

KISHI Genya : “Basic Researches on Theories of Circuits and Systems”

1. Biography

Birth of 1928.03.23. 1951.03 Graduated from Tokyo Institute of Technology. 1957.01 Associate Professor, Tokyo Institute of Technology. 1960.03 Doctor of Engineering. 1966.02 Professor, Tokyo Institute of Technology. 1988.03 Retired, Professor Emeritus of Tokyo Institute of Technology. 1988.04 Professor, Takushoku University. 1994.04.18 passed away (66 years old).



(Prof. Genya KISHI)

2. Summary

Prof. Genya KISHI's researches cover a wide range of lumped constant circuit theory and signal theory. For his original and epoch-making research achievements mentioned below, he was awarded the 1967, 1968, 1972 and 1982 IEICE (Institute of Electronics, Information and Communication Engineers) Best Paper Awards, the 1980 IEICE Achievement Award and the 1990 IEICE Distinguished Achievement and Contributions Award. He was also recommended as the IEEE Fellow in 1983 and received the 1987 Tokyo Science and Technology Achievement Award. Furthermore, in 1993 he was nominated as an honorary member of the IEICE. In 1994, he received the Order of the Rising Sun, Gold Rays, and the Third Prize.

3. Summary of Research Achievements

Prof. KISHI's research results, some of which are outlined below, were always pioneering and instructive. His results made a great contribution to the establishment of circuit theory and signal theory, and raised the academic level of Japan and were highly evaluated worldwide.

3.1 Elucidation of Relationship Between Energy Storage Capacity and Group Delay Characteristics of a Circuit and Establishment of the Concept of Conservative Operators in N -port Networks

Prof. KISHI noticed a close relationship between the energy storage capacity and the group delay characteristics of a reactance circuit terminated with a resistance, and started his research based on this excellent reasoning. He succeeded in deriving a general formula to express the sum of magnetic and electrostatic energies in all circuit elements by using only the physical quantities observed at the terminal pairs of the circuit, that is, the elements of scattering matrix. Furthermore, through these studies, he succeeded in constructing a unified theory of stored energy in the lumped constant network for the first time in the world.

Next, in the process of conducting research on the energy stored in a circuit, Prof. KISHI noticed the following research theme. That is, the converse problem. What are the functions (generally, operators) of voltage and current for which the sum over all elements in the circuit is equal to the sum over the terminal pairs? Prof. KISHI answered to this fundamental question in the circuit theory. He showed that the necessary and sufficient condition is that the operator is additive with respect to both voltage and current. He named the operator the conservative operator of multi-terminal pair circuits. Prof. KISHI derived the necessary and sufficient conditions for a two-variable operator to be a conservative operator, and clarified the interrelationships among stored energy, group delay, element sensitivity, etc. and then paved the way for the subsequent researches. The IEICE awarded him the 1967 Best Paper Award^[1] for some of the above achievements.

3.2 Study on Principal Partition of Graphs and Topological Circuit Analysis

Noting that the nodal and the loop analyses of a circuit generally yield coefficient matrices of different sizes, Prof. KISHI succeeded to get a hybrid analysis method that minimizes the size of the coefficient matrix by properly applying the nodal and the loop analyses in a given circuit.

In the process of deriving this method, Prof. KISHI presented the concept of principal partition of a graph for the first time in the world. That is, by focusing on the two trees that are at the maximum

distance from each other in a graph, Prof. KISHI showed that a graph can be uniquely divided into the following three parts: the first part where the size of the coefficient matrix becomes smaller when the loop analysis is performed than when the nodal analysis is performed, the second part where the size of the coefficient matrix becomes smaller when the nodal analysis is performed than when the loop analysis is performed, the third part where the size of the coefficient matrix is the same in both analyses.

This concept had great impacts not only on the subsequent researches on circuit analysis, but also on the development of graph theory itself, and have been highly evaluated and cited worldwide. He was awarded the IEICE Best Paper Awards in 1968^[2] and in 1972^[3] for these achievements.

3.3 Studies on Sampling Theorems Prof. KISHI elucidated various properties of circuits in signal waveform transmission. He established a method to determine from a finite number of sample values the waveform which is a solution of a linear ordinary differential equation with constant coefficients. This is considered as a sampling theorem which forms the junction between lumped constant circuit theory and signal theory.

He also considered the frequency band and the degree of freedom of a signal waveform in communication, and pointed out that the Someya-Shannon's sampling theorem, which uniformly requires past and future sample values, has a problem in using it as the basis of PCM communication. In response to this problem, he newly created an interpolation formula in which a band-limited signal can be reproduced only from its past sample values. This epoch-making new sampling theorem provided a basis of pulse communication and received the 1982 Best Paper Award ^{[4][5]} from the IEICE.

4. Remarks

Prof. G. KISHI, since graduated from the Second Department of Electrical Engineering, Tokyo Institute of Technology in March 1951, had been involved in electrical and electronic engineering education and researches at Tokyo Institute of Technology, Takushoku University, etc. for over 40 years. In addition to his many outstanding research achievements, he has sent many excellent researchers and engineers to society. In particular, he had been deeply interested in the fields of circuit and signal theory since his special research student days immediately after graduating from the university, and in 1955 asked the world a book "Fundamentals of Circuit Analysis ^[6]", which is still known as a masterpiece for its consistent ideology. Thus he pioneered his own territory at a young age.

Prof. KISHI served as a dean and a councilor of the newly established Graduate School of Science and Engineering on the Suzukakedai Campus and greatly contributed to the development of the university. In addition, he donated a stone carving (Mitsuaki SORA, product) named "Creation out of Succession" to the campus when he retired. It is a monument that watches over and encourages young researchers in the field of science and technology^[7].



(Stone carving "Creation out of Succession")

5. References

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- [7] G. KISHI : "Creation out of Succession in Science and Technology," IEICE Fundamentals Review, Vol.2, No.1, pp.4–8, Jul. 2008

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