Modeling and Implementation of Algorithm Test System Based on Component

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Abstract: For establishing a universal test system of data fusion algorithms, COM technology is used, interface rule is ordered, so that the algorithm what conforms to the rules can connect to the system well. Later, it will become easy improving the algorithm and testing the algorithm with this system. Because the first interface rule was conformed .The system becomes an assistant platform for the algorithm development and research universally.

Keywords: COM Technology   Data Fusion   Performance Evaluation

1 Introduction

Information Fusion Technology was mentioned in 70s’in the 20th century , as the development of technology, in the field of military affairs and industry, nowadays which Plays an increasingly important role. In several regional wars of the world, Information fusion has demonstrated the great power too. In the multi-sensor detection network, information fusion algorithms handles the information from different sensors with the method of detect ,association and relevant, then the detected targets’ uncertainty is reduced and which can increase the handling capacity of integrated information systems and response capabilities [1].

Performance evaluation of the information fusion system is one of the major means of information fusion technology’s research. The comprehensive evaluation of the information fusion system’s performance indicators could provide guidance and direction for the research and development of information algorithms, clearly show the differences in the performance of different algorithms. Moreover, in the algorithm’s study, we use different research tools, development platforms, but for the same algorithm, the algorithm is a general sense of the consistency of interface features. Therefore, the establishment of a generic algorithm to complete the integration of different information is of great significance for the testing and evaluation platform [2].

This paper introduces the component technology and the framework of testing and evaluation, discussed in detail, the interface needs of algorithm component in the testing and evaluation platform, and finish the system designing and development. Simulation test shows the advantages for algorithm research by this system, finds the disadvantages of algorithm performance and guide the direction for the improvement of algorithms.

2 COM technology and code reuse

Information fusion algorithm development is a process of continuous improvement. Effective performance evaluation system can provide guidance to the algorithms for improvement. Component Technology is a good solution for that the system can load many different algorithms or load the same algorithm time after time. As long as the information fusion algorithms meet the interface requirements of fusion algorithm, the algorithm’s changes will not affect the link of internal algorithm and system, facilitate the algorithm’s re-testing and evaluation. From the point of view of software development, component technology becomes code reusing greatly and improved development efficiency.

COM is composed by the COM interface, COM client and COM server component. As Interface Specification of communications between the Component Objects. The objects can keep mutual communication by meeting the COM Interface. Although these objects from the different manufacturers, different programming language, the different Windows versions, and even in the different
computers. COM objects through COM interface to visit clients, access COM service. Each interface uses a unique identifier (GUID), marked as IID; COM objects are marked as a GUID called GLSID, which was registered to the system registry.

COM server, the key is to obtain the reference of COM object, that is, to create COM object. COM’s creation depends on a COM library and a class factory, they provide the building COM and COM registration, identify the registration database server, locate the COM server and return to the object pointer [3]. COM library provides these API function used for creating COM object. They are CoGetClassObject(), CoCreateInstance() CoCreateInstanceEx().

3 Test Evaluation System Framework

![Figure 1 Simulation test and evaluation system’s framework](image)

There are three relatively independent functional modules in evaluation system and they closely linked to each other. They were the environment and target simulation module, information fusion center, and performance evaluation center. TCP/IP data transmission and a database linked three modules together.

Targets and environmental simulation module simulates the detection information, what the acoustic sensor, radar, or other sensors gained from the objective (helicopters or missiles) in the external environment, such as clutter or noise. Based on the algorithm’s characteristics and test’s requirement, the attributes are setted, such as the types of targets, flight characteristics, and then the external sensor attributes are setted too. When the sensors detect a target into the scope, the detected data is calculated by the attribute of flight targets, the sensors’ performance, relative spatial location and environmental impact. Which is sent to the fusion center by TCP/IP method. At the same time the real tracks of simulation targets are saved into the database system.

