

## A Study on The EW Effectiveness Evaluation Based on Full Pulse Information Extraction

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**Abstract.** Problem: With the evolving and rapid development of information warfare, how to effectively use of electronic warfare equipment, give full play to our capacity, has become the focus of common concern. In the course of the actual confrontation, the opponents of electronic countermeasures are often hidden and unknown. Because against both sides is very dependent on and pay attention to the use of the information resources, we judge against opponents, most of the time are relying on the electronic warfare equipment reconnaissance information to collect the pulse description word parsing. Methods: through computer programming skillfully, the simulation of the confrontation environment, the confrontation scene settings according to the need to be customized, through the preset process of the confrontation simulation, according to the underlying mathematical model deduction, the confrontation process is intuitive and real-time display, the high fidelity simulation of the reactance equipment in the actual use of the whole process of confrontation effectiveness. Results: compared with the algorithm simulation results before and after the interference and the full pulse sorting results, the passive receiver is difficult to obtain the multi-mode signal parameters of the given radiation source before the interference is effective. Conclusion: the interference of radiation sources is effective.

### Introduction

With the constantly evolving and rapid development of information warfare, how to effectively use of electronic warfare equipment, give full play to our capacity, contain each other, has become the focus of common concern. In practice, however, the opponents of electronic countermeasures are often hidden and unknown. In the face of unknown opponent in the true sense, only by limited number of drills drills, we actually is unable to fully grasp its characteristic parameters, to participate in against experiments on the other side of the radiation source information cannot fully grasp, is not based on the accurate positioning and get their effectiveness in the practical use of electronic warfare equipment is accurate assessment, as well as the system itself and the ability of coordination and collaboration between all kinds of electronic information platform of comprehensive evaluation, etc. In recent years, the United States adopts the evaluation method of " reducing loss rate ", which is to evaluate the operational effectiveness of reactance by reducing the proportion value of reactance before and after the implementation process. such a method is simple and intuitive, and it has the practical value of operation, but the disadvantage of not and avoidance is that it must require a large amount of practical experience data accumulated from the actual process of reactance equipment, otherwise it is difficult to achieve the result with sufficient reliability. The problem is equally faced at home. The main research situation in China is divided into two kinds, one is the theoretical modeling simulation based on pure theory, the theoretical foundation is solid, the realization is convenient, but the lack of practical engineering system model and data reference and case verification, the reality is not enough; The other is the entity practice site, although the practical data can be based on the practical data, but the assessment means and theoretical support, the change and expansion of the space is very limited. How to combine the two kinds of situation organically, and evaluate the overall system performance and efficiency is a very important and difficult problem that we need to face.

## Information Processing Flow and Object of the System

**Signal Processing.** Routine information processing system is commonly: first carried out by the reconnaissance receiver system search, by antennas intercept enemy emitter signals in the electromagnetic environment, at the current signal through radio frequency channel signal detection, in turn, the measurement of characteristic parameters, such as the arrival time, working frequency, direction of arrival, pulse width, etc., do some pretreatment, form the PDW flow, and then further signal sorting and identification work, determine the nature of the radiation source, function, location and so on, thus the target to carry out surveillance activities and determine the position of radiation source, real-time information source intelligence.

**Characteristics of Typical Receiver Principle.** Receiver work generally includes intercepting, detection and signal processing, every link all weakness, different receiver system to obtain the results for the analysis of the effect assessment of signal is influential, so the receiver of the system of using different signal processing, we need to understand and master its characteristics and weaknesses in advance, is advantageous for the subsequent simulation experiments in the process of selecting the most suitable for the pulse signal receiving system, facilitate more effective signal extraction analysis, late for all pulse signal analysis of effectiveness evaluation is closer to the actual engineering usage.

**Full Pulse Descriptor Generation.** After the electromagnetic signal enters the receiver, the measuring of the relative parameters of the receiver, including: 1) the measurement of carrier frequency; The modern majority electronic countermeasures system only detects the signal by intercepting the radiation source signal from the frequency domain and measuring the carrier frequency of the signal. 2) reach the Angle measurement: direction finding is electronic warfare equipment, one of the main functions of the system signal detection based on the principle of direction finding direction finding can be component of the amplitude and phase method of direction finding method direction finding two categories; 3) time of arrival measurements: input rf signal by envelope detection, video output video signal after amplification and detection threshold, to more than detection limit, mouth judgment signal, outputs a TTL level pulse signal, called a wide pulse, bao wide pulse current time is the pulse arrival time value; 4) pulse width measurement, pulse width information is from the wide pulse, to enter the forefront of TTL level of wide pulse start the machine for the clock count pulse width, pulse width counter to stop the end of the pulse width along the trigger after the latch signal, the pulse width values in the latch. 5) amplitude measurement: the forefront of the threshold detection signal after the delay for A fixed plant used as sampling - keep the start signal circuit and A/D converter, A/D converter after A certain time of the end, the signal reading allows, the front micronization blunt will signal A/D conversion of data into A parameter latch, formation of the pulse. This form the pulse description word PDW, PDW is the foundation of the follow-up information processing.

