Scheme of the error backpropagation implementation is presented in Figure 1.
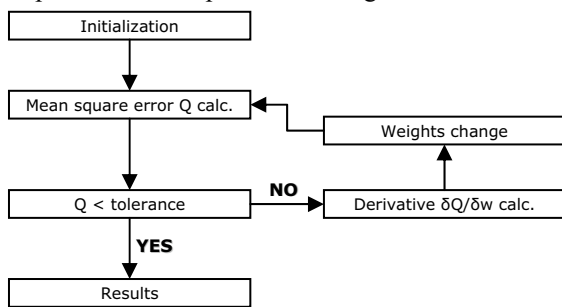

Fig. 1 Fitting procedure based on the error backpropagation algorithm.
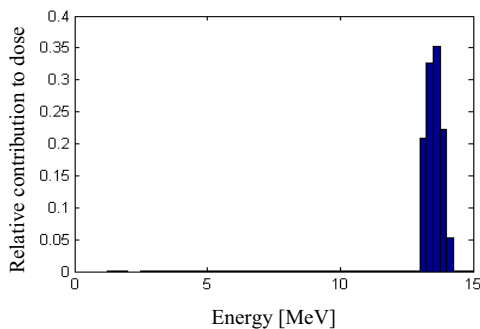

Fig. 2 Derived energy spectrum of wide field electron beam without scattering foils and applicator (note that deflection system energy slit filter was not optimized).

The mean square error tolerance was set to achieve agreement with measurements within 1% of maximum absorbed dose or less than 1 mm shift in isodose values. The derived initial electron beam energy spectrum can be found in Figure 2.

Finally, the uncertainty of the presented method was evaluated. Distinct initial values for known energy spectrum have been studied. Less than 1% dose difference can be achieved for energy distributions varying by ±250 keV, but it might be an effect of established energy intervals. On the other hand, the initial beam energy seems to be less sensitive to variations of percent depth dose than the dose to deviation of energy distribution. Further research should be carried out to investigate this promising inverse Monte Carlo method.

[1] P.Björk, T.Knoos, P.Nilsson, Influence of initial electron beam characteristics on Monte Carlo calculated absorbed dose distributions for linear accelerator electron beams; Physics in Medicine and Biology 47, 22(2002)4019-4041

[2] D.W.O.Rogers, B.A.Faddegon, G.X.Ding, C-M.Ma, J.Wei, T.R.Mackie, BEAM: A Monte Carlo code to simulate radiotherapy treatment units; Medical Physics 22(1995)503-524

[3] J.Żygierewicz, Neural Networks; Lectures available (in Polish) at http://brain.fuw.edu.pl

12.7 New Control Systems for SIMAX Simulator and Coline 4 MeV Accelerator Based on PLC Drivers
by A.Baczewski

The programmable driver PLC (Programmable Logic Controller) is a modular industrial computer designed to control objects with a number of two-stage digital inputs and outputs as well as analog inputs and outputs. Programmable drivers are used in automatic industrial systems, manufacturing processes etc. In our case the PLC drivers were applied for control systems for simulator Simax and Coline 4MeV accelerator. The designed control systems are based on PLC driver SIMATIC S7-300 from Siemens. A basic unit of PLC driver consists of supply, CPU processor and I/O units. Components are assembled on DIN rail. The industrial network MPI (Multi Point Interface) with a speed of 1.5 Mbps for communication between the CPU unit and the PC is used. Programming the driver SIMATIC S7-300 can be done on PC with the software STEP 7. The software WinCC 6.0 Siemens company is used for visualization on PC screen and for in line control and steering of a simulator or an accelerator as well as to collect data.

The simulator SIMAX control system is based on a single PLC driver (6ES7314-6BF01-OABO) with 24 digital input, 16 digital output and 4 analog I/Os.

Additionally the system is equipped with five analog and 3 digital extensions. It gives additionally 32 analog and 80 digital I/Os.

The control system of Coline 4 MeV accelerator is realized on the two programmable drivers SIMATIC S7-300 with CPU 313C. Applying two PLC drivers permits to create two independent, controlling each other dosimeter channels. It gives the possibility to switch off the accelerator in any unpredictable case. This solution guarantees maximum patient safety during radiation. The serial port RS 232 is used for communication between PLC driver and the internal hospital network. The control module of Coline 4 MeV accelerator consists of the two units 6ES7313-5BE01-OABO and additional analog (8AI-6ES7331-7NF10-OABO, 8AI-6ES7331-1KF01-OABO, 8AI-6ES7331-7NF00-OABO and 6ES7332-5HD01-OABO) as well as digital (16DO-6ES7321-1BH10-OABO, 16DO-6ES7322-1HH01-OAAO, 8DO-6ES7322-1HF01-AAAO) extension units. Finally such system has a possibility to control and stirring 80 digital inputs, 56 digital outputs, 32 analog inputs and 8 analog outputs.