Proposal and realization of dynamo control by ControlWeb

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Abstract

Proposal and realization of program for control over dynamometers converter by ControlWeb software. Convenient sensors connection and usage for control over dynamometer. Usage whole application for measurement of other machines parameters with a view to Micro turbine plus high-speed synchronic generator.

Key words

Control, Dynamometer, Micro turbine, High-speed synchronic generator, ControlWeb.

1. Introduction

Proposal and realization of whole program depends on measuring different parameters on others machines. The most important is connection between Micro turbine and High-speed synchronic generator, which will be subject matter of our future work. Whole realization is divided in following steps:

a) Initiation of dynamo entire
b) Selection of right measuring sensors
c) Creating of required environment for controlling and measuring for touch panels
d) Initiation of machines for measuring of different parameters
e) Implementation of full measurement solution

At present are done the first three steps (from a to c), which are more describe at this papers.

2. HW equipment

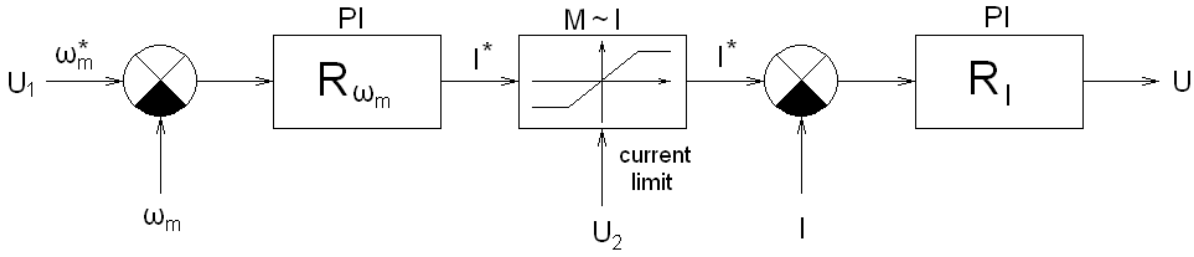
For this research intent has been bought new electrical table (see below ***Pic.1.***).

Pic. 1. *„Piano“ – new electrical worktable*

This electrical worktable contains switchboard and provides control and measuring with general machines (manual switches, potentiometers, pointer-type measuring instruments etc.) but also with HMI (Human Machine Interface) boundary line which is connected to central PC unit.

2.1 Dynamometer

Separately excited bipolar dynamo has 1500rpm rated speed and 500Nm nominally moment. Dynamo is controlled by SIMOREG DC MASTER 6RA70 converter which is set up by two analog and four digital inputs [2]. Analog inputs are necessary for requirement on speed and torque and digital inputs are used for unblocking pulses, unblocking regulators and reversal direction of speed. Basic regulation schema for requirement speed and torque is demonstrated in ***Pic.2.***

