Radoslav Horvat and Mirko Milić

Founders of Circuit Theory in Former Yugoslavia

Ljiljana Milić, University of Belgrade, Serbia
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Beginning

• The beginning of circuit theory at the University of Belgrade is considered to be the year of 1956 when Professor Radoslav Horvat established the undergraduate course on “Theory of Electrical Circuits” in the Faculty of Electrical Engineering.

• In the same year, Mirko Milić took position of a teaching assistant for electric circuit theory.

• Through decades, Belgrade school of circuit theory became recognized worldwide, and had influenced development of circuit theory at the other universities in Former Yugoslavia.
Professor Radoslav Horvat

• Born 1920, in Bečej (Serbia)
• Graduated: electrical engineering (1947), mathematics (1959), University of Belgrade
• 1948 Assistant at the EE Institute of Serbian Academy of Sciences
• Sabbaticals: Imperial College London 1951 and MIT USA 1960
• Prof. Horvat passed away in December 2004 at the age of 84
Professor Radoslav Horvat

• Professor Horvat realized early the importance of circuit theory for future engineers.
• In 1956, he established a course on **Theory of Electrical Circuits** where he introduced the most up-to-date topics at that time dealing with circuit analysis.
• Through decades, Prof. Horvat was responsible for education of thousands of EE students: future engineers, researchers, and scientists.
  • Excellent and precise lectures and up to date textbooks
  • Establishment of the modern program of circuit theory at the University of Belgrade
  • Supervision of a number of M.Sc. and Ph.D. students
  • Contribution of the development of circuit theory at other universities in Former Yugoslavia
  • Establishing the series of international Symposia on Network Theory
• The first textbook *Theory of Electrical Circuits* published in 1959.
• Complex mathematical methods in the analysis of electric circuits and systems.
• The book was widely used and served as an example for younger universities.

• **Special Electrical Circuits** published in 1965 that contained coupled circuits (transformers), two-port elements, and filters.
• **Synthesis of Electrical Networks** published in 1970 for the graduate course including: Synthesis of Two-Terminal Networks, Synthesis of Two-Port Networks, and Approximations in the Synthesis of Electrical Networks.

• He finalized the series of textbooks in 1989 with the book entitled **Time Domain Analysis of Electrical Circuits** where he used a modern approach to describe principles of analyzing circuits in the time domain.
Members of Prof. Horvat’s team

Professor Horvat paid great attention to his team. He always surrounded himself with extremely capable collaborators.

Distinguished members;

• Late Professor Marija Šušnjar

• Late professor Mirko Milić, member of the Serbian Academy of Sciences and Arts, and outstanding scientist with an international reputation.

• Professor Branimir Reljin, member of the Academy of Engineering Sciences of Serbia. Professor Reljin extended the curriculum with new disciplines such as Signals and Systems, Image Processing, Telemedicine, Neural Networks, authored several textbooks, and numerous scientific papers.
Development of circuit theory at other universities

• During his career between 1950 and 1985, Professor Horvat established programs in *Theory of Analysis and Synthesis of Electrical Circuits*, first at the University of Belgrade and then, in cooperation with his former students, at other university centers in former Yugoslavia: Niš, Novi Sad, Podgorica, Čačak, Banja Luka, Sarajevo, Skopje, and Priština.

• In those centers, students of Professor Horvat continued to work in the area of circuit theory.

• He also developed close cooperation with centers established in Split, Zagreb, Ljubljana, and Maribor.
International Symposium on Network Theory
The first international conference on circuit theory in Europe

• In 1968 Professor Horvat had established a series of international symposia on theory of electrical networks, *International Symposium on Network Theory (ISYNT)* that were held in Yugoslavia. Professor Mirko Milić was a scientific secretary.

• Organizer the *Yugoslav Committee for Electronics, Telecommunications, Automation, and Nuclear Sciences (ETAN)*.

• Note that the *European Conferences on Circuit Theory and Design (ECCTD)* started in 1974, six years after the *ISYNT*. 
• The first ISYNT was held in 1968 in Belgrade and was subsequently held in Herceg-Novи (1972), Split (1975), Ljubljana (1979), Sarajevo (1984), and Zagreb (1989).
• They were attended by the best-known scientists in this field.
Professional activities and services

• Program Committee member of the *European Conference on Circuit Theory and Design (ECCTD)*
• Member of the Editorial Team of the *Int. Journal on Circuit Theory and Applications*.
• Honorary Chair of the *IEEE Conference of Artificial Neural Networks (NEUREL 2000)*
• Reviewer for the *IEEE Trans. Circuits and Systems* and *Int. Journal on Circuit Theory and Applications*.
• Founder and active member of ETRAN Society and its Honorary President.
School in Theory of Electrical Circuits

