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A Case Learning Method for Radio Interference Finding

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Abstract. According to the needs of radio interference finding, the author analysis the matching between similar cases by a case learning method. In order to resolve the radio interference problems much better, this paper gives the ever used finding method as a new reference problem solution by visual programming.

Keywords: RADIO INTERFERENCE, CASE LEARNING

1. Introduction

With the development of radio communication and the use of new technologies, the chance of interference increased frequency, the complexity and difficulty of interference increases. Quickly and accurately troubleshoot the spectrum of electromagnetic interference with the effective use of scientific management and protection of the foundation, but also to measure an important indicator of the level of radio management. Over the years, radio interference were manually search for, find the efficiency of interference by the officers to find a broad knowledge of the extent and impact of science [1]. Therefore, the development of intelligent search system interference and improve the investigation of radio interference management of the efficiency of radio management has been an important area of research.

When people encounter a new problem, firstly, they usually search from memory problems to find a similar case with the new, then, put the case in the re-use information and knowledge to solve the new problem. Case learning method is based on actual experience or experience of the past reasoning learning [2], can help us deal with the past cases to solve new similar problems. According to this idea, we have to sum up the experience to find the interference to solve such problems as a success story for the later work can be used to find the interference of the reference case studies.

2. The Case of Radio Interference Structures

Case learning based on the knowledge that is case based. Get the case is easier to obtain than the rule; it greatly simplifies the access to knowledge. Case knowledge is constructed to solve the results of past re-use, rather than derived from scratch again, you can quickly get answers to your questions, improve problem solving efficiency.

There are many ways of access to case information, such as access to relevant references, learning experience from experts in the field, relying on the machine learning. Finding information on interference included interference with the identification, analysis, interference location, identify and deal with interference and other sectors, this paper focused on the interference information, identification and analysis. That of the previous summed up in practice to find the experience of interference to summarize the

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characteristics of interfering signals from the start, through the establishment of interference and interference characteristics of the link between the disturbances for the analysis to provide solutions. Although the interference of time each occurrence, intensity, and the reasons are different, but because they cause interference can be grouped into several types of relatively determined. For example, it is displayed on the monitoring equipment, the interference signal wave characteristics, summarizes the experience of some of the reasons for distinguishing interference [3]:

- Observed from the spectrum analyzer to the waveform bandwidth of about 20 kHz, and there are three peaks in the case of a two-signal second-order reciprocal interference.
- Observed from the spectrum analyzer to the waveform bandwidth of about 30 kHz, and the case has four peaks, the two signal third order reciprocal interference.
- Observed from the spectrum analyzer to the waveform bandwidth of about 50 kHz, and there are four peaks in the case of a two-signal fifth-order reciprocal interference.

Among them, the four peaks appear on the monitoring equipment needs further confirm the distance between peaks. If the distance between the four peaks is almost equal, then that is the two signal third order reciprocal interference; if the four peaks in the middle of two short distance, and distance on both sides, it is a two-signal fifth-order reciprocal interference.

The above reasoning is the process of looking for people to interfere with lessons learned, has certain credibility, we analyze these experiences as a basis for future judgments interference occurs. Basic idea is to construct the similarity of text based, to matching new problems with existing methods; returns have been cases of the problem solution. Will have to find the source of the problem as an interference case, when people look at the process of interfering signals that interfere with the source case with similar waveform characteristics, they can use to find the source of interference cases the experience to solve new problems. Case base structure information shown in Figure 1.

