Original Structure Could Be Reintroduced

about European education and collaboration with professor Piotr Tatjewski

Piotr Tatjewski – is Professor at the Faculty of Electronics and Information Technology of Warsaw University of Technology. He is Director in the Institute of Control and Computation Engineering, and also Head of Control & Systems Division. Academician, member of Automation & Robotics Committee of the Polish Academy of Sciences. He also worked for Technische Universität in Hannover, City University in London, University of Birmingham. Tatjewski is most know from his research on control and on-line optimisation of the multilayer structures.

From 1993 to 1997 Professor Tatjewski managed the EU Structural Fund Project named TEMPUS S-JEP 07181 – *Information Technology for Control and Decision – Support Curriculum Development*. The three-year-long project connected 16 technical universities from all European Union countries and had a budget of 700 000 ECU*.

He wrote more than 80 articles and papers. He published also few books, like acclaimed *Advanced Control of Industrial Processes: Structures and Algorithms*, and lately with M. Brdys *Iterative Algorithms for Multilayer Optimizing Control*.

JAMRIS: Professor, let's talk about teaching of automation in Poland. What future this field has? Accusations that Polish universities do not groom students to work in in a present-day company appears quite often. You are the expert, who prepared a proposal of new standards for this branch of study.

What can I say? First of all automation and robotics has light and unthreatened future, because equipment using automatic solutions is everywhere – in every house, in every vehicle, every office, every factory, only specifics and scale are different. The second is that contemporary automation is extremely close to information technologies, which means that installations of present day automation are designed by use of information technology (IT) hardware and software solutions to a great degree. At present day automation and robotics engineer has to be also an IT specialist. Therefore education of students' – in both fields has very much in common. The studies in automation and robotics should be based to an increasing degree on IT, or even can be finished with a formal specialization e.g. in computer science. On the contrary, the studies can be in computer science but with specialization from the field of automation and robotics, as it can be met for example in our department. Even on the job market – if you look at graduate students all over the country – graduates in automation and robotics have no troubles with finding a well-paid job, to a large extent because they usually have a good background in IT.

Professor is an enthusiast of sport, the Baltic Sea and classical music.

J: Therefore, incorporated changes have been necessary to modernize the actual teaching standards?

There had to be a readjustment of teaching standards to the demands of the Bologna process, and adjustments of study programmes at individual universities will follow. First, the Bologna process introduced a partitioning of the studies into lower (bachelor) and higher (master) levels, and second, it concerns completely differently the question of teaching standards. The old-type Polish standards contained certain number of subjects, treated as single or multiple courses, which should to be lectured at each university, college or academy. Currently European standards of teaching impose on the schools not only a demand of certain contents of the curriculum, but first of all duty of developing definite skills, which students should posses after completion of their education. Not before that we can test graduates from this point of view – if they fulfil standards or not. However, new teaching standards are not based on a concept of a subject or a course. They use a notion of teaching contents, which enclose the knowledge and, first of all, skills demanded from a student. The new standards are rather general directions how education should be organized, defining general requirements and a basis for a curriculum (study programme). According to the valid regulations, this basic contents do not need to cover more than 40% of the final curriculum. Every university must define its 100% curriculum autonomously, providing that its structure and 40% of its contents is in accordance with the standards. As you can see the main duty in constructing a programme of studies depends on a school. By the way, it is a challenge for the State Accreditation Commission. The accreditation process will have to be run in a different way than before, checking consistence of formal aspects of the teaching program with the teaching standards will be far not enough.

J: So, we have replacement of responsibility now: individual work of the student became equally – or even more – important than the topic of lecture. It is not enough to learn lectures by heart. It can be a little revolution in many Polish schools, especially in those less known.

Yes, indeed, but it is not the main difference. Individual students' work always played a dominant role at technical universities. But before, the standards shaped major

part of each individual curriculum. Arranging the whole programme merely by fulfilling standards was possible.

J: That is, universities have to be more competitive now?