- The School in Theory of Electrical Circuits of Professor Horvat was known and recognized worldwide, as noted in the article by Van Valkenburg in 1984 that appeared in the issue of the *IEEE Transactions on Circuit Theory* published on the occasion of the IEEE Centennial.
Professor Mirko Milić

- Born 1932, Galati (Romania)
- Research consultant (1961-1965) Institute *Nikola Tesla* and Mathematical Institute, Belgrade.
- Visiting professor-researcher, University of California, Berkeley, 1970.
- Prof. Milić passed away suddenly on September 9th 1993 in Bern at the age of 61.
Teaching

Professor Milić was primarily teaching *Circuit Theory*, a fundamental subject connecting all areas of electrical engineering and a number of other subjects offered to undergraduate and graduate students, such as:

- He introduced the course entitled *Electrical Modeling of Physical Processes*.
Graph Theory and Application, 1971, 1977

Theory of Electrical Circuits Course notes, 1973
Professor Mirko Milić was interested in a wide range of fundamental problems of the theory of electric circuits and systems. He highly appreciated and applied complex mathematical methods and algorithms in the analysis and study of electric circuits and systems where he achieved new and remarkable results.

Prof. Milić contributed to several areas of fundamental circuit and system theory:
• He was one of the pioneers in the foundation of spectral graph theory.
• His papers cover a variety of areas:
  • Topological dynamic properties of passive and active networks,
  • State-space descriptions of linear and nonlinear networks,
  • Qualitative analysis and bounds of the solutions of semi-state models,
  • Lagrangian descriptions of nonlinear networks,
  • Numerical analysis, modeling, and signal processing.
Scientist

- He introduced a new model based on anti-Lagrangian equations for describing nonlinear networks with topological degeneracies.
- Especially important are papers that introduce semi-state models with the use of Liapunov functions that enable efficient solution of large linear and non-linear stationary and non-stationary systems.
- During the last years of his life, he was interested in neural networks, particularly cellular neural networks (CNN) where he suggested a novel CNN cell having only one active element.
- Among others, his result concerning unique solvability of linear time-invariant generalized RLC circuits has proved to be one of the deepest results in circuit theory.
- The main characteristic of his research was “to be at least one step before others.”
Professional activities and services

- Professor Milić was an active member of several international and Yugoslav scientific societies and committees as well as chair and member of a number of conference committees (ISCAS, ISTET, ECCTD).
- Scientific secretary of ISINT (Int. Symp. on Network Theory).
- Permanent member of the Scientific Committee of the International Symposia of Theoretical Electrical Engineering (ISTET).
- Member of the Information Committee of SEFI (Société Européene pour la Formation des Ingénieurs).
- Senior member of the IEEE
- Member of the Yugoslav Society for ETRAN
Seminars on Neuro-Computing

• With several colleagues, Prof. Milić initiated the first Seminar on Neuro-Computing, held from December 20–21, 1990 in Belgrade.

• During the Winter of 1992–93, at the time of enormous inflation in Serbia and Montenegro, he organized the second Seminar on Neural Networks as a series of lectures held on Saturdays from November 1992 to May 1993.

• The seminars now continue as the biennial Symposium on Neural Networks and Applications (NEUREL). In co-operation with the IEEE Signal Processing Society, It hosts authors from all over the world.
Recognitions

For his work, Mirko Milić obtained many awards and acknowledgements from universities and societies. Among others:

• In 1984 he received the *Special Certificate* from IEEE on the occasion of centenary of the IEEE Society,
• *Silver Medallion* of the Technical University of Istanbul (Turkey).
• He was elected a corresponding member of the Serbian Academy of Sciences and Arts.
Unfinished works

• After Prof. Milić’s sudden death in September 1993, his co-authors finalized and published four research papers.
Foundation of Professor Mirko Milić

• Professor Milić loved to work with students and introduce them to research. To popularize the circuit theory and motivate students for this subject, in 1990 he decided to establish a foundation for awarding talented students in the Faculty of Electrical Engineering at the University of Belgrade. The funding was to be provided from his own income.

• Unfortunately, his early death in 1993 stopped these plans. In 2004, his wife, Professor Miroslava Olujić, established the Foundation of Professor Mirko Milić.

• Each December during the celebration of the School Day, the best senior student having the highest grade in Circuit Theory and a student having the best published paper in the field of circuit theory are recognized and awarded.
Thank you!