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Prof. Dr.-Ing. habil. Proske **March 2010**
Lab.Eng.: DI Sbieschni

1 Objective

The behaviour of a speed control with virtual-continuous designed controller adjusted according to the Technical optimum has to be analyzed.

2 Preparation

2.1 Repeat the learning matter of the corresponding chapters of the course!

2.2 Ascertain the transfer function of a continuous controller for the control loop shown in Fig. 1 according to the Technical optimum. Calculate the controller parameters (serial realization) according to the plant parameters given in section 4. Transform these parameters to the parameters of the parallel realization.

2.3 Ascertain the parameters for a virtual-continuous designed controller fort he control shown in Fig. 2 using the sampling times given in Table1. Transform these parameters to the parameters of the parallel realization.

Stand	T_{A1}	T_{A2}	T_{A3}	T_{A4}
4	5 ms	30 ms	60 ms	120 ms
5	5 ms	20 ms	40 ms	80 ms

Table 1

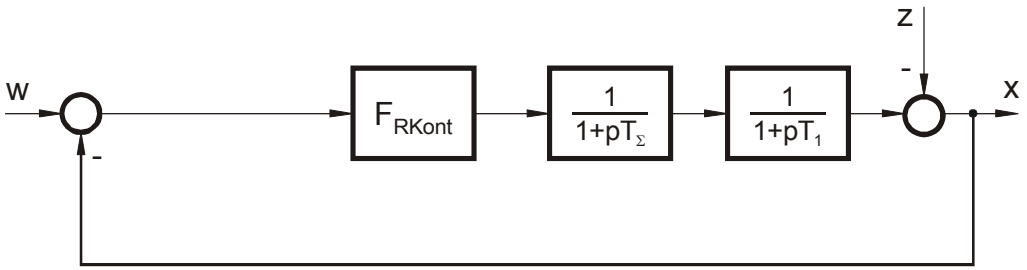

Fig. 1

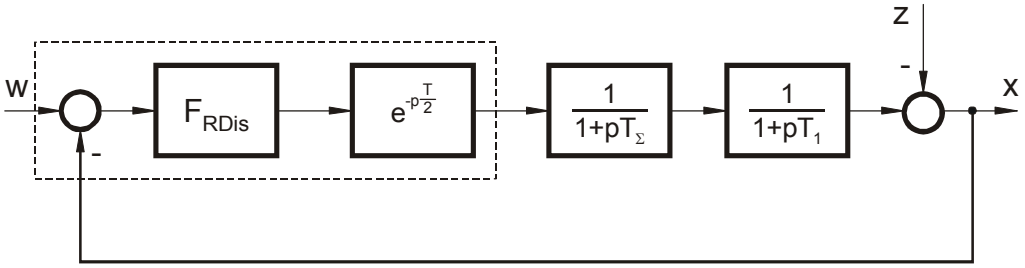

Fig. 2

3 Literature

[1] Proske, D.; Regelungstechnik, Berechnung von Regelkreisen - Teil 2 Entwurf von Reglern für einschleifige Regelkreise. FB Elektro- und Informationstechnik an der Hochschule Zittau/Görlitz

[2] Proske, D.; Regelungstechnik, Einführung in die digitale Regelung. FB Elektro- und Informationstechnik an der Hochschule Zittau/Görlitz

[3] Schönfeld, R.; Grundlagen der automatischen Steuerung; 1. Auflage 1984, Berlin Verlag Technik

[4] Günther, M.; Zeitdiskrete Steuerungssysteme; 2. Auflage 1988, Berlin: Verlag Technik

[5] Unbehauen, H.; Regelungstechnik II; 6. Auflage 1993, Braunschweig/Wiesbaden: Friedr. Vieweg u. Sohn Verlagsgesellschaft mbH

4 Experiment set-up

The experiment set-up shown in Fig. 3 consists of a separate excited dc motor (M) with rectifier SIMOREG for excitation, a dc chopper converter with IGBT, a PLC S7-314IFM, a continuous PI-controller, a PC for measurement, a pulse generator and components for power supply.