**Clustering.** Clustering is a common description job. In massive amounts of data processing, we can directly obtain clear value level data flow is extremely detailed parameters and the regularity, we pass a certain regularity, seemingly not fuzzy and uncertainty can be random data, according to the specific conditions of a specific aggregation rules, the data is divided into several groups, when has the high similarity of the group together after reaching a certain amount, can find out an understandable description model, make groups with similar characteristics after can gather together into classes according to this model. Before it is important to note that the clustering of data does not know the final group of class number and model of the polymerization, at the same time can not have relevance between different group of class, they can vary greatly, but the group data in the group of class data characteristics similar to distinguish between degrees.

**Data Mining.** Data mining is the most popular and used data of the nautical mile data. Data mining algorithms is to a large number of data processing and put forward and the development, based on the complete database technology, with the aid of the kind of data analysis tools, take reasonable algorithm in the vast amounts of data integration, extracting data model and carries on the analysis, the analysis of specific aspects of specific areas to guide and promote development. Data mining itself

is a general knowledge discovery technology, is mainly from a large number of, the original, random database, purposeful mining, extraction, qiao, classified the implied you and xing qiao is the specific needs of the useful information for a particular user.

### **The Principle of Effectiveness Evaluation for Full Pulse Extraction**

**Signal Processing Vulnerabilities Analysis.** Electronic warfare equipment system signal sorting identification process, various system receiver working generally includes intercepting, detection, parameter measurement and signal sorting, which link problems will affect the subsequent processing. The system receiver is a physically realizable system, with the receiver processing the simultaneous multi-signal capacity and the limit of the adaptability of the pulse environment density. When the processing capacity is saturated, the receiver will not be able to respond to all of the pulse signals in the environment.

**Interference Scheme Research.** By analyzing these vulnerabilities, interference of electronic countermeasures equipment system mainly from system in signal detection, parameter measurement and signal separation process, such as real vulnerabilities in their process of breakthrough. Interference in this paper, the experiment selected design mainly aimed at the step signal coincidence detection and typical process parameter measurement, although different electronic counter party on the clustering algorithm of signal preassigned choose processing take different criteria, such as using different distance measurement, the selection of different initial clustering points and update rules of the different classes, etc., but the clustering algorithm itself will have the same thoughts, clustering algorithm for the signal sorting, can be broadly divided into two categories; The class clustering and hierarchical classes are divided into categories. This experiment were selected for clustering and hierarchical clustering algorithm is divided into two kinds of jamming methods to design modeling, and simulation verification, according to the actual situation analysis of experiment data evaluation.

**Rule of Jamming Effectiveness Evaluation.** This paper assumes that the electronic countermeasures system adopts the multiple hypothesis to the sorting and recognition of the signals, so the main points for the effective evaluation are. 1) analysis of the ability to cross the radiation source signal. Of radiation sources in complex electromagnetic environment to staggered processing practical ability were analyzed, and compared before and after the interference of the whole process of pulse data, respectively, to join the PDW before and after the interference source DOA, PW, the RF d the simulation, to see whether there is unable to complete the clustering mining or draw wrong information of the drying effect, to evaluate the jamming effectiveness. The characteristic parameters of the whole pulse electromagnetic characteristic of system signal processing are analyzed. According to the information system full pulse extraction for simulation mode interference behavior of jamming effect evaluation analysis, the signal detection, parameter measurement and signal separation of signal processing such as interference effect is in line with the destruction of electromagnetic characteristic parameter statistical properties.

### **The Experimental Results and Analysis**

**Radiation Source Design.** According to the design and principle, the source design is shown in table 1. The initial set value is the simulation data of the laboratory, the detailed results of the experiment only represent the effective results of this experiment, and the data value is for reference only.