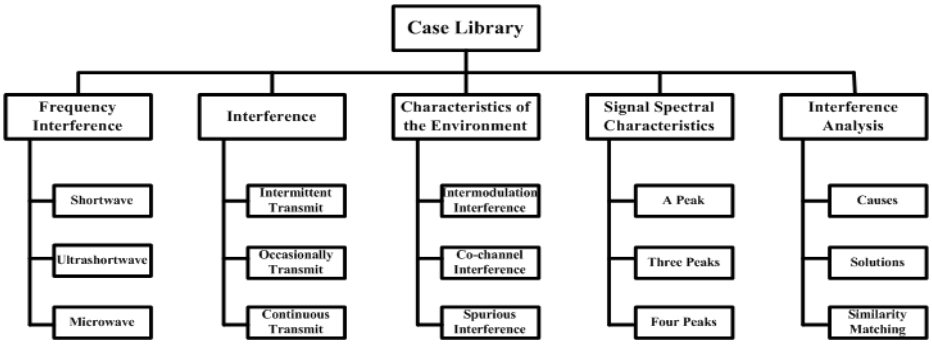

Fig. 1. Design of interference searching case database

3. The Case Learning Methods for Radio Interference

This phased search strategy and objectives to establish the source case the link between cases. In describing the characteristics of interfering signals, the characteristics of the electromagnetic environment with E_i said, indicating the presence in the environment can be generated reciprocal interference source; Ti indicate a problem with the phenomenon of features, value as intermittent emission, and occasionally launch and continuous emission. E_i and T_i values to the case library will be designated as 4 parts: {E_i = 1, Ti for the continuous emission}, {Ei= 0, Ti for the continuous emission}, {E_i= 1, Ti for the intermittent emission}, {E_i= 0, T_i for the intermittent firing}. When the case retrieval, the first part of the rough 4 election. When select a section, using the breadth-first search method [1]. The first part of the interference characteristics of information and case information database to match, through matching, to reduce the number of case searching, and then match the case base case has been analyzed and compared the information obtained with the input closest case problem-solving approach.

Case retrieval is to match the purpose of the event characteristics and features of the source case methods. Characteristics of the known conditions are not necessarily identical with the case, so when conducting case-based reasoning knowledge must first consider the input feature matching and case characteristics, namely the degree of similarity between the two can be considered to what extent the two are similar. We take the

gray relational analysis method closeness between the two, when the close is greater than a certain threshold, the match between the two that can be reused case.

Here's how：

3.1. Determine the data column

Eigen values of the source case as the correlation analysis of the reference sequence X_i, extract the relevant features of the target event as a comparison series X_0. In which, $X_0=(x_0(1),x_0(2),\ldots,x_0(n))$,n behalf of the number of compared characteristics, $x_0(n)$ behalf of the eigenvalues of the representative cases, remark on digits.

3.2. Grey relational coefficient calculation[4]

X_0 series compared with the reference sequence correlation coefficient between X_i.

$$\zeta_i(j)=\frac{\min\limits_i\min\limits_j\left|X_0(j)-X_i(j)\right|+\rho\max\limits_i\max\limits_j\left|X_0(j)-X_i(j)\right|}{\left|X_0(j)-X_i(j)\right|+\rho\max\limits_i\max\limits_j\left|X_0(j)-X_i(j)\right|} \quad (1)$$

Where, ρ is the resolution factor, generally the ρ = 0.5; $\min\limits_i\min\limits_j\left|X_0(j)-X_i(j)\right|$ called the two smallest difference $\max\limits_i\max\limits_j\left|X_0(j)-X_i(j)\right|$ called the two greatest difference, X_0 (j)－X_i (j) as the first j X_0 and X_i the absolute difference of data. So you can find the correlation coefficient of X_0 and X_i:

$$\xi_i=\{\xi_i(j),\ j=1,\ 2,\ \ldots,\ k\} \quad (2)$$

3.3. Grey relational grade calculation

Compare the characteristic values in each series on the average correlation coefficient for the math average value. That is to obtain more data series relative to the reference sequence of the gray relational degree, denoted by γ (X_0, X_i).

$$\gamma(X_0,X_i)=\frac{1}{k}\sum_{j=1}^{k}\zeta_i(j) \quad (3)$$

Comparison of gray correlation reflects the sequence similarity with the reference series, the degree of correlation the greater the similarity is higher.

Set a certain threshold, when the gray relational grade is greater than the threshold, you can target the event that a successful match with the source case, to achieve case retrieval.

