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## CONSTANTIN BELEA AND SYSTEM THEORY

Gheorghe Manolea\*

University of Craiova, 13 A. I. Cuza Street, Craiova, Romania

\*email:ghmanolea@manolea.ro

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**Abstract.** Constantin Belea had remarkable contributions to the domain of System Theory, but also to the foundation of the School of Automation from Craiova. He initiated several pioneering directions, among which: Linear automated systems on portions, Numerical methods for transient automated systems, Invariance of automatic systems in relation to disturbances, Switching in linear electrical systems and applications of distribution theory, Optimal systems based on the minimum time criterion. Numerical methods for transient automated systems, Calculation of nonlinear auto-aspirations based on rapidly converging Fourier series.

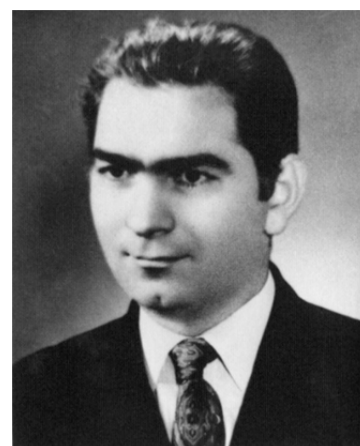
**Keywords:** *Belea Constantin, System Theory, Optimal Automatic Automated Systems.*

**Rezumat.** Constantin Belea a avut contribuții remarcabile în domeniul Teoriei Sistemului, dar și la fondarea Școlii de automatizare din Craiova. A inițiat mai multe direcții de pionierat, printre care: Sisteme automatizate liniare pe porții, Metode numerice pentru sisteme automatizate tranzitorii, Invarianța sistemelor automate în raport cu tulburările, Comutarea în sisteme electrice liniare și aplicații ale teoriei distribuției, sisteme optime bazate pe criteriul timpului minim, metode numerice pentru sisteme automate tranzitorii, Calculul aspirațiilor auto neliniare bazate pe seriile Fourier cu convergență rapidă.

Cuvinte cheie: Belea Constantin, Teoria sistemului, Sisteme automatizate automate optime

### Short biography

**Belea Constantin** was born on 6-th of March 1929 in Slanic Prahova, Prahova County. He attended the Plopeni Metallurgical Technical School, followed by the admission at the Polytechnical Institute of Bucharest, Faculty of Electrotechnics, in 1950. After two years, in 1952, he was selected and transferred, by a decision of the Council of Ministers, to the Technical Military Academy of Bucharest, the Faculty of Aviation. He graduated in 1954, obtaining a Diploma of Electrical Engineer on Board Electric Installations in Aeroplanes. PhD at the Military Technical Academy



He continued studies at doctoral level both in Bucharest as well in Moscow defending his thesis in 1959 at Jucovski Military Academy of Aviation Engineers in Moscow. He was awarded the title of Candidate in Technical Sciences (according to USSR regulations). The subject of his dissertation was "Nonlinear oscillations in automatic regulation systems" which was published on the recommendation of the Jukovsky Academy of Sciences Council, in the form of a 264 - page monograph (the original title "Nelineinyie kolebaniya v sistemah avtomaticheskovo regulirovania i upravleniya"), in the Maşghiz Publishing House, Moscow. In this paper he developed an exact method of determination of periodic regimes from non-linear automated systems, established the exact dependence of the amplitude and period of auto-cycles on nonlinear parameters, established the characteristic equations that solve the problem of stability of periodic regimes, studied several possibilities for removing the periodic regimes of functions of nonlinear automatic systems and so on. He continued his research work at a higher level of PhD thesis, also at the Jukovski Military Academy of Aviation Engineers the approached subject being : "New Methods in Automatic Regulatory Systems Theory", defended successfully in 1962. Based on this achievement he obtained his Doctoral Degree in Technical Sciences, USSR version, awarded by the Commission of the Ministry of Higher Education and Special Environment of the USSR, which in turn was recognized by the Higher Education Commission of the Romanian Ministry of Education as a New Doctoral Degree in Technical Sciences, named „DOCTOR DOCENT". The approached subjects in the thesis were development of methods for calculating automatic systems, finalized by proposing two new methods based on series of rapidly converging powers, replacing the trigonometric series and the classic series of exponential functions development in the dynamic calculation of automatic systems of different types. At the same time, he dealt with the coordinate and parametric invariance of the automatic systems, establishing some important theorems.

### **Teaching and research activity**

Between 1962 and March 1965 he held teaching and scientific activities at the Department of Radioelectronics at the General Military Academy, as well as reading the following courses as lecturer: "The Basics of Automatic Regulation", "Automation", "Computation Electric Machines", "Cybernetics" and so on. He coordinated the scientific research activity of the department and was a member of the editorial board of the General Military Academy Bulletin.

