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NONLINEAR MEASUREMENT OF RANGE TO A RADIO RADIATION SOURCE BY THE METHOD OF DELIBERATE CROSS MODULATION OF ITS SIGNALS

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A new technique is proposed for measurement of the range to a radio radiation source. The technique is based on the nonlinear effect of cross modulation of the signal created in the radiation source transmitter due to irradiation by a strong pulse field. The paper includes an example of the functional diagram of a nonlinear range-only radar embodying the technique suggested and the results of its experimental approbation.

Improvement of methods for determination of the range to objects with nonlinear electric properties is one of the important lines of development in contemporary nonlinear radio location of military objects.

Unfortunately, the known methods of measurement of distances to nonlinear targets based on application of frequency modulation [1] or with account for curvature of the phase front of the received wave [2], have not found wide application in the practice of nonlinear range measurements because of hardware complexity. The classical pulse method of range measurement, successfully used in ordinary radar systems, in the case of nonlinear applications has a single, but rather significant limitation. It is well known that the nonlinear radar is, first of all, a radar of short distances, since the signal reflected from an object is often very small and can be detected only at relatively small distances to the object. Under these conditions, the pulse range-only radars are inefficient, because their resolving capacity $c\tau/2d \sim c\tau/2$ in terms of range d (here τ is the pulse duration and c is the signal propagation speed in the environment) becomes commensurable with the range because of smallness of the range.

However, as has been shown by analysis, in our case we deal with location of so-called passive nonlinear objects, such as, for instance, a mine with rusty casing, an equipment unit with transistors, etc. In the case of location of actively radiating nonlinear objects, such as radio transmitters, the radar range of action, because of the higher level of the received signal due to use of the primary signal of radio radiation, can be increased substantially. As a result, we satisfy the condition $d >> c\tau/2$, which permits us to use effectively the pulse method of measurement of the object range.

The purpose of this work is to describe the new technique of pulse nonlinear radar measurement of range to nonlinear sources of radio radiation.

The technique is based on the effect of cross modulation [3] of the signal formed in the transmitter of a radio radiation source (RRS) when the RRS undergoes an impact of external powerful irradiating field. Due to the presence of elements with nonlinear electric properties in output stages of the transmitting path of the RRS, there appear in the radiation spectrum frequency components caused by action of the external signal. If the external sounding signals represent a pulse sequence, the intrinsic signal of RRS, created in the path, will be modulated by this sequence. Thus, based on time delay between the moment of radiation of each successive sounding pulse and the moment of reception of the backward pulse-modulated radiation of RRS, we can determine the range to RRS.

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