Table 1 List of source signal parameters

Serial number	Carrier frequency	Pulse width	Double frequency	Amplitude
Radiation source1	1250MHZ	20 $\mu$ S	550 $\mu$ S	-42dBm
Radiation source2	1300MHZ	2 $\mu$ S	21 $\mu$ S	-42dBm
Radiation source3	1350MHZ	10 $\mu$ S	240 $\mu$ S	-42dBm

**Interference before Full Pulse Related Information Sorting Algorithm Simulation.** The full pulse data information generated by its separation is shown in Fig.1 and Fig.2 through visual software transformation.

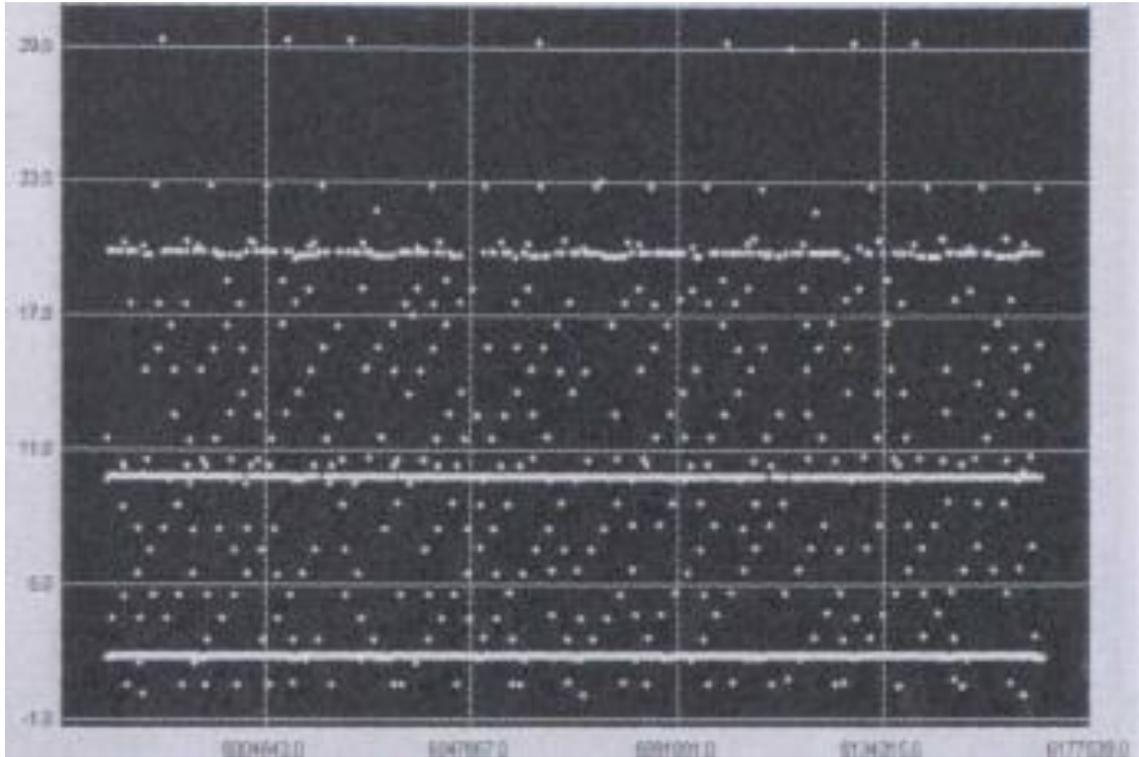


Figure 1. Interference with the pre-pulse duration characteristics

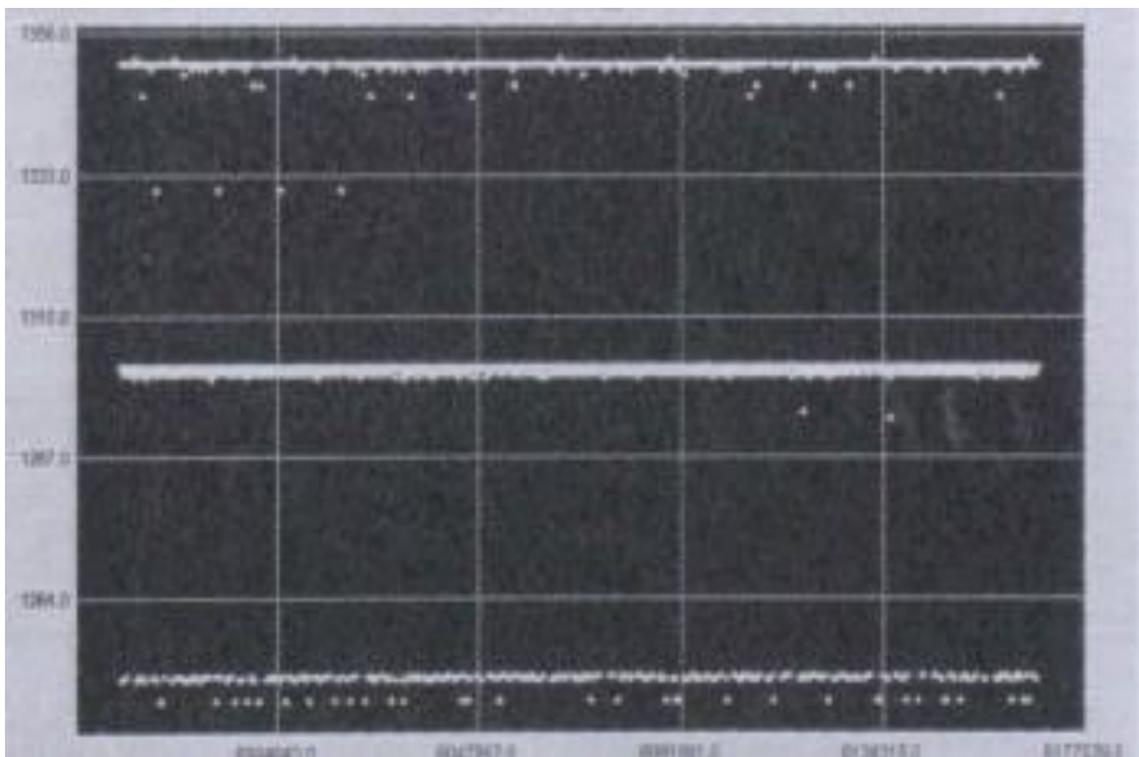


Figure 2. The interference frequency time features before

**After Interference Algorithm Simulation.** The post-interference pulse width time feature is shown in Fig.3. The frequency time characteristic of interference is shown in Fig.4.

