CC Prakt_RT2_02CC	Course: Automatic Control Theory Exercise: Cascade control CC	Fakultät Elektrotechnik und Informatik

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Lab. Eng.: Sbieschni

1 Objective

A speed control with secondary armature current control loop has to be assembled for a drive with separate excited dc motor. The control loops should be set up according to the Technical optimum.

The plant parameters have to be measured or calculated to realize an optimal adjustment of the controllers. The necessary plant parameters are the time constants T_1 und T_2, the gain of the armature loop and the gain of the mechanical part. These plant parameters are the basis for the calculation of the controller parameters for the laboratory exercise.

Afterwards the controlled variables have to be tested for a transient behaviour according to the Technical optimum if desired and disturbance variables are changed. The armature current loop has to be investigated in the first part of the exercise. The speed loop has to be optimized and investigated in the second part.

2 Preparation

The knowledge on electronic power converters (especially rectifiers) and on the operational behaviour of a rectifier fed direct current motor have to be repeated. Further on have to be repeated methods for the parameter estimation of delay elements by use of the unit step response.

The dynamic behaviour of the drive has to be lined out mathematically in written form.

3 Literature

- Felderhoff, R.: Leistungselektronik, Carl Hanser Verlag München Wien 1984
- Proske, D.: Regelungstechnik: Grundbegriffe der Regelungstechnik. Hrsg.: FB Elektro- und Informationstechnik an der Hochschule Zittau/Görlitz
- Proske, D.: Regelungstechnik: Beschreibung linearer Systeme mit Hilfe der Laplace-Transformation. Hrsg.: FB Elektro- und Informationstechnik an der Hochschule Zittau/Görlitz
- Meyer, M.: Elektrische Antriebstechnik, Band 2: Stromrichtergespeiste Gleichstrom-maschinen und voll umrichtergespeiste Drehstrommaschinen. Berlin, Heidelberg, New York, Tokyo: Springer 1987
- Bystron, K.: Leistungselektronik, Carl Hanser Verlag
- Michel, M.: Leistungselektronik, Springer Verlag
- Heumann, K.: Grundlagen der Leistungselektronik, Teubner-Studienbücher
- Hagmann, G.: Leistungselektronik Grundlagen und Anwendungen, Aula-Verlag Wiesbaden
- Jäger, R.: Leistungselektronik Grundlagen und Anwendungen, VDE-Verlag

4 Stationery

- Single logarithmic millimetre paper Nr. 495 (www.papersnake.de)

5 Experiment set-up

The set-up of the exercise is shown in Fig. 1. The experimental rig consists of a separately excited dc motor (M) with tachometer (TG), a three-phase bridge rectifier (B6) with control device, a variable isolating transformer (Tr), two controllers, a current transformer for the potential-free measurement of the armature current and an invertor fed three-phase motor (G) for load.

Parameters of the dc motor:

U_N = 220 V; I_N = 8,0 A; P_N = 1,5 kW; n_N = 2000min^{-1}; U_{err} = 220 V

The structure of the control loop is shown in Fig. 2 .

