameter AT_dir”, it corresponds to the actual movement of a multiple of this specified range. It is used for every optimisation step of the Auto Tuning.
### Tuning / Parameter Setting
#### Auto Tuning / Comfort

<table>
<thead>
<tr>
<th>Option</th>
<th>AT_dir</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+/-</td>
<td><strong>Pos-neg-home:</strong> First positive direction, then negative direction with return to initial position</td>
</tr>
<tr>
<td>2</td>
<td>-/+</td>
<td><strong>Neg-pos-home:</strong> First negative direction, then positive direction with return to initial position</td>
</tr>
<tr>
<td>3</td>
<td>+ with return to initial position</td>
<td><strong>Pos-home:</strong> Only positive direction with return to initial position</td>
</tr>
<tr>
<td>4</td>
<td>+ without return to initial position</td>
<td><strong>Rotary_axis_Pos:</strong> Only positive direction without return to initial position</td>
</tr>
<tr>
<td>5</td>
<td>- with return to initial position</td>
<td><strong>Neg-home:</strong> Only negative direction with return to initial position</td>
</tr>
<tr>
<td>6</td>
<td>- without return to initial position</td>
<td><strong>Rotary_axis_Neg:</strong> Only negative direction without return to initial position</td>
</tr>
</tbody>
</table>
Tuning / Parameter Setting

Auto Tuning / Comfort

**AT_Mechanics : System coupling type:**

- Direct Coupling
- Belt Axis
- Spindle Axis
“AT_n_ref”, “AT_n_tolerance”:

To find the optimal controller settings, auto tuning starts a speed jump (AT_n_ref) and check the actual speed (n_act) performance. Afterwards the actual speed has to be in the rotation window (AT_n_tolerance).
Tuning / Parameter Setting
Auto Tuning/Comfort

Ctrl_Globgain: increase or reduce the stiffness

After the auto tuning is finished, it is possible to optimize the controller parameter with the parameter Ctrl_Globgain. In the same way as auto tuning, the parameter Ctrl1_KPn, Ctrl1_TNn, Ctrl1_TAU_nref and Ctrl1_KPp are synchronous changed.

The value 100 represents the theoretical optimum.

Value larger than 100 mean that the regulation is tighter and smaller values mean that the regulation is looser.
Tuning / Parameter Setting
Auto Tuning

Demonstration Autotuning
Linear axis PAS42
BSH1002
No gear, direct coupling

- JMotor = 2.3 Kgcm²

- Jextern (Load 3.75Kg): 38.1 Kgcm²

- Inertia mismatch = 16.6 !