Review of Modern Engineering Solutions for the Industry

Edited by
Zhenyu Du and Bin Liu

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2012 International Conference on
Mechatronic Systems and Automation Systems
(MSAS 2012),
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Edited by

Zhenyu Du and Bin Liu

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PREFACE

2012 International Conference on Mechatronic Systems and Automation Systems (MSAS 2012) is launched by Information Technology & Industrial Engineering Research Center. It is the most international academic conference per year in mechatronic systems and automation systems area. The main aim is to provide an academic platform to exchange experience and production for researchers in the fields of mechatronic systems and automation systems. The conference will be held on July 21, 2012 in Wuhan, China. The book title of this conference is "Review of Modern Engineering Solutions for Industry".

In this conference, we had received about 300 submissions from 5 countries and regions. Each of the papers was reviewed carefully by two famous specialists in this field. After received the revised papers on the basis of the specialists' advice, finally we collected about 100 papers into the proceedings. In addition to the regular publications of the papers, we have also invited several specialists and scholars in this field to make keynote speech at the conference.

We would like to take this opportunity to express our thanks to the individuals and organizations for their efforts to serve the conference. We'd like to extend our thanks to members of academic committee for their effort to the conference; especially, we'd like to thank to members of organizing committee for their hard working; finally, we would like to express our appreciations to the participants of this conference.

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Co-simulation Technology Development and Application of Electromechanical System

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Keywords: mechanical and electrical system; co-simulation; modeling; application

Abstract:current electromechanical products are moving in the direction of large integrated and small intelligent, a mechanical and electrical equipment is usually composed of many parts, we not only need physical test to know whether these parts perform well or not, but also need simulation analysis for many times to verify the performance of the whole device. Firstly, this paper depicts the current development situation of mechanical and electrical co-simulation technology, then researches its practical application combined with industrial production.

Introduction

Currently, many mechanical devices develop in the direction of mechanical and electrical integration. Accompanied by the rapid development and wide application of computer technology, electromechanical technology is an unprecedented breakthrough. Electromechanical is an organic integration of mechanical technology, electrical and electronic technology, microelectronics technology, information technology, sensor technology, interface technology and signal conversion technology, it's an integrated technology apply above technologies to practical production. Today, the vast majority of modern automatic production equipments are electromechanical integration equipments. While electromechanical technology brings integration, automation and intelligence for electromechanical products, it also increases the difficulty of testing and maintenance. For example, the "Courage" and "opportunity" Mars rovers launched in June 10, 2003 by US need to perform the half-year exploration mission alone, during this period, the equipment failure is inevitable, and therefore they requires designs of fault-tolerant error correction, in lieu of people to perform diagnostic and maintenance tasks. This type of electromechanical system has high level of randomness which is difficult to predict, but a lot of engineering practice show that only a relatively small number of failures are emergencies, most of them are caused by certain reasons that can be avoided if we can diagnose and maintain in time. This paper elaborates the current development situation of mechanical and electrical co-simulation technology, and then analyzes its application in connection with electromechanical systems at home and abroad.

The Current Development Situation of Electromechanical System

Today, many mechanical devices are equipped with machinery and electronics systems, it usually consists of the mechanical subsystem, the electronic control subsystem, hydraulic subsystem, pneumatic subsystem. Because its components are complex, with only one simulation software to simulate all the subsystems is not practical. In the present co-simulation of the electromechanical systems, we usually use the MATLAB and ADAMS software to co-simulate.

MATLAB Simulation Software MATLAB is a very powerful engineering calculations and numerical analysis software which is developed by the US Math Woks company. The development of the software is from the matrix operations, and subsequently it becomes a highly integrated computer language. MATLAB software provides users with a powerful scientific computing, flexible program design process, high-quality graphics visualization and community design, visualization, modeling and simulation functions. In recent years, the MATLAB software has gradually developed into a mainstream tool for electromechanical systems simulation.

In the MATLAB software, Simulink module has the function of visual modeling and simulation saving the process of code written to greatly improve the range of applications of MATLAB software. Simulink blocks adopt appropriate control module depending on the modularization and standardization of the charged objects, they also can analyze and compare different control methods to pick the optimal control algorithm.

MATLAB software is mainly used in the simulation analysis of the field of electrical, automatic control and engineering computing, it can combine with other mechanical system simulation software to form a joint simulation system for mechanical and electrical co-simulation operation.