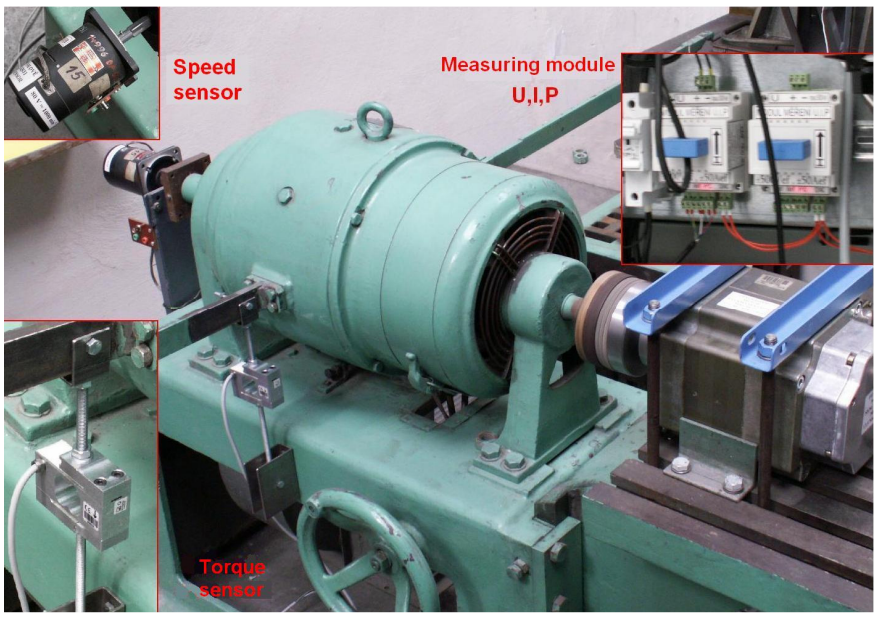


Pic. 2. *Regulation scheme of required speed and torque in converter SIMOREG 6RA70*

U_1 – required speed U_2 – required torque U – dynamo output control

2.2 Measuring instruments

On the basis of dynamo control was necessary to choose sensors for accuracy functioning verification. The *Speed Sensor* output with range 80V on 1000rpm has been modified at unified signal 0÷10V through the resistance voltage divider. *Torque transducer S2* with *measuring amplifier RM4220* is possible to set exactly at proper signal level. These both sensors are working with unipolar signal with range 0÷10V, more in ***Pic.3.***



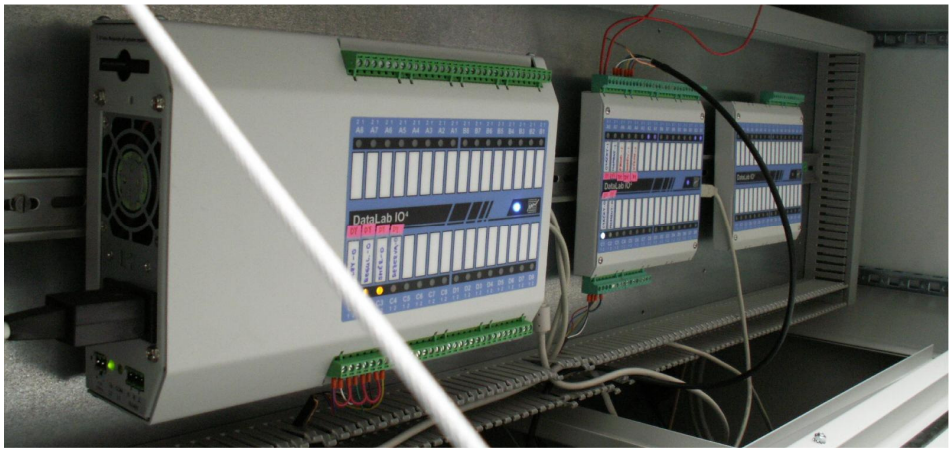
Pic. 3. *General view on dynamometer with connected speed and torque sensors.*

For measuring of effective value of current supply, voltage and active power is used *module U, I, P*. Connection of this module is illustrated in ***Pic.3.*** The U,I,P module outputs are unipolar unified current signal in range 4÷20mA or 12÷20mA (for active power). For obtaining the real value (in appropriate units) it is necessary all convert by (in program intimated) easy relations of all outputs signal.

2.3 Control system

ControlWeb software environment is directly established for industrial computer system of the same company which name is DAtaLab. Complete system is composed of central processing unit DataLab PC, touch panel (which conveying HMI communication) and additional expansion module DataLab IO.

Control unit is fully compatible with standard PC, it means it is possible to use common operation system Windows 2000/XP, Linux and their embedded versions. It makes possible to create, test, adjust layout and use application right on the used machine. There are self interface which is mounted by chosen combination of inputs/outputs (16 digital outputs and 16 digital inputs). Other possibility of monitoring, measuring and system controlling is to use expansion module connected through USB port. In our case we are using module with 8 analog outputs (for controlling) and 16 analog inputs (for measuring). All components are easily mounting to DIN bar and place the system in to the switchboard (see ***Pic.4.***). For operating the running application is used touch panel which supply communication between the machine and user.



