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Analytical Theory of Multi-Stage Gyro-Amplifiers

G.S. Nusinovich
University of Maryland, College Park, Md 20742-3511
and
B. Levush
Naval Research Laboratory, Washington, DC 20375-5000

Nowadays there is an active development of high-power, large-bandwidth, high-gain gyro-amplifiers for various applications. Design of such amplifiers is usually based on using numerous computer codes. Operation of amplifiers, however, depends on a large number of parameters. Therefore, a more or less complete optimization of all parameters requires a lot of computer time. A search in this multidimensional parameter space can be done much faster when some basic dependences of the device operation on parameters are known. Such dependences can be found when a simplified (semi-) analytical theory of the device is developed.

In recent years there has been significant progress in the development of a simplified theory describing the operation of stagger-tuned, multi-cavity, single-beam and multi-beam gyro-klystrons [1,2], gyrotwystrons with multi-stage prebunching [3,4] and two-stage gyro-traveling-wave-tubes [5]. In some cases the analytical approach was developed for describing not only the small-signal operation of the device but also the saturation effects occurring in the large-signal operation.

In the present paper we plan to provide an overview of these theoretical studies, summarize the results, and discuss their applicability to real tubes.

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(Contributed papers at ICOPS-99).