Yes, they have. They may more individualize and specialize programmes of the studies – to match them with the structure and specific expertise of the staff or with the profile of the local job market. For example, there are areas with a need for specialists in control theory, in particular in decision support theory, which is a part of modern automation. It is possible to shape the teaching programme according to that situation. In such a rather non–industrial region as Warsaw, specialists knowing IT and analysis of dynamic systems from the point of view of decision support techniques are important. An example: in my Institute is Professor Toczyłowski's research group, since many years engaged with problems of energy market in Poland. They create aggregate mathematical models of electrical energy production and transmission, decision planning, simulation of market's behaviour etc. These models are optimised, and on the basis of those e.g. decision–making rules, proposals for energy market organization are rising.

J: You repeatedly stressed researches concern of multilayer systems of processes control and optimisation.

From the time of my master thesis I am interested in this very general subject matter, that Prof. Findeisen formerly practiced with great success. Later professor Krzysztof Malinowski led this group, and further I have had my own team. We are working on multilayer control and optimisation methods, mainly for industrial processes.

Multilayer control consists in decomposition of the initial, control task – which is naturally economical, e.g. to produce a prescribed quantity of petrol at minimal costs. Overall goals like that are decomposed to a set of simpler, partial sub-goals of different nature implemented at different control layers in the multilayer control hierarchy. Two basic control layers are: the direct control layer responsible for stabilization of technology objects at prescribed working points by means of feedback controllers, and the set-point optimisation layer which task is to define on-line short-term optimal working points (set-points) for the feedback controllers of the lower layer. Next higher layers of the hierarchy are concerned with mid-term and long-term production management and planning. The multilayer control system, for years a common practice in industry, is significantly simpler to be operated by humans and more resistant to breakdowns. Lower layers can work without the higher ones if these are out of order - of course, for not too long time, until a failure will be removed and original system structure will be reintroduced. However, an engineer at technical university is interested mainly in two lower layers: direct feedback control and optimisation of working points. My research group – known as Control Engineering Group – is working on this type of problems. In the last years we were mainly concerned with development of advanced control techniques, in particular modern predictive control algorithms for both linear and non-linear processes, and with development of set-point optimization algorithms, including those precisely tuned to work with predictive controllers.

J: You were also a leader of the international project – like TEMPUS.

I was a contractor and coordinator of a rather large project within the EU TEMPUS program in the 1990's, concerned with modernization of the curricula in the area of control and decision support. In this threeyear long project several technical universities took part: four from Poland (from Warszawa, Kraków, Gliwice and Rzeszów) and eight from the European Union countries. Generally, EU decided to support educational systems in East European countries, including Poland, long before they became the EU members – the TEMPUS program was elaborated to achieve this goal. It financed exchange of academic staff and students and purchasing equipment for laboratories. In effect, at four technical universities in Poland control laboratories were modernized, and a number of new courses was devised. Moreover, in Warszawa we introduced then, in 1990's, the two-stage model of studies at our Department (the first experience of that type at Polish technical universities). This model is being introduced currently at other technical universities as a result of the Bologna process.

J: Therefore, after all that finally we educate engineers at the world level?

We were never ashamed of the educational level at Warsaw University of Technology. I graduated in 1970's and many of my course colleagues' work at highly respected universities and laboratories all over the world. European or American universities have never questioned diplomas of Warsaw University of Technology. Our graduates were and are very welcome at western universities to do PhD studies. What counts in the world is the reputation of the university, not the country. In my judgement, not very good opinion about Polish education in general, which can be met now more and more often, has been caused by a free-market type policy which was taken in 1990's in development of private high education schools, without providing an appropriate accreditation system from the very beginning. As a result of that, but also of insufficient financial support of state universities, general educational level in Poland has decreased. On the other hand, what happens at secondary schools providing candidates for university education makes our life also harder. I must confess that I was in dismay when during last session of our Department Council the information was given how many pupils will take the secondary school final examination (matura) in mathematics and physics on expanded level in this year.

J: How many?

About 10% in mathematics, circa 6% in physics. Do not forget, that final exams in mathematics and physics at the expanded level are usually required for admittance to a technical university, e.g. are necessary to be enrolled to the Warsaw University of Technology.

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* ECU former EU currency replaced by EURO.