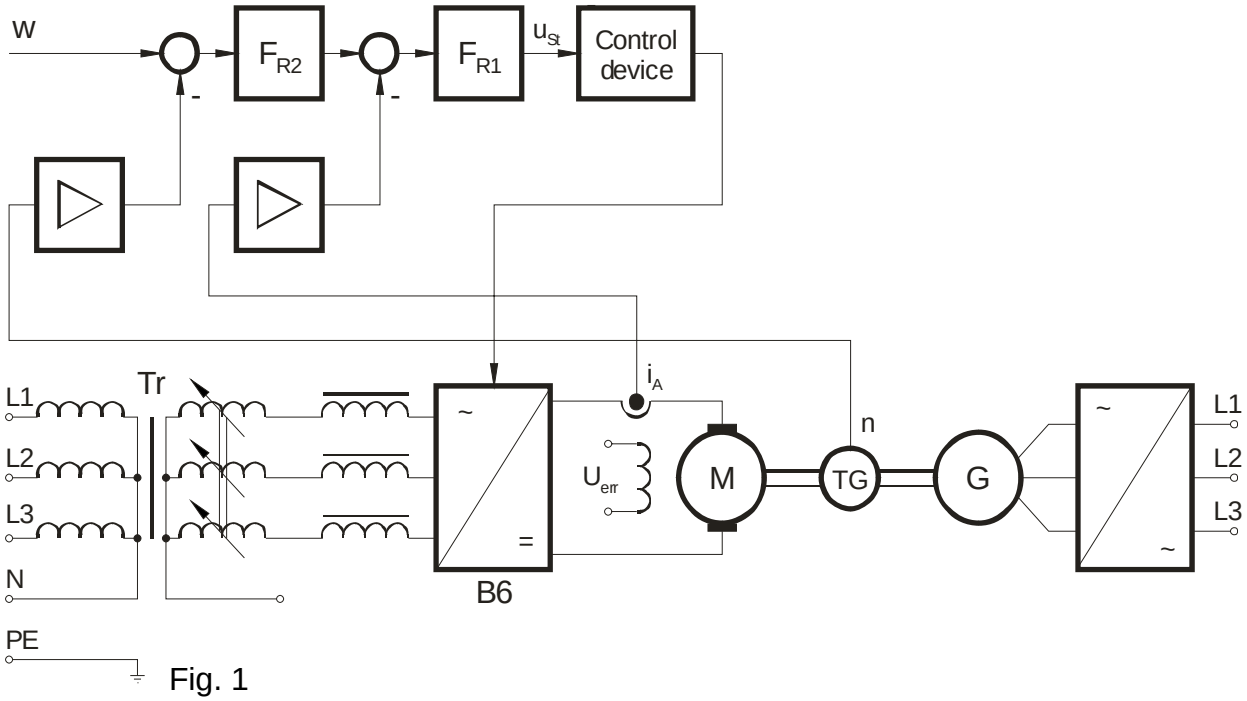

Fig. 1

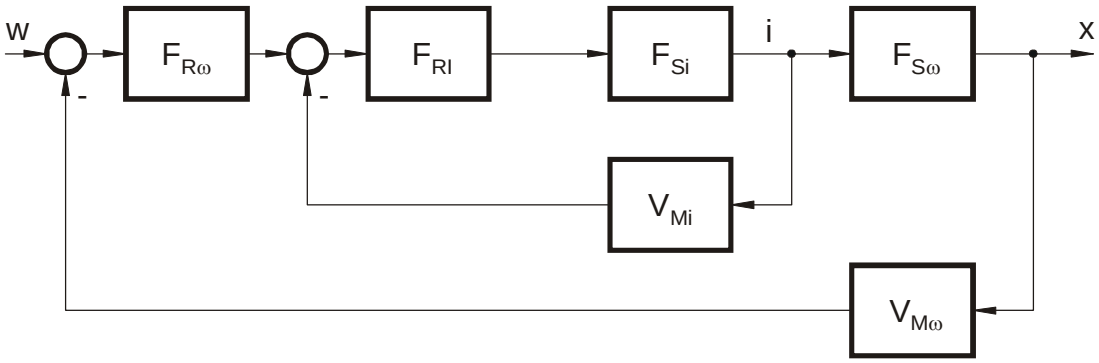

Fig. 2

5 Duties

5.1 Measurement of time constants and gain of the plant

The gain of the armature loop has to be measured in the standstill of the motor (Excitation switched off). The output voltage of the variable isolating transformer has to be adjusted to 25V.

The input voltage u_{St} of the control device has to be adjusted to an armature current of 5A. The gains V_{Si} und V_{Mi} will be ascertained by this measurement.

The time constants of the plant will be ascertained on a speed of 1000 min^{-1}. After switching-on of the excitation the output voltage of the variable isolating transformer has to be adjusted to 100V. The input voltage u_{St} of the control device has to be adjusted to a speed of n = 1000 min^{-1}. An additional jump of Δu_i = 0,2V has to be connected to the control device for the measurement of the jump response. The time constants and the gain of the plant should be determined by use of suitable methods.

After this the gains $V_{S\omega}$ and $V_{M\omega}$ should be ascertained. The measured time constants should be transformed into a format suitable for the use of the Technical optimum.

5.2 Start-up of the control loops

The current controller has to be set up on the determined parameters. Its behaviour should be measured after start-up (Excitation switched off!) in proof of the accordance to the Technical optimum. The controller set-up has to be corrected if necessary.

After this the current controller has to be set up on the determined parameters and the excitation has to be switched on. The behaviour of the speed loop has be measured after start-up in proof of the accordance to the Technical optimum.

6 Report (Interpretation)

- Summarization of the determined performance indices for the reference variable response and disturbance response
- Comparison of the measurement results and discussion of the effect of the correction elements