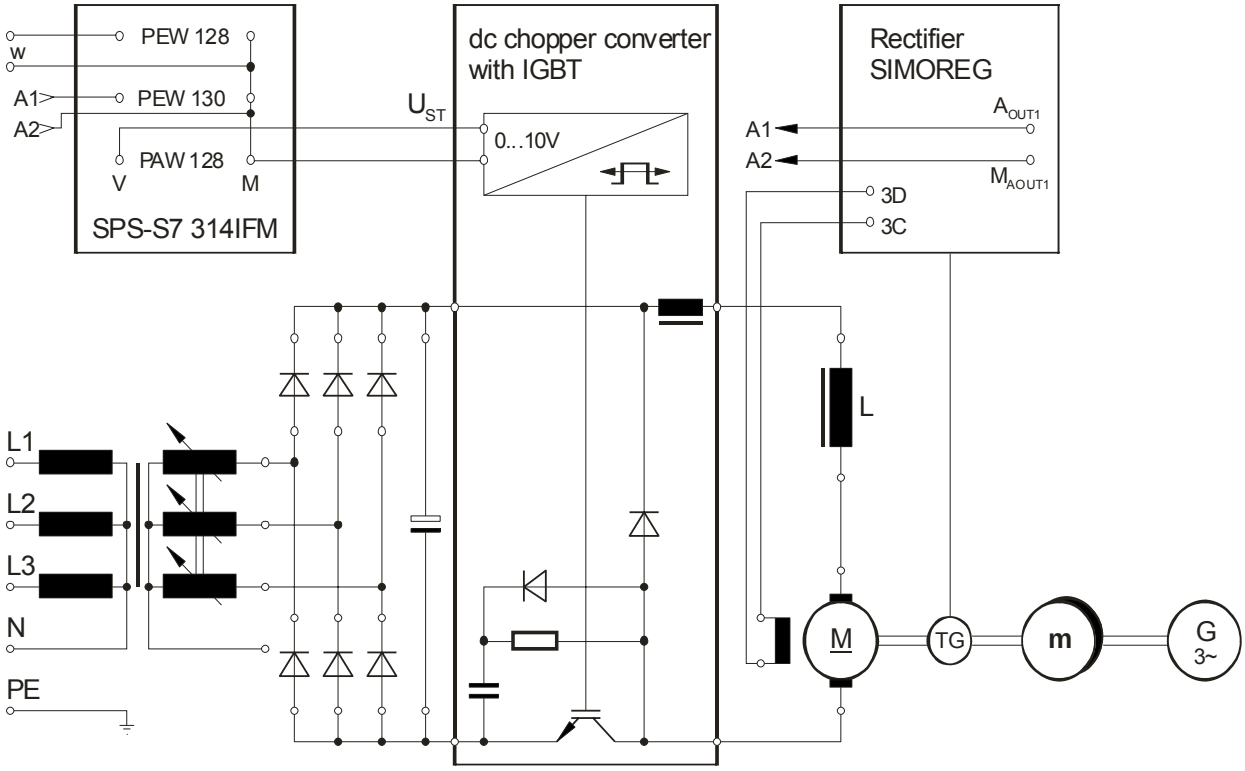

Fig. 3

Parameters of the dc machine:

U_N = 220 V; I_N = 6,0 A; P_N = 0,8 kW; n_N = 1200 min^{-1}; U_{err} = 110 V

Parameters of the plant shown in Fig. 1 and 2:

Stand 4: V_S = 0,53; T_1 = 0,32s; T_Σ = 0,06s

Stand 5: V_S = 0,56; T_1 = 0,22s; T_Σ = 0,045s

5 Handling of the devices

5.1 Adjustment of the rectifier SIMOREG

Activate the choice of parameter by pushing button „P“ and adjust with buttons „↓“ and „↑“ parameter P51 (Access). After once more pushing of button „P“ adjust parameter 51 to 30 (Access service personal) and quit with pushing button „P“.

The parameters P82 (Excitation voltage), P740 (Analogue output 1) and P742 (Filter time constant for Analogue output 1) have to be adjusted for the experimental procedure as follows:

P51:	30	Access service personal
P82:	01	Excitation off
	03	Excitation on
P740:	04	Speed to Analogue output 1
P742:	40 ms	Filter time constant for Analogue output 1 at stand 4
	25 ms	Filter time constant for Analogue output 1 at stand 5

5.2 Programming of the PLC

5.2.1 Adjustment of the controller parameters

a) Using the Standard – SFB „PID – controller“

The controller is programmed in module OB35 of the project DigRegSFB.

After calling up the programme SIMATIC-Manager the project DigRegSFB has to be opened to adjust the controller parameters. The module OB35 is located in the file folder “Bausteine”. The editor will be opened by double click on the module. The controller coefficients can be changed in network 4 at the system function module „CONT_C“. The sampling time T_A has to be adjusted at input „CYCLE“, the gain K_P at the input „GAIN“ and the reset time T_N at input „TI“. The changed module has to be transmitted subsequently to the PLC using the command „CPU“ -> „Download“.

b) Using the user written controller program

The controller is programmed in module OB35 of the project DigRegQK. Open the project DigRegQK to change coefficients. The module OB35 is located in the file folder “Bausteine”. The editor will be opened by double click on the module. The controller coefficients are indicated in the program by the comment „//Koeffizient C1“ or „//Koeffizient C2“ and should be overwritten in the REAL format (i.e. with decimal point).

Transmit the changed module subsequently to the PLC using the command „CPU“ -> „Download“.

5.2.2 Adjusting the sampling time

The sampling time can be adjusted by using the program SIMATIC-Manager. The object „Hardware“ will be shown in the left window after marking „SIMATIC 300 Station“ in the right window. After opening of the object the program „HW Config“ will be activated. The sampling time will be adjusted as „Cycle Interrupt“ in the object attributes of the CPU module. The module OB35 will be called up and executed each time after the end of the time adjusted in „Cycle Interrupt“.

The changed module has to be transmitted subsequently to the PLC using the command „CPU“ -> „Download“.

5.3 Using the measurement program

The measurement will be carried out with the program DigReg. The program offers the possibility to adjust the measurement interval.

The measured values will be stored as ASCII table in the format

Time in ms; measurand channel 0; measurand channel 1; measurand channel 2.

6 Duties

6.1 Analysis of the transient behaviour of a continuous control

The continuous controller has to be adjusted to the values calculated in point 2.2.

Switch on the excitation of the dc motor by parameterization of the rectifier SIMOREG. Adjust the feeding voltage of the dc chopper converter to 220V. Determine the operating point of the speed to 750 min^{-1} by applying of 4 V dc at the input of the dc chopper converter. Add a ±0,25 V square wave voltage form a wave form generator for the measurement of the step response. Measure the speed at the analogue output Aout1 of the SIMOREG with channel 1 of the PC measurement board.

Measure the actuating variable with channel 2 of the PC measurement board. Cannel 0 will be used for triggering and has to be connected to the output of the pulse generator.

6.2 Analysis of the transient behaviour of a virtual continuous control

The coefficients calculated in point 2.3 have to be entered by using the editor into module OB35 of the project DigRegSFB of DigRegQK and have to be transmitted into the PLC. The sampling time has to be adjusted as „Weckalarmzeit“ in the hardware configuration and to be transmitted into the PLC. Measure the step response according to point 6.1 for the sampling times according Table 1 without or with correction of the influence of the time-discrete operation mode.