ADAMS simulation analysis software ADAMS software is an automatic analysis software of mechanical system dynamics developed by the US MDI. Until now, it has been widely used in scientific research, manufacturing and other fields and applied by hundreds of manufacturing companies.

Table 1 ADAMS software modules

Basic modules	1.user interface module； 2.solver module； 3. Post-processing module
Expansion modules	1.hydraulic system module；2.vibration analysis module；3.linear analysis module； 4.high-speed animation module； 5.test design and analysis module； 6.durability analysis module； 7.digital assembly playback module
Interface modules	1.flexibility analysis module； 2.control module； 3.graphic interface module； 4.CATIA professional interface module； 5.Pro/E interface module；
Professional field modules	1.car module；2.suspension design package；3.conceptualization suspension module；4.driver module；5.powertrain module；6.tire module； 7.flexible ring tire module； 8.flexible body generate module； 9.experience dynamics model； 10.engine design module；11.valve module；12.timing chain module；13.accessory drive module；14.rail vehicle module；15.Ford Motor Company vehicle module；
Toolboxes	1.software development kit； 2.virtual test toolbox； 3.virtual experimental modal analysis toolbox； 4.leaf spring toolbox； 5.aircraft landing gear toolbox； 6.tracked/wheeled vehicle toolbox； 7.gear transmission toolbox；

ADAMS software creates a fully parameterized geometric model of the mechanical systems using the interactive graphical environment and libraries, the constraint library and power library (ADAMS software modules are shown in Table 1). Its solver uses the Lagrange equation approach of multi-body system dynamics theory to establish the system dynamics equation and analyzes the statics, kinematics and dynamics of the virtual mechanical system then outputs the displacement, velocity, acceleration and reaction curve. ADAMS software simulation functions can be used to predict the mechanical performance of the system, range of motion, collision detection, peak load and calculate the finite element input load.

The basic process of mechanical and electrical co-simulation method First of all, you can use the ADMAS software or other 3D modeling software (such as: SolidWorks, UG, Pro/E software, etc.) to create a solid model. Take the SolidWorks software for an example, you should first draw various parts needing to be simulated, then assemble every part to get the total assembly, and at last, change the storage format into the type ADMAS software can identify.

Then, import the total assembly into the ADAMS/View after changing the format, set the parameters of material used in various parts of the total assembly, so that the part can get the quality, rotational inertia and other physical information automatically in the virtual environment during simulating; set the motion constraints for all parts after setting the parameters; then add a dynamic element to the solid model.

After defining the material parameters and constraints of the various parts, define the input variables and output variables. In the joint simulation of electromechanical systems, the input variables and output variables are only in terms of the motion model for the ADAMS software, and the output variables are similar to the evaluation value of the sensor to control the input variables, the input variables come from the output variables that control the simulation software, in other words, it’s the control variables.

Next, build the modular electrical simulation system in the control simulation software, it includes the controller, the virtual prototype model and calculation modules. Take MATLAB for an example, build every sub-module of virtual prototype simulation system in Simulink blocks and realize the connection of the ADAMS and MATLAB (through the Controls interface module in ADAMS).

After completing all settings, run the virtual prototype simulation system to observe the simulation results of the analysis. There are three observation methods: ① real-time observe the movement of virtual prototype simulation system in ADAMS/View; ② playback the simulation results on ADAMS/Post Processor and draw parametric curves; ③ record operating results by MATLAB, draw parametric curves.

Finally, according to the results of the observed co-simulation analysis of electromechanical systems, adjust the virtual prototype and the control system model and simulate, observe and adjust back and forth until the results of the simulation analysis agree with the actual working conditions.

Applications of Electromechanical Co-Simulation Technology

Application in the missile design Missiles stand for a national military strength as an important member of military family. Different from the general mechanical and electrical products, the missile can’t always carry on physical experiments, so simulation technology plays a very important role in every aspect of missile development. For example, in the progress of missile overall design and development, researchers can choose the most optimized system overall program and sub-systems program through studying the rationality of missile system tactical and technical index, and can optimize the main performance parameters of the missile which can provide the raw data for technical design of missile sub-systems. Through the application of co-simulation of electromechanical systems, we not only can realize the above experiments, optimization analysis and the top-level design of the missile, but also save a lot of research funding for our country to improve the missile research and development cycle.