4. Experiment and Result Analysis

In this paper, VC + + as a programming language, CLIPS as the embedded development tool, display the target case to match the source case.

Prepared in accordance with the rules of CLIPS specification [5], the case —"From the spectrum analyzer bandwidth is observed on the waveform about 30 kHz, and the case has four peaks, the two signal third order reciprocal interference", as the source case editor as follows:

```
(defrule case1 “Waveform for the four peaks”
(and “Waveform bandwidth of about 30 kHz”)
=>
(Explain “case1” “The reason is two-frequency interference to meet the conditions for reciprocal interference” ))
=>
(If (Boolean “The distance between the four peaks” “Equal” “Not equal”)
Then
(TextShow “Two signal third order reciprocal interference”)
Else
(TextShow “Two fifth-order reciprocal interference signal”))
```

Boolean function defined above is used to interact with the user information, TextShow function help users to select the results transmitted to the VC + + program to match with the source case.

In VC + + code to start CLIPS [6]:

```
Void Search ()
```

```
{char *RuleName, *pFileName
 RuleName="E:\GanRao\reason\rule.clp"; // Rule base
 pFileName="E:\GanRao\reason\facts.txt"; // Fact database
 InitializeCLIPS( ); // Initialize CLIPS environment
 Load(RuleName); // Load the rule base
 Reset( ); // Reset the CLIPS
 LoadFacts(pFileName); // Loading fact database
 Run(－1L); // Start CLIPS
}
```

Program matching reasoning shown in Figure 2.

Fig. 2.Matching the characteristics of the interface wave

When the user selects the "Four Peaks" option, the program will set the case series X_i and the comparison series X_0 as follows:

X_1= (20, 3, 300, 620, 20)
X_2= (30, 4, 300, 650, 21)
X_3= (50, 4, 300, 680, 23)
X_0= (36, 4, 300, 630, 22)

Program according to the literature [4] to calculate the gray relational grade, we obtain $\min_i \min_j |X_0(j) - X_i(j)| = 0$ $\max_i \max_j |X_0(j) - X_i(j)| = 0.44$. Take ρ = 0.5, according to expression (1), get

$$\zeta_i(j) = \frac{0.22}{|X_0(j) - X_i(j)| + 0.22} \qquad (4)$$

On the type of calculation results are shown in Table 1.

Table 1. Calculation results

$\xi_i(j)$Value	j=1	j=2	j=3	j=4	j=5
i=1	0.33	0.47	1	0.92	0.71
i=2	0.56	1	1	0.88	0.81
i=3	0.36	1	1	0.88	0.81

Get the Table 1 data into expression (3), obtained the gray correlation degree:

$\gamma(X_0, X_1)$＝0.686
$\gamma(X_0, X_2)$＝0.85
$\gamma(X_0, X_3)$＝0.81

Experiments show that compared user-selected series of X_0 and the case library source most similar case series of X_2. To further confirm the interference information, the program settings dialog box shown in Figure 3.

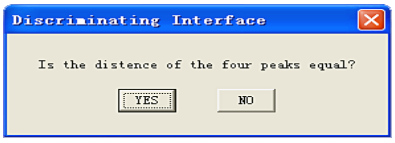

Fig. 3. Discriminating interface

Matching results shown in Figure 4.

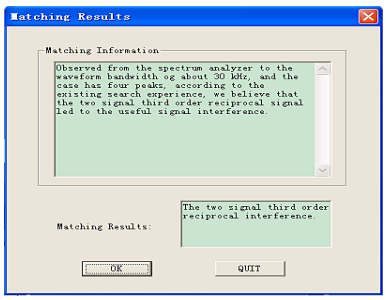

Fig. 4. Matching show information

Made by matching the source case and target case study methods, to resolve the interference to find the actual problem, proved that the method of radio interference find quickly identify interference is helpful. In order to provide more accurate matching of cases, the expansion of more reliable source of case information will be the next important issue to be resolved.

5. Acknowledgements

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