Between April 1965 and February 1966 he worked at the Bucharest Research and Design Institute for Automation, as chief designer at the Complex Automation Department, on topics related to the introduction of computing technique in industry.

Between February 1966 and September 1966 he worked at the Institute Power Energy of the Romanian Academy as Head of the Nonlinear Systems Division, activity that was prolonged on half-time basis until 1968, when he became honorary researcher of the same institute.

In the scientific activity, he was involved in developing the theory of nonlinear systems and the numerical methods of dynamic calculation of automatic systems. He studied the self-adaptive systems, the theoretical principles and methods of optimization of automated systems, the study and construction of computational devices, the study of parametric systems, the optimal reception of signals, the numerical modeling of nonlinear systems, the construction of linear dynamic systems based on the distributions theory.

### Professor at the University of Craiova

On the 1st of September 1966, he was appointed professor at the University of Craiova, Faculty of Electrotechnics, coordinating a series of departments: Electrical Machines and Devices, Devices (1966-1967), Automation and Electrical Devices (1967-1969) Automation (1969-1975) and Automation and Computers (between 1976-1985).

He founded the Automation Department in 1967. Between April and November 1968, and between 1969 -1974, he served as a vicerector of the University of Craiova. Since 1968 he was appointed as Scientific Coordinator of PhD activity in the field of Automation and Remote Control. Under his guidance 10 doctorate theses were defended.

He was the founder of the Automation Research and Design Institute – Craiova branch and in 1980 initiated the National System Theory Symposium, which is regularly held today at the international level. He was the Chairman of the System Theory Commission within the Automation Section of the National Council of Engineers and Technicians, sponsored by the National Council of Science and Technology.



Constantin Bela and his team in 1977

In 1983 he obtained the title of "Meritorious University Professor", awarded by the Order of the Ministry of Education No. 5121 / 16.06.1983.

Between 1981-1985 he chaired the course "Automation of Automatic Flight and Navigation Devices" at the Faculty of Aeronautics of the Polytechnic Institute of Bucharest.

He was awarded the Traian Vuia Prize of the Romanian Academy. He is the author of numerous studies, university courses, monographs, and synthesis works in Romanian, Russian and English languages, publishing over 200 articles in following magazines: *Avtomatika i Telemehanika*; *Izvestiya Akademii Nauk Energetika i Avtomatika*; *Automation and Electronics*; *Power Energy and Electrical Engineering Research*; *Revue Roumaine des Sciences Techniques Series*; *Electrotechnique et Energétique*; *Bulletin of the General Military Academy*; *Annals of the University of Craiova*.

He translated synthesis works from Russian and English,

He initiated several pioneering directions:

1. *Linear automated systems on portions.*
2. *Numerical methods for transient automated systems.*
3. *Invariance of automatic systems in relation to disturbances.*

4. *Switching in linear electrical systems and applications of distribution theory.*
5. *Optimal systems based on the minimum time criterion. Numerical methods for transient automated systems.*
6. *Calculation of nonlinear auto-aspirations based on rapidly converging Fourier series.*

Among the reference published works there have to be mentioned:

1. Belea Constantin, "Nelineinyie collebaniya v sistemah avtomaticheskovo regulirovaniya i upravleniya Maşghiz, Moskva", 1962.
2. Belea Constantin, "Cybernetics and its role in the analysis and provision of the combat actions", Military Publishing House, Bucharest, 1964.
3. Belea Constantin, "Programming in Electronic Computing Machines", Military Publishing House, Bucharest, 1969.
4. Calin Sergiu, Belea Constantin "Adaptive and Optimal Automatic Automated Systems", Technical Publishing House, Bucharest, 1971.
5. Belea Constantin, "Nonlinear Automatic. Theories, examples and applications. Ed.Tehnica, 1983.
6. Belea Constantin, Vartolomei Mihai, "Algebraic Methods and Algorithms for Optimal Synthesis of Dynamic Systems, Publishing House of the Academy of Socialist Republic of Romania, 1985.
7. Belea Constantin, System Theory, Didactic and Pedagogical Publishing House, Bucharest, 1985.
8. Belea Constantin, Lungu Romulus, Constantin Cismaru "Gyroscopic Systems and Their Applications", 1986

He died in Craiova on 16 December 1985.

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2. Manolea Gheorghe *Despre doctorat şi doctoranzi la Facultatea de electrotehnică din Craiova*, Editura AGIR, Bucureşti, 2015