Application of fault-tolerant and correction in mechanical and electrical design With the development of the mechanical and electrical products integration, information and intelligence, its internal circuitry is more and more complex, so the traditional hardware fault-tolerant technology has seriously restricted the development of electrical system. In order to improve the stability and precision of the mechanical and electrical equipment, researchers have proposed the fault dynamic self-detection and repair functions. Electromechanical system simulation technology plays a very big role in the successful development of this new function.

Application in development of car EPS controller Electric power steering system (EPS) is a device to help drivers for power steering using motor-generated power. EPS controller is usually composed by the torque (steering) sensors, electronic control unit, motor, reducer, mechanical steering and the battery cells and other components. Because the components of car EPS system are complex and it's more expensive to verify the pros and cons of the vehicle steering performance applying the physical experiments, so in general experimental study, scientists often use the co-simulation of electromechanical system simulation testing for automotive EPS systems. Among them, the use of simulation software can be tested on EPS steering light performance, turning back to the positive performance and snaking test performance. In many research institutions and universities, they often adopt the co-simulation technology to simulate and analyze the performance of the car EPS controller to supply the first-hand data for later physical experiments, so that promote the smooth development and research of the steering system.

Conclusions

In short, the modern mechanical and electrical products research and development can't be separated from co-simulation of electromechanical systems. With the development of the mechanical and electrical products integration, information and intelligence, many tests need to be simulated by virtual prototyping in order to shorten product development cycles, reduce product development costs and improve the quality of the product testing. Although the current electromechanical systems co-simulation is widely used, but many application modules need to be developed. Therefore it needs more technology and money into research and improvement of the electromechanical system co-simulation software.

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The Use of Automobile Electric Control Technology in the new Energy Vehicles Industrialization Process

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Keywords: new energy vehicles; industrialization; automotive electronics; control

Abstract: this paper analyzes the development situation of new energy vehicles and the problems in the industrialization process. and then introduces the use of automobile electric control technology in new energy vehicles.

Introduction

As our society is developing at an amazing speed,the need for energy becomes bigger and bigger,so energy had become a major concern for the whole society. Automobile,as a big consumer of energy ,has been borne aloft .Requirement of automobile ont only seek for property and comfort,but also make demand of energy consumption and environmental protection. To improve the quality of life in the world in which we live, Guarantee the sustainable development of society. And to slow down the speed of use of nonrenewable resources. new energy vehicles is imperative. The so-called new energy vehicles is that fuel needs is ont the traditional gasoline oil and other fossil fuels ,but the other alternative fuel and electricity hybrid cars. new energy vehicles do ont adopt the traditional fuel ,on that account, it is difficult for traditional mechanical device to meet the requirements in the power transmission. Therefore it is necessary for the introduction of the automobile electronic control technology. Thus, it can not only improve the car's power, but also reduce the cost ,and make cars safer.it plays a very big role for the industrialization of new energy vehicles.

The Development And Problems Of New Energy Vehicles New energy vehicles. Such as the pure electric vehicles and two ether vehicle etc. from a technical perspective,technology is perfect.But in real life , as the imperfection of supporting facilities and the difficult for Filling fuel for new energy vehicles. All hinder the industrialization process of new energy vehicles. Thus,from the characteristic of our country, we should make corresponding policies to promote the development of new energy vehicles . it will be of great help to alleviate the high pressure of energy consumption. New energy vehicle is different from conventional fuel vehicles, it is marked by new drive and power supply device, and more advanced technology, more innovative structure. The common new energy vehicles mainly include the following categories:

Table 1 The new energy vehicle classification

Energy type	New energy vehicle types
Petroleum fuel	Clean diesel vehicles, hybrid cars
Gas	CNG vehicles, LPG car
Alternative fuel	Two ether, hydrogen engine vehicle
Biomass energy	Ethanol gasoline, biological diesel
electric energy	Pure electric vehicles, fuel cell vehicles

Different types of new energy vehicles are different in various performance indicators.such as dynamic performance, fuel combustion efficiency and power output efficiency, etc . the chief tasks of new energy automobile is industrialization as far as possible at the present stage. Gradually substitute for energy car such as oil. make a contribution to the world's energy conservation and environmental protection.draw the following comparison for the performance of new energy vehicles. As shown in the following table:

