

Experimental filter setting for bearing controller with cascade speed controller

The following description is for the boards APCI-8001, APCI-8008 and CPCI-8004.

This instruction is only valid for drive systems with servo speed controllers. For other drive systems, like current regulated systems or stepper motor systems, this procedure cannot be used.

Standard controllers

When using a speed controller, the following filter parameters must be set: K_p , K_i , k_{fcv} .

All other parameters stay on 0. The setting can be improved with K_d only in insufficiently damped systems. This instruction requires that the user knows the menus and terminology of the program mcfg under Win 32. The procedure for taking over the modified filter parameters (Update Filter) and for starting and running back the trapezoid profiles as well as the display of the traverse movement in a graphical interface must be known.

Furthermore, it is required that the user is aware that the axes are sometimes traversed uncontrolled and that this is possible at any time and that, for example because of a wrong entry, unexpected traverse movements occur. Therefore it must be guaranteed that the respecting motor can turn freely and that a Stop by the emergency shutdown is guaranteed at any time.

Presettings

Firstly, the traverse movement is recorded in the open loop. Here, it must be checked if the turn direction is correct (positive output values must cause positive count direction) and if the transient response of the speed control corresponds with system in accordance with the rules (comparable with the e-function of the transient response of the true speed). It may be necessary to start by setting the speed controller correctly. Otherwise, it may only be possible to set the overlaid position controller to a limited extent.

Setting of K_p

The axis is traversed with a trapezoid speed profile with adequate acceleration ramps and adequate maximum speed. The traverse distance should be so long that for the acceleration range, the linear traverse range and the braking range always 1/3 of the traversing time is required. Now the proportional factor K_p is calculated experimentally of small values (approx. 0.1), beginning until the true value follows the set value the best way but without that the stability is worsened obviously. Realistic values range between 0.1 and 10. The found value for K_p will be written down.

Setting of k_{fcv}

Afterwards K_p is set again on 0 and the speed pre-regulation coefficient k_{fcv} will be calculated in a similar way like K_p . However, in this case the value begins with 1. Realistic values range here between approx. 10 and 200. This parameter is compared in the way, that the max. speed is on the same level at the true value and set value. The found value will be written down.

Caution: When this setting is used, the system will be operated only controlled, this means that a speed set value is put out and the set speed course is proportional (trapezoid course). In some cases an overswing can be noted, especially after the end of the acceleration and braking phase can be noted. Furthermore, because of inadequately selected factors unexpected big or fast traverse movements are possible. In addition, the system may not stay unattended, as otherwise the axes would drift away and cause damage. After the calculation of k_{fcv} , the control loop should be opened in order to prevent traverse movements in jumps by the reactivation of the proportional controller.

Common setting of Kp and kfcv

At Kp and kfcv the values that were written down will be entered. When traversing, the axis should be stable. The true velocity course should follow the set velocity course without any significant deviation. Only at the end of acceleration and braking ramp, overswingers or transient processes may be noted. In general the value of Kp must be modified here slightly downwards in order to improve the controlling behaviour or to find an optimum. However, optimum does not mean that the overswinger is eliminated.

Optional D-part

If the oscillation behaviour cannot be set without overswingers, these can often be eliminated by adding a D element (Kd). When this value has been determined, Kp can normally be increased still further. Realistic values are between 0.001 and 1.

For experimental setting, we first determine Kp and kfcv as described in this application note and set them in such a way that the target point is reached with an overswinger (position and/or velocity). We then add a D element using Kd. This should start with a low value, e.g. 0.001. The value is then progressively doubled and the control behaviour observed. The correct value is found when the overswinger is minimised.

But be aware: At any value, the position control loop can be destabilised by just a slight increase.

When a suitable value has been found, Kp can generally be increased further also, increasing the rigidity of the control loop.

Setting of Ki

In order to compensate the input offset of the speed controller, an I-part can be added. This is required, especially then, when the position precision in the bearing control is not sufficient. Here it must be considered that they can change as consequence of temperature and long-term conditions. Also K_i must be calculated experimentally. Realistic values range between 0.1 and 100. The values are increased slowly. Stability and transient response may not be deteriorated.

Changing the scan time

Changing the scan time of a system affects the speed pre-regulation coefficient kfcv. If this is not to be experimentally redetermined, it can also be calculated.

The kfcv value has to be decreased or increased at the same ratio as the scan time is increased or decreased. If, for example, the scan time is halved, kfcv must be doubled. Where required, the acceleration pre-regulation coefficient needs to be adapted as well, however using the square of the ratio. Generally, all other filter parameters can remain unchanged.

Taking over the value into the file SYSTEM.DAT

After finding the optimal settings, the found values must be saved. Hereto, click firstly on the button „Update System Data“. Herewith, the values are taken over into the window „System Data“. Afterwards, this window must be opened, for example, with Ctrl+S. Now you can save it, for example, by clicking on the floppy disk icon. Herewith, the values will be saved in SYSTEM.DAT and are available for the next session or application.