

Book review:

**STABILITY AND OSCILLATIONS
OF NON-LINEAR PULSE-MODULATED SYSTEMS**

by

A.Kh. Gelig, A.N. Churilov

The book is dedicated to Professor Yakov Zelmanovich Tsytkin, a member of the Russian Academy of Sciences, who passed away in 1997. The dedication is fully justified, since his contribution to the theory of sampled-data control systems can not be overestimated.

The primary fields of interest of the authors are pulse-width, pulse-frequency and pulse-phase modulated control systems. Many versions of this type of pulse modulation, used in engineering practice, are considered. The peculiarity of the book is that all the sampled-data systems are considered in continuous time, so no discrete time schemes are presented. The authors pay a little attention to pulse - amplitude modulation since it is treated in a vast number of publications. In opposition, the pulse-modulated systems are seldom presented in scientific journals. As for books the significant part of them are in Russian, hardly available for a non-Russian reader.

The authors are mathematicians but when writing the monograph they had both engineers and mathematicians in mind. Hence they maintain the mathematical rigor without using sophisticated mathematical tools. Thus, the understanding of the book requires only knowledge of the linear algebra and differential equations. In spite of that, the authors supplied their book with an extensive appendix that contains a lot of mathematical results.

The special feature of the differential or integral equations describing non-linear pulse-modulated systems is the lack of the continuous dependence of solutions on initial values. Moreover, for some models of modulation the trajectories are discontinuous. This requires unconventional methods of investigation. The first of them is the frequency - domain analysis of the qualitative behavior of solutions. Consequently, the main method used for studies of stability, auto-oscillations and synchronization effects is the so called averaging method. It combines the ideas of absolute stability theory and of averaging the pulse signal.

The other important problem which has been considered is the existence of periodic solutions. This problem has been approached by some conventional

method. However the most interesting seems to be the fixed-point method developed in the book. The fixed-point corresponds to the periodic solution of the system. For pulse-modulated systems the problem is discontinuous and the known fixed-points principles do not work. The authors overcome this difficulty by constructing regions in state space where continuity is ensured.

Overall, this is a very useful and good book that will help readers to understand many of the concepts used in describing different phenomena in non-linear pulse-modulated systems. It fills a glaring gap in the scientific book market.

Jakub Gutenbaum

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