Table 2:Comparison of new energy automotive technology index

	Diesel oil	Biomass energy	hybrid	fuel gas	Pure Electric power	Fuel cells
performance	moderate	moderate	well	bad	moderate	moderate
Fuel efficiency	moderate	bad	well	bad	moderate	well
Energy density	well	bad	moderate	bad	bad	bad
Easy storage sex	well	moderate	moderate	bad	bad	bad
the adaptability of the existing engine	well	moderate	moderate	moderate	bad	bad
Emission quality	bad	moderate	well	moderate	well	well
convenience	moderate	moderate	well	bad	bad	bad
load	well	moderate	moderate	bad	bad	bad
Vehicle cost	well	moderate	moderate	bad	bad	bad
Fuel costs	bad	well	moderate	well	well	bad

From the graph we can see clearly that hybrid cars are dominant in the comparison of technical index. Especially it would achieve a new energy vehicles high standards by improving simply the vehicles. Biomass energy, gas and other new energy vehicle have a great advantage in emissions quality and fuel costs. But these energy amount is insufficient. It will also hinder the development of new energy vehicles. From the comprehensive comparison of each technical indexes the above table ,we can draw a conclusion that the development direction of new energy vehicles should be hybrids and fuel cell cars . As for the fuel cell vehicle, there are many technical problems to be solved in the technical level.the development may also be affected by certain obstacles. Hybrid cars just as its name implies have two kinds of power output , So has two power supply: Battery + engine. This kind of vehicle in the design, Can use electric or engine strat in a car's launch phase , while the engine not output work,it wil transfer the excess kinetic energy into computer storage to the battery. Hybrid cars are divided into two classes: Ordinary hybrids and plug-in hybrids on the basis of whether it can be charging. Ordinary hybrid can't plug charge, When the battery does not work, you need to replace the battery. However, plug-in hybrids can plug charge When the battery does not work. This type of car is mainly a transition models to pure electric cars. Because pure electric cars are limited by battery problems, it needs to be internal combustion engine to provide energy output. In addition, the charging time of the battery compared with the traditional fuel add much longer. so this also affected the development of pure electric vehicle to some extent. Hybrid cars are classified by the drive system configuration, Can be divided into the following categories:

Table 3: Hybrid cars classification and characteristics

	Control system	battery	Energy transfer efficiency	Environment pollution
tandem type	Only motor drive	Large capacity, increase the vehicle weight	Existing energy conversion loss, reduce the energy utilization ratio	Emissions small
Parallel connection	Give priority to engine, motor as auxiliary power	Small capacity, low power requirements of the battery	High energy efficiency	Emissions big, large noise
Hybrid type	When low speed driven by a motor, increased speed driven by engine and motor	Battery low dependence	High energy efficiency	Between series and parallel

In our country, the development of new energy vehicles started relatively later Compared with Europe and the United States and other developed countries, but development speed is quick . the gap with the international advanced level is not great, even in some bottleneck areas of research be in the world leading level. But the development of new energy vehicles in China still can not relax. Just as in the traditional automobile field,in china, the gap with some famous world car great power is still quite large . Especially in the core technology and own innovation level, As a hybrid car batteries and battery charging and discharging performance. in the development of new energy vehicles perspective, there still are many problems. Mainly displays in the following aspects:

●In technical terms , although china's development of new energy vehicles also have a very long period of time, and also achieved good results. But there is a big gap with the overseas advanced level in the technical level. Such as vehicle assembly technology, battery management system and power transmission system, etc. This leads to China's new energy vehicles in the reliability and dynamic performance and endurance are far behind the foreign brands.

●In cost and industry chain terms, New energy automobile production is a kind of new technology application, The production line before can't work, It is necessary to build the new product line, This makes the manufacture cost of new energy automobile is much higher than the traditional automobile . most of new energy vehicles do not have domestic core technology and cannot production in raw materials and parts. Mostly rely on foreign imports .therefore, to a certain extent, new energy vehicles industrialization is also subject to foreign resources.

●In infrastructure terms, For the development of new energy vehicles the largest block should be the infrastructure construction, If energy supplies for new energy vehicles is as a traditional vehicle in words that fast, this will exercise a great pushing influence on e development of the car

● in consumers terms,when domestic consumers purchase the first car, they have relatively high requirements for all the aspect. And cost and convenience are the major aspects of buying a car, the consciousness of environmental protection may be more deficient, This leads to difficult that new energy vehicles to promote in China. On the other hand, as a new type of car, Its repair and maintenance costs are higher, And the repairs and maintenance site is lacking at present, These factors obstruct consumers to purchase the new energy automotive,

● in the integration of resources terms, China's new energy automobile development research mostly fight the enemy separately, enterprises have no contact and communication, Industry Association is not to act as a broker, Lead to many enterprises have to do something that other people have done, this action is time-consuming and wasted resources seriously. therefore, how to motivate effectively market resources allocation function, allocate reasonably new energy vehicle market resources and production factors, is a important task we have to face.

