

## **AUTOMATIC CONTROL EDUCATION AT THE UNIVERSITY “POLITEHNICA” OF BUCHAREST**

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The first attempts, made in Romania, to tackle and solve the many issues related to the Automatic Control are recorded in the early fifties. They were tightly related to the evolution of science and technology. The Romanian Academy was the promoter of the first actions concerning the process automation and the development of the Automatic Control as a new field of science. Important personalities from the Mathematics and Engineering fields of study, such as Grigore Moisil, Corneliu Penescu, Aurel Avramescu, Ilie Papadache, Constantin Apetrei, Marcel Sarbu, Nicolae Budisan, Sergiu Calin, Simion Florea, and others formed a group of visionary experts that established the foundation of the Automatic Control in Romania. They were supported by the Automatic Control Commission from the Romanian Academy of Sciences.

The activity of these personalities was in line with the initiatives of many important researchers in Europe and the United States of America, who became founder members of the International Federation of Automatic Control (IFAC), in Heilderberg, in 1956. Today we can appreciate that, in 1957, Romania was among

the first countries that became an active member of IFAC.

The major objectives of the Automatic Control Commission were dedicated mainly to the formation of the specialists in Automatic Control and to the development of a powerful industry with a high degree of automation. The first specialist courses in automatic control have been organized in the period between 1957 and 1962. B.Sc., as well as post-graduate courses were available. At the same time, the first courses on Automatic Control are introduced in the curricula of all engineering fields of study. The first education programme on Automatic Control became operational in 1962 within the Faculty of Power Engineering, with a distinct curricula for the 3<sup>rd</sup> and 4<sup>th</sup> years of study.

In 1967 the first unit of Higher Education in Automatic Control in Romania was established at the University Politehnica of Bucharest. From that moment on, the Faculty of Automatic Control and Computers graduated year after year many generations of engineers in Automation and Computers.

New facilities for practical work with students were created, matching the actual evolution of the sciences of Automatic Control and Computers worldwide. The curricula were continuously upgraded. The new building of the Faculty of Automatic Control and Computers was ready for use by 1973, offering over 40 000 m<sup>2</sup>.

1968 was the first year when the Ph.D. on Automatic Control and Applied Informatics was awarded. Starting in 1969 the curricula were extended with new post-graduated courses.

The research activity in the Faculty of Automatic Control at the University Politehnica of Bucharest had a strongly related evolution to the education programs on Automatic Control. The research directions were very diverse. Among these we can find those on *System Theory*, stability of *Nonlinear Systems*, *Optimal Control* with application to the Power Industry, Chemical Industry and Automotive Industry, *Modeling and System Identification*, and many others. We can appreciate that the most important results obtained in the field of Automation were achieved by professors from our Faculty. The research results of our colleagues led to the industrial implementation of more than 40 various types of control equipment, computing devices and new technologies. As a special contribution by the teaching staff from our Faculty we can highlight the fact that Romania has important merits to the conception and development of personal computers, being among the first countries in Europe that produced and marketed personal computers and minicomputers, with original design and technology.

The two departments - *Automatic Control and Industrial Informatics* and *Automatic Control and Systems Engineering* - form the academic and scientific basis of specialist education in *Automatic Control and Applied Informatics*. The courses are taught for the students from the Faculty of Automatic Control and Computers and for a general education on Automatic Control for all the other specialists from the University "Politehnica" of Bucharest. These curricula include systems theory, process control, industrial automation and automation devices.

Over 100 topics from the curricula of Automatic Control and Applied Informatics are taught by

faculty staff from these two departments. The curricula cover all three levels of education, i.e. Bachelor, Master and Ph.D studies.

Over 60 staff members from these two departments are involved in research activities. The research interests inside the department of *Automatic Control and Industrial Informatics* are dedicated to the following topics:

- information systems
- artificial intelligence and robotics
- information acquisition, processing and transmission
- data processing and automatic diagnosis
- industrial processes modeling and control
- discrete event systems.

The department of *Automatic Control and Applied Informatics* covers the following research topics:

- dynamic systems and optimization techniques
- signal processing
- system identification, modeling and simulation
- intelligent control systems and bioengineering
- automation and advanced control systems.

The 12 research groups from these two departments are integrated in three research centers that are organized within the departments and in the framework of the CANTI research platform that is managed at the Faculty level. CANTI stands for *The Platform for Education and Interdisciplinary Research*.

For these two departments of Automatic Control 25 laboratories are organized for teaching and research. Over 30 students from the Master programmes and more than 50 Ph.D. students are involved in the research programmes with these two departments. These research programmes are financed on the basis of national and international research grants.

A very important topic of research – with real implementation on products and advanced technologies – regards the design and the deployment of numerical control systems.