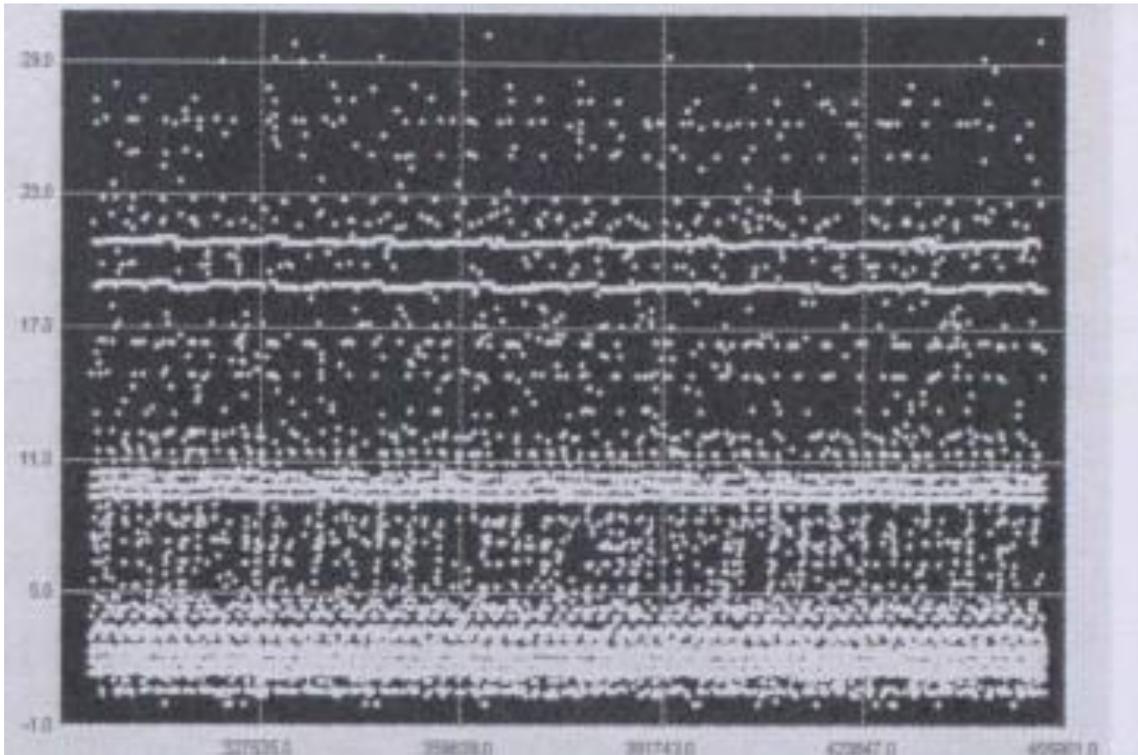


Figure 3. The pulse width time characteristics of interference

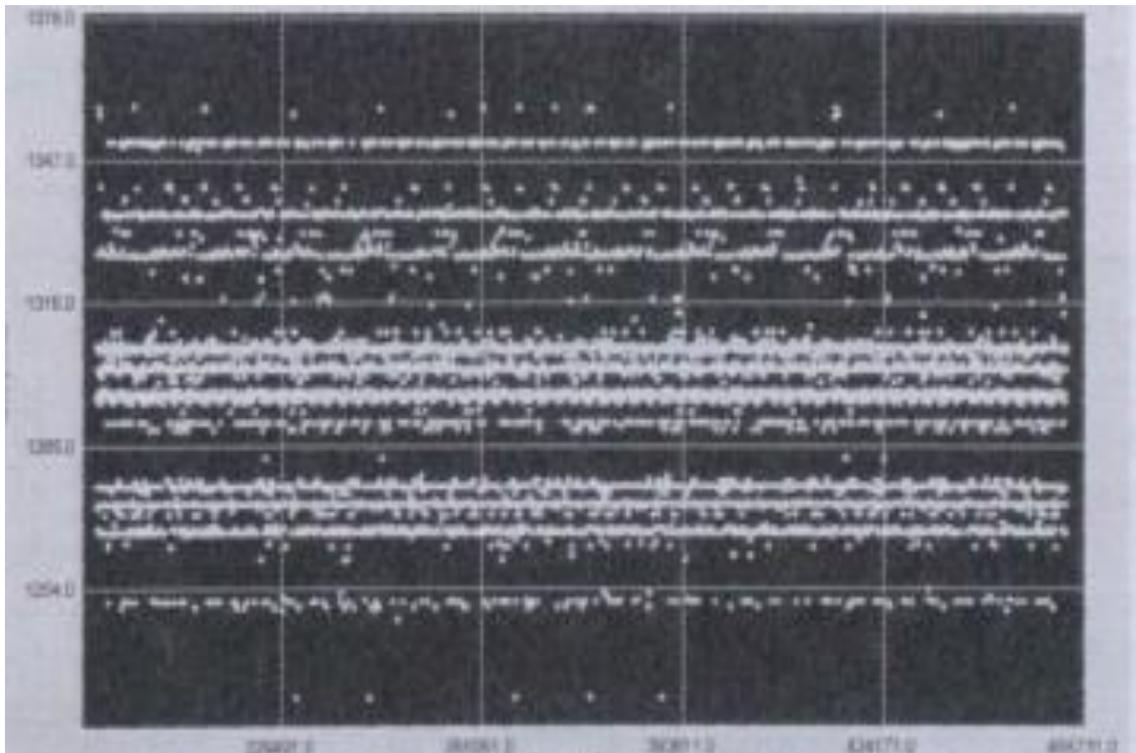


Figure 4. The frequency time characteristic of interference

The method of separation and identification of signals is often used by the passive detection system, so the effectiveness of interference efficiency is based on the following. 1) Use the characteristics of radiation source electromagnetic parameters were analyzed, and the destructive characteristics of electromagnetic parameters of statistical properties of dry Jude, difficult to achieve the electronic warfare equipment system for complex electromagnetic environment of the source to cross processing.

2) algorithm using data for clustering of data mining algorithm design of jamming signal, make the electronic warfare equipment system successfully completed to crisscross, even for some signal parameters can't complete the clustering mining or draw wrong information.

**Simulation Analysis.** Can be seen from the actual experimental data analysis, contrast before and after the interference algorithm simulation results and the whole pulse sorting result, passive receiver is difficult to get more than a given source mode before the signal parameters. This simulation, with the introduction of noise, the rights to add extra radiation signals, the passive detection receiver received radiation source signal parameters is difficult to through the clustering data mining to get useful information, such as interference effectively.

## Conclusion

The article mainly around the pulse description word produce process, from the signal detection, acquisition, analysis, and processing link is vulnerable to external complex electromagnetic environment of the shadow of the norm of vulnerabilities, and by means of electronic warfare equipment typical classification algorithms in the system, design a typical radiation source. In semi-physical simulation platform to carry out the verification experiment, die qiao experiment prototype extraction experiment simulation environment by analyzing the information collected full pulse, through the data accumulation, probably find some target after the disturbance of some shipped to potential \"trends\", unique in the ew receiver performance verification and assessment, the implementation of electronic warfare equipment sources more reliable qualitative judgment, and in a reasonable assessment to its, as a scientific basis for the improvement suggestion.

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