●In the aspect of International, many large manufacturers in the world have driven into the new design and development of energy vehicles. and a significant portion of the car come into production , This is definitely a huge challenge for domestic new energy vehicles market, now the whole world is in financial crisis, consumption mind of consumer tends to be rational and mostly **are conservative , so it** is unlikely to achieve new energy vehicles high sales in the short term, It inhibits to a great extent the production of new energy vehicles.

Automotive Electronic Control Technology Promotes New Energy Vehicle Development

For new energy vehicles, whether the product itself or manufacturing, the electronic control technology is indispensable, In recent years, with the electronic control technology and the rapid development of information technology and computer and put into application , automotive electronic control technology has also got rapid progress, car modernization level is measured by mainly the application level of automotive electronic control technology.as new energy vehicles is different from the traditional internal combustion engine car, so she is more dependent on automobile electronic control technology , In new energy vehicles, many aspects need the support of the automobile electronic control technical, such as the traction power system, the vehicle information system, the running state of vehicles and vehicle status control, here is the further introduction to the automotive electronic control technology which is part of new energy vehicles .

Power Traction System The electronic control technology in the application of the traction system is mainly to improve the power performance of the engine , Improve power output, increase the ride comfort, So in the power of the traction system, we control Mainly fuel atomization injection, ignition time and gas circulation .

(1) the fuel injection spray control is to make the air and fuel mix fully and achieve the best mix proportion, So can achieve the best combustion ratio, and improve the utilization rate of the fuel ,accordingly reduced energy consumption and exhaust emission. The control process in the engine is to install the detection sensor, monitor the mixture (air and fuel gas) information, once deviation appear, and modify the fuel and air proportion, keep a highly efficient fuel efficiency.

（2）Ignition timing control is based on different speeds, to achieve an optimum ignition timing. The quantity must be accurate, to ensure the engine output power, sufficient burning of fuel, and reduce exhaust emissions, Realization process also needs sensor to monitor factors affect ignition, feedback regulation, so as to achieve the optimum ignition timing.

（3）Gas circulation control is to make a portion of exhaust gases mixed with fresh air. then mixed with fuel atomization gas, so that to restrain harmful gas production to a certain extent. The realization process is to monitor the operation of the engine, then feedback regulation and recycle exhaust gas of engine, in order to achieve a minimum of harmful gas emissions.

Vehicle Running State The electronic control technology in vehicle running state control is mainly to guarantee car running with high efficiency and safety and to make the rider comfort, it mainly displays in the following aspects:

Anti-Lock Braking And Anti-Skid System the two is to ensure that the vehicle drive safely. Antilock brake systems is to prevent vehicle lateral spreads, and prevent slippery system is used to prevent vehicles wheel skid while starting or speeding up. Both are designed to ensure the stable operation of the car and good driving condition.

Automatic Transmission The electronic control technology is applied to the automatic transmission, is a sensor which feedback the information related to shifting rules. This car in operation, power output efficiency highest, is also relatively energy consumption ,prolongs the service life of a car.

Electronic Suspension System Electronic suspension system is main to promote the riding stationarity and riding comfort.

adjust the car height according to the different road condition. And make the car be in a steady state.

Auto Cruise Control System The automatic cruise control is automatic constant speed, Even without stepping on the accelerator, the car can drive at a constant speed ,this is done by vehicle speed detection sensor and the engine speed control system and still keep the same mixture gas, to achieve auto constant speed running, enhance driving pleasure, to reduce driver fatigue driving.

The Car Body State The state of the electronic control is to achieve the ride comfort and safety, Improve the fun of drive. Mainly embodied in the following aspects:

Air Conditioning System Air conditioning system need to control outlet temperature automatically , to ensure that the driver and passenger are comfort. This is mainly done by the temperature sensor in the car, monitor and feedback the temperature of the car and the surrounding environment. to calculate information collected by the computer, Then provide the most suitable outlet temperature for the car by the air conditioning control system,

Lighting Control System Lighting control system require that automotive electronic control system can judge and automatically adjust the lamp lights and bright degree according to the circumstances of the light level information.and improve the car driving safety .

The Airbag Control System through the test if the car got serious impact, airbag control system test the extent of the impact , If reach the standard of release airbag , then immediately to have the airbag inflatored, protect the personnel inside the vehicle. The airbag is a passive device driver, is the last protection measures, so it is necessary to ensure it stable and feasible.