The research results were published by scientific journals in Romania and abroad and were presented at the international conferences, including those organized by the IFAC. Even though the political system in Romania did not allowed a more intense communication with the international research community during these years, sporadic participations to the international events were possible and some papers were published in *Automatica* (IFAC Journal) and *IEEE Transactions on Automatic Control*. Starting 1975, the Faculty of Control and Computers organizes an international conference on Automatic Control and Computers, making a stronger connection with worldwide specialists on Automatic Control and Computers. The Proceedings of the Control Systems and Computer Science CSCS Conference, containing the most representatives papers presented to the English speaking conference, became trade knowledge with other scientific work, like books, proceedings of other international conferences, scientific journals, etc., that were absolutely necessary under the restrictive political system.

In this restrictive context with limited resources and limited access to the related scientific work, the teaching and research staff from our Faculty, that benefit from documentation and specialization stages in more developed countries, imposed an elevated environment in which younger students could formed themselves in Automatic Control and Computers.

Those over 6000 graduate students from our Faculty of Control and Computers in Bucharest, together with the graduate students from other Universities in Romania from Timisoara, Craiova, Iasi, Cluj-Napoca, represented the supporting base of the research programs on Automatic Control and Computers and of the industrial process automation programs.

The important social and political changes after 1990 influenced the education and research activity in a significant way. The reorganization of the Faculty as a whole and of the departments inside the Faculty itself led to the formation of two new departments which are oriented towards the specific problems of Automatic Control. At the same time, these two departments are importantly oriented towards the special topics of *Applied Informatics* and *Systems Engineering*.

The curricula were adapted accordingly and the organizing structure of the education process adapted to the new requirements, being compatible with 3 main education cycles: Bachelor, Master and Ph.D.

Starting with the year 1990 the Faculty of Automatic Control and Computers adhered rapidly to the new requirements of an open education process, which has to be connected to the European Higher Education System. We connected to this European Higher Education System by participating at the first European debates concerning the education in Automatic Control that were organized by WEPAC (West European Professors of Automatic Control), than by EPAC (European Professors of Automatic Control). Cooperation programs (for research and undergraduate and postgraduate studies) were initiated together with Automatic Control Departments from different Universities in Europe (Darmstadt, Grenoble, Valencia, Vienna, Berlin, Paris, Turin, Helsinki, Rome, Madrid, Lyon, etc).

At the same time, in the framework of the Tempus and Socrates exchange programs cooperation agreements were signed with the most representative departments in Europe, and exchange programs for students and professors were realized with Technische Universitaet Darmstadt, Institut Fur Automatisierungs Technik, Ecole Supérieur d'Ingenieurs d'Annecy, France, etc. As a member of the Department of Automatic Control and Systems Engineering, prof. Costica Nitu have been involved in cooperation activities that included research stages for Romanian students for the preparation of their final year projects together with the following European Universities: City University (London, Great Britain), Ecole Universitaire d'Ingenieurs de Lille (France), Instituto Politecnico do Porto, Universidad Politecnica de Madrid, Katholieke Hogeschool Sint-Lieven (Gent, Belgium), and Univrsita' degli Studi di Catania (Italia).

Scientific research programmes were initiated together with the Universities of Grenoble, Lille, Lyon, Upsala, Helsinki, Oulu, with different topics like Intelligent Control Systems, Intelligent Manufacturing Systems, Signal processing, Modeling and Identification, Robot Control.

The scientific research activities were

reorganized and reoriented towards some research fields with real impact over the knowledge development. Three research Centers were created: Advanced Control of the Continuous Systems, Integrated Control of Manufacturing and Robotics, Intelligent Control Systems and Bioengineering. In the 25 years that passed since the initiation of this research program more than 200 specialists became Doctors in Automatic Control after they finalized their Ph.D. program. They work now like faculty staff with those two Departments, with research institutes, or with different research labs all over Europe, USA or Canada.

The scientific production and the quality of the scientific work has continuously increased over the recent years. Scientific contributions originated from at the Faculty of Control and Computers from the University Politehnica of Bucharest are presented at the most

representative conferences organized by IFAC or IEEE. The number of the papers that were published in the ISI scientific journals tripled over the last years. Besides the CSCS, the international conference organized by the Romanian Society of Automatic Control and Technical Informatics (SRAIT) and the Faculty of Control and Computers, other 8 IFAC Conferences were organized in Romania in the last 12 years.

The Romanian Society of Automatic Control and Technical Informatics (SRAIT), which was born in 1991 has an important role in promoting a competitive system and of some consistent research programs. As a NMO – IFAC, SRAIT continuously promotes the IFAC principles in Romania, being the connection between the education system and the research and the economic environment.