Rozprawa doktorska

Mikrofalowe oscylatory synchronizowane iniekcyjnie, jako źródła zakłóceń radiolokacyjnych

mjr mgr inż. Dariusz Gibalski

Abstract

The basic research problem of this dissertation was related to the need to develop and test jamming transmitters, adapted to counter pulse compression radars as a part of the spatial jamming system, developed at the Military Institute of Armament Technology. At the same time, the results of the author's earlier research showed the potential possibility of designing jammers, in a way "adjusted" to interfere specific radars, with the involvement of relatively low costs. Therefore, the main goal of the work was to develop a new type of repeat jammers against radars and to analyze the possibility of using, for this purpose, analog microwave oscillators, synchronized with the signal of disturbed radar as a result of the injection locking (*IL*) phenomenon.

In order to assess the feasibility of the proposed jamming concept, as part of this study, comprehensive studies were planned and performed, divided into three main groups: simulation studies, laboratory tests and experimental tests similar to real ones. In order to reduce costs and to use the available research and measurement infrastructure as effectively as possible, individual groups of tests were carried out sequentially, starting with the simulation.

The research focused primarily on the analysis of the operation of the digital compression path of a typical linear frequency modulation pulse compression radars under effect of jamming caused by the microwave oscillators, designed and manufactured at work, synchronized with the injected signal of the disturbed device.

As a result of the simulation tests carried out, it was initially confirmed, that for continuous radar signals and pulsed *LFM* signals, the proposed concept is correct and can be implemented in practice.

Then, based on the positive results of the simulation and the author's mathematical model of the *IL* phenomenon developed in the paper, dedicated to the design of oscillators as sources of interference for radars, real models of jammers were designed, made and tested.

In the course of laboratory tests of the developed transmitters, it was found, that the classic way of injecting the synchronizing signal, presented in the literature, is ineffective for radar applications. The possibility of optimizing the designed oscillator models in terms of increasing the synchronization bandwidth has also been demonstrated.

On the other hand, the analysis of the research results allowed for the conclusion that, based on the original mathematical model, it is possible to develop real jammers, in the form of cheap, analog oscillators, synchronized with modern radar signals, both simple and complex. The proposed design, despite its uncomplicated structure, made it possible to synchronize a single jammer in the frequency range of 300 MHz, with a carrier frequency of 3 GHz. This means, that a single oscillator can generate smart, synchronized jamming across the full tuning range of modern radars.

In the last stage of the work, experimental tests were carried out. The signals at the output of the digital compression system, ie after demodulation in an analyzer imitating coherent radar's receiving systems, were analyzed here. As a result of the conducted research, it was finally confirmed, that the jamming generated by the oscillator using the *IL* phenomenon are processed in the same way in the digital radar compression path, as the return signal, reflected from real airborne objects. This made it possible to prove the dissertation thesis, that „***there is a possibility of remote disturbance of the radar operation by signals generated by the microwave oscillator system, using the phenomenon of synchronization by injection of the signal of the disturbed device***".

Dariusz Gibalski