Vehicle Information System Vehicle information system is a facility to enhance the automobile quality, is a kind of systems to promote the driving pleasure,and provide convenient service.

Information Display System The displaying content of information display system is mainly various state information

Provided for the driver's vehicle . Including the fuel, battery status, the temperature inside the car, car condition (speed, engine speed and running time) and auto parts temperature (water tank temperature and oil temperature). and through the sensor detects feedback we get this information.

Multimedia Navigation System Multimedia navigation system is main to improve the driving pleasure and convenience, Include a variety of media entertainment system, such as CD / DVD player, audio, radio, mobile phone system and the global GPS navigation system. The navigation system,recevive satellite signal by the body within the GPS, and position accurately with the built-in map information, to help the driver to reach the destination.

Conclution

Automotive electronic control technology plays a very significant role in industrialization process of new energy vehicles, this paper analyzes the development situation of new energy vehicles and the problems in the industrialization process. and then introduces the use of automobile electric control technology in new energy vehicles. Now in the new energy automobile industry there is one important problem, the battery and motor, thus there is the need for further research .

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The Research on Scenario Demonstration Engine of Plan Demonstration in the Detection System

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Keywords: Scenario Demonstration Engine; Detection Model; The Virtual Detection Systems; Agent; Virtual Unit.

Abstract. Through research and analysis of the detection system plan demonstration system from the topology, software architecture and the basic systems functions, this paper discusses the basic components, the model library and run the process of scenario demonstration engine of plan demonstration in the detection system. It introduces the running control algorithms of scenario demonstration engine, the obscured corner priority judgment method, the command processor, scenario processor, and model design to achieve some of the key technology in scenario demonstration engine.

Introduction

Detection systems play an increasingly important role in modern human life. The accuracy, timeliness and completeness of intelligence information in the detection system will directly affect weapon effectiveness, and has a major impact on the entire process and the result. Detection systems and their confrontation is always compete for the electromagnetic power [1]. With the upgrading of integrated electronic interference, the target of stealth technology and the further development of low-flying aircraft technology, the ability of detection system obtaining information is subject to many constraints, anti-radiation weapons is a direct threat to the survival of the detection system[2]. The four threats faced by these traditional detection systems such as electronic jamming, stealth, the destruction of anti-radiation and low-altitude penetration which promote the detection system must be careful planning, capacity analysis, plans demonstration verification and evaluation. In order to analysis program, check plan, understand task, it usually needs to plan demonstration before the implementation of the action. Demonstration plan is prior to action for the implementation of planned order and the process step by step, various stages of deployment and operations of the state caused by the drill process. Careful planning is an important part of the whole process which is essential to a key link in the organization and implementation of action. Scenario engine as a core part of detection system is directly affecting the operation of the system speed, reliability and realism. Therefore, it must develop a run control algorithm optimization, rapid information processing, complex environmental simulation, and other realistic scenario of the inference engine. Based on the analysis of the basic composition of plans demonstration system in detection system and the discussion on the scenario demonstration engine, it proposes a novel method to solve the problem of system running speed and complex environmental simulation problems, so that situational awareness is the real trend of rapid information processing and transmission.

System Basic Components

System Topology. The plan demonstration system of Detection system is based on Adjusting the Ministry and intelligence processing center, information network as a link to associate various information processing unit and director seats .It depends on the support platform to realize a comprehensive detection plan demonstration simulation platform. Its topology is shown in Fig.1.

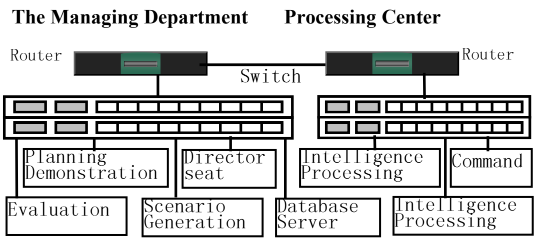

Figure1.Topology Structure of Planning Demonstration System of Detection System

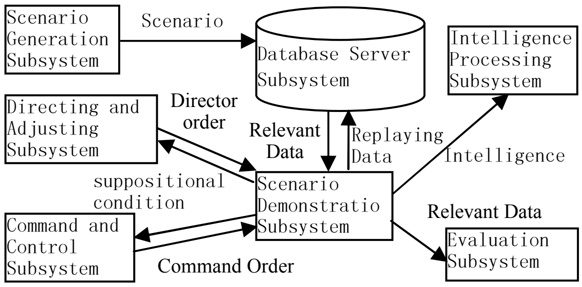

Figure2.The Information Interactive Relation between Scenario Demonstration Engine Subsystem with other Subsystems