Information fusion center is an independent platform for equipped with information fusion algorithm. Which is connected with the environment simulation modules or the testing and evaluation module by TCP/IP protocol communications. Which is a core of Algorithm Test System, and the algorithm package is finished here, for achieving universal call for a variety of information fusion algorithm. On one hand, at the end of the sensors’ detection cycle, it receives the detection data from the simulation environment simulation module, and then sends these to data fusion algorithm by a uniform COM interfaces; on the other hand, at the end of the sensors’ detection cycle, it gets the results from the fusion algorithm, and sends these to the testing and evaluation modules. Above process, from when targets enter the sensors’ detection range, to the time when the targets move out of the range.

Performance evaluation center includes database management, receiving algorithm simulation results from fusion module and gaining the real tracking of simulation targets in the database. The center conducts a comprehensive quantitative evaluation for different algorithms by a comprehensive evaluation system of the algorithm [4], and saves the results of testing and evaluation.

The Database achieves the saving of the fusion tracking and performance evaluation results, which is good for the analysis deeply of testing and evaluation. Meanwhile, the database system includes the system login information and system log, etc. The entire system is C/S structure, the database server is MS SQL Server 2000.
4 COM structural analysis and algorithm packaging
Considering the characteristics of Information fusion algorithm, the characteristics of COM packaging and testing requirements for system, the Component model is built, shown in Figure 2 [5].

Figure 2 Information fusion module COM interface

![COM Interface Diagram](image)

COM provides a total of two external interface, which includes four interface function: FusionIniti(), loads some initial work for algorithm; FusionIn(), loads the algorithm’s input parameters, mainly sensor detection data; FusionOut(), gains the outcomes of algorithm, mainly referring to fusion results of information fusion algorithm; GetFusionTime(), calculates algorithm’s necessary resources, mainly referring algorithm processing time. In COM, using IDL interface definitions, interface definition is as follows.

```idl
Interface IFusion: Iunknown {
    HRESULT FusionIniti([in] BSTR * pbstrFusionIniti);
    HRESULT FusionIn([in] BSTR * pbstrFusionIn);
    HRESULT FusionOut([out] BSTR * pbstrSensor);
}

Interface IAlgoRes: Iunknown {
    HRESULT GetFusionTime([out] ULONG * FusionTime);
}
```

5 Platform Simulation Test
After system is achieved, a variety of experiments’ results show the system characteristics of comprehensive and accurate evaluation for algorithms commonly, Summary of the experimental data with the following example shows.

Test algorithms are Join Probability Data Association (JPDA) and Join Probability Data Association - Particle Filter (JPDA-PF) [6]. Comparing the algorithms’ performance in the same clutter density and non-Gaussian noise environment, using Monte Carlo simulation, 100 simulation for each test. The experimental results, as shown in table 1.

<table>
<thead>
<tr>
<th>Algorithm Name</th>
<th>correct correlation Probability</th>
<th>Wrong correlation Probability</th>
<th>Wrong end Probability</th>
<th>False alarm rate</th>
<th>Tracking Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>JPDA</td>
<td>96.7%</td>
<td>3.3%</td>
<td>0%</td>
<td>6.7%</td>
<td>0.424km</td>
</tr>
<tr>
<td>JPDA-PF</td>
<td>90%</td>
<td>10%</td>
<td>6.7%</td>
<td>6.7%</td>
<td>0.351km</td>
</tr>
</tbody>
</table>

The experimental results show that the JPDA-PF is more suitable for the non-Gaussian noise environment in the information fusion system, test results are consistent with the current theoretical research findings. JPDA-PF improvement’s proposal is improving the performance in Gaussian noise environment.

6 Summary
By the COM technology we completed the platform of testing and evaluation algorithm. The system can load extern algorithms by COM technology, can carry out reliable test and evaluation for a variety of information fusion algorithms, so as to achieve the common purpose of the testing system. But in the development’s process, due to insufficient understanding of the algorithms, the algorithm interface definition is limited. The algorithm may not meet the requirements of some special need, and in the future the system needs further study.

References