Pic. 4. *Currently configuration of industrial computer system DataLab*

3. SW realization

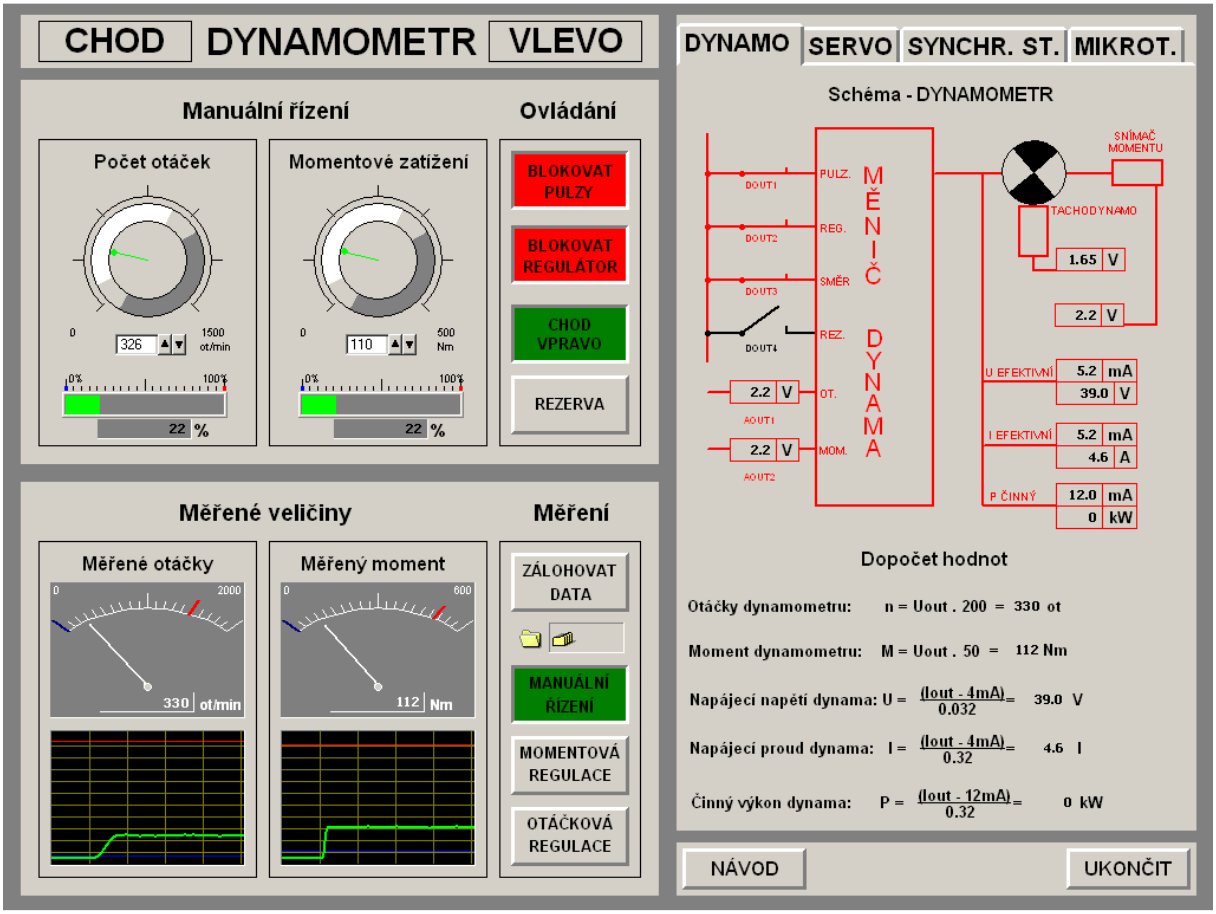
The most important part of all applications are correcting settings of inputs and outputs. Their full list is presented in ***Table 1.*** It is only contemporary list of signals where it is seeable that with increasing intensity of system will be raising number of signals. Program structures include the primary demand for possibilities of parameters measurements on the other machines. The screen is divided into two main parts: controlling and measuring parts. In the controlling part (on the left side) is situated control of dynamometer, its settings and signalization of main signals (torque and speed). In the measuring part (on the right side) is established bookmarks panel with possibility of switching among measuring machines. Next to dynamometer on the appropriate bookmark is situated basic schema of control (dynamo

converter input) and measurement with intimated connected sensors. There are pictured measurement signals and their convert for real values.