The System Software Architecture. The detection plan demonstration system is composed with seven subsystems such as the director control subsystem, fixed production subsystem, scenario demonstration engine subsystem, assessment subsystem, database subsystem, integrated information processing subsystems, command and control subsystems. It also includes the running support environment. The communication relationship of the scenario demonstration engine subsystems and other subsystem is shown in Fig.2.

System functions. The main function of the detection system plan demonstration system is:

1) Through a unified application layer protocols and communications standards to achieve the demonstration system unit physical interconnection and data interoperability;
2) The realistic simulation of probe system operational characteristics;
3) set production and modify the operational settings of special situations capabilities;
4) The capacity to director command, control command, respondent;
5) The capacity to a virtual detection system;
6) The capacity to repeat records and assessment;
7) The capacity to simulation of complex environmental;
8) The capacity to record and repeat the demonstration process.

The Principle of Scenario Demonstration Engine

The operating environment of detection system plan demonstration system is to support various types of inference physical simulation resources for dynamic operating simulation platform; the main scenario demonstration engine is to control the entire running system. The function of scenario demonstration engine is controlled by adjusting control instructions, according to detection action and manual intervention command, detection systems and other related branches of the military action model in every combat simulation step solver process refresh the relevant data library, complete inference and tactical operations of the detection system in the simulation process the scenario distribution. At the same time, the recorder is a equipment to record and store the model results in the simulation process, each operational entity status, command and control information and interactive information.

System Components. The scenario demonstration engine is composed with 14 components , including electronic countermeasures reader, electronic warfare attack subroutine detection system deployment reader detection subroutine, anti-jamming subroutine, anti-radiation missiles subroutine, anti-radiation unmanned machine program, the virtual detection system builder, command processor, and want to scenario circumstances processor, scenario decomposition, run controller, situation of the transmitter, a repeat of the logger.

Model Library. The model library is a fixed core component of the scenario demonstration engine, including air target model, detection system model, electronic countermeasures model, position model, model of chaff, active interference model to probe the model, the anti-interference model of the detection system, detection system motor model to detect anti-radiation missile model, the detection system anti-UAV model, the target RCS model, command and command-response model, and the command-response model.

Running Operation. Directed by released demonstration start command, set to deploy the reader to read the database server electronic confrontation deployment scenario, the detection system deployment scenario and positions in the surrounding environment and other data, the virtual detection system unit generator call detection system model, position model, detection systems model, the detection system anti-interference model, the detection system motor model, anti-radiation missiles model of the detection system, detection system anti-UAV model to generate virtual detection system unit; virtual electronic warfare unit generator calls electronic countermeasures class model, positions, the model generates the virtual electronic counter unit. During demonstration, scenario decomposition set to split scenario to the present moment node, at the same time, it sends scenario to set the situation to want to scenario circumstances processor. Scenario processor received the scenarios would like to set to go to change the virtual unit of property or status. the run controller reads the node scenario and call the virtual detection system unit target detection, anti-jamming and anti-fire combat and target RCS model module, change their properties or state intelligence in order to obtain the form of packets sent to the intelligence integrated subsystems Broadcasting would like to set the situation, the record command, the state of the virtual detection system unit and node scenario; it calls virtual electronic counter unit for electronic counter measures against air targets.