Table 1. *– List of whole present inputs and outputs, which were used in program application.*

OUTPUTS	Title	Range	Description
AOUT1	DY_OTACKY_OUT	0÷10V	analog output 1
AOUT2	DY_MOMENT_OUT	0÷10V	analog output 2
DOUT1	DY_PULZY_OUT	0/24V	digital output 1
DOUT2	DY_REGULATOR_OUT	0/24V	digital output 2
DOUT3	DY_CHOD_OUT	0/24V	digital output 3
DOUT4	DY_REZERVA_OUT	0/24V	digital output 4
INPUTS	**Title**	**Range**	**Description**
AIN8	DY_OTACKY_IN	0÷10V	analog input 8
AIN7	DY_MOMENT_IN	0÷10V	analog input 7
AIN6	DY_PROUD_IN	4÷20mA	analog input 6
AIN5	DY_NAPETI_IN	4÷20mA	analog input 5
AIN4	DY_VYKON_IN	12÷20mA	analog input 4

Digital outputs are represented by four buttons. At first is necessary unblock pulses in dynamo converter and then unblock regulators. Dynamo direction is possible choose by button „*CHOD VPRAVO*“ or „*CHOD VLEVO*“. This button is active only in quiescent mode of the machine (when dynamo is stopped). If pulses and regulators are unblocked it is possible to set requirement speed and torque limitation by two potentiometers (analog outputs). This is method how to measure random settings of outputs parameters.



Pic. 5. *Dynamometer control and measuring screen in ControlWeb application*

But it is possible to switch it in to „*MOMENTOVÁ REGULACE*“(or „*OTÁČKOVÁ REGULACE*“) mode. In this case the speed (or torque) is set up to maximum and appropriate potentiometer is locked up. Measurement proceeds only by regulation of torque limit (or speed).

All measurement values are spared during the measuring. For further elaboration is necessary to save these values at portable medium (e.g. USB flash disc) and eventually run in relevant software. After restarting system are measured value overwritten due to small capacity of DataLab PC internal disc.

Brief description of measuring is mentioned at separate list, which is shown by touching button *„NÁVOD“*. When the measuring is done, the application can be left by pressing button *„UKONČIT“*. Position of all control buttons and measuring graphs on the screen is in ***Pic.5.***

4. Conclusion

As it was mentioned earlier from complete assignment has been finished only several points. At present is the system in testing period and it is fully functional. During first measurements was found unwelcome disturbances especially in voltage signal. Influence of this disturbance has been mostly eliminating by proper algorithm, but also trough that it would be better to use current signal. It is about measurement speed and torque. Next step will be launching servomotor and measuring parameters of the same characters like on micro turbine and high-speed synchronous generator.

List of symbols

U_1	required value of speed	[rpm]
U_2	required value of torque	[Nm - A]
U	output from regulation loop – control of dynamometer	[A]
M	torque limitation	[Nm]
ω_m	actually speed	[rpm]
ω_m^*	required speed	[rpm]
I^*	regulated current	[A]

References

[1] Uhlir, I., Novak, L., Novak, J. a kol. *Elektrické stroje a pohony*, Praha: Nakladatelstvi CVUT, 2007, ISBN 978-80-01-03730-0

[2] *SIMOREG DC Master 6RA70* - Navod k obsluze a udrzbe, SIEMENS s.r.o. 2009

[3] *Force Transducer S2/S9* – Mounting instruction, HBM 2008

[4] *S.G.-Amplifier RM 4220* – Operating manual, HBM 2008

[5] http://www.mii.cz 10.12.2008

[6] http://www.siemens.cz 5.12.2008