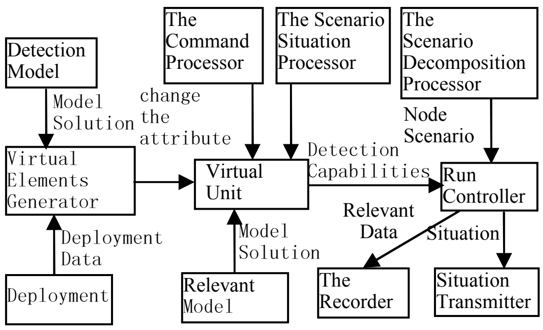

Figure 3.The Run Control Process

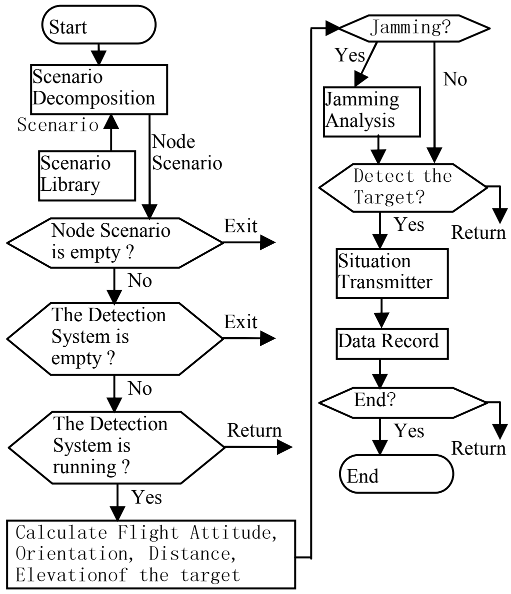

Figure 4.The Run Controller Flowchart

In the demonstration process, the command processor receives the command of the operator command and director, calls the command-response model and guide command-response model, and change the attributes of the virtual unit or state. The run control process is shown in Fig.3; the virtual unit is virtual detection system unit and virtual electronic counter unit.

Key Technologies

The running controller algorithm. Run controller is the fixed core component of the demonstration engine, it controls the whole scenario step forward, whether the broadcast control scenario, control the information whether the grouping of the detection system report and control of a repeat of the record. Scenario decomposes node scenario with time. It calculates each batch of the target relative virtual detection System Orientation, distance, elevation, flight attitude, calls the virtual detection system target detection model and the target RCS model to judge the virtual detection system whether it can be found the target. if target can be found , it is compiled batch target group report and send messages. The flowchart shows is shown in Fig.4.

Optimization algorithm. In order to avoid to a large amount of calculation in the computer, the algorithm design process of the scenario demonstration engine must be optimized, it would like to set the scenario demonstration engine uses the following three kinds of optimization algorithms. Virtual detection system determine whether finding the target, first to determine the orientation of the target high mountains such as shadowing angle, the comparison target relative virtual detection system data and related data masking angle relative virtual detection system, as well as combination of detection systems shadowing angle detection capabilities, it determine the virtual detection system can find the target, if the position is no masking angle, shadowing angle detection system detection capability to judge. These methods do not need to create and save a full range of the detection data distribution in virtual detection systems; it can reduce a lot of data, saving a lot of memory.

The command processor and the scenario situation processors. In order to better verify and evaluate and plan and command, during the demonstration process, the virtual detection system must be able to respond the command to change certain attributes or status of the virtual detection systems, such as mobile, shut down and start etc. The virtual detection system must also respond to the director-dispatch command to change some of the properties or state of the detection system, such as detection of system failure, communication interference, has been the firepower. In demonstration system, the command processor completes the change in the properties of the detection system or the state. The command processor received by the command legitimacy detected the command records, the command with the corresponding property characteristics, and property or state changes in the five major components. In the demonstration process, it would like the given scenario such as ext message, to set the default situation, etc. virtual detection systems must want to go to set in these scenario situation, carried out processing, to set a text message by the wish to set circumstances processor detect its legitimacy forwarded to director seats and the command, set the default processing by the scenario situation processors, to change some of the properties of the detection system or state.

Agent. Agent acts as a autonomous, interactive, adaptive and intelligent software entities which can help people independent access to information and services, complex tasks. [6-8]The demonstration system using Agent technology achieve the various intelligent entities, each Agent-based expert system knowledge, experience, knowledge or pre-established rules, autonomous intelligent processing of a variety of situations. Guide and command Agent can choose the implementation of the operation, behavior or action has a higher priority.

Model Design. The model is described and an expression of the object of study entity; the simplification of objective things, reflect and abstract. Model has analytical model, the empirical model. The analytical model has the form of formulas, equations, etc.; empirical model is to have taken place in the law and experience to analyze and describe the operational process model, is an establishment of statistical comparisons in the lethality of weapons on the basis of the model[3-4]. The former is sometimes more complex in system design, difficult to achieve; if there are reliable statistics, the latter sometimes in the system design is relatively simple, easy to implement. Scenario demonstration set the scenario demonstration engine to contain a large number of virtual units, each virtual unit is running to be solving a large number of models; the design of the model must be optimized. The detection model using the method of combining the analytical model and empirical model is the establishment of an ideal detection model for statistical data including simulation or experimental data and using the empirical model for the statistics using the analytical model. Class model for the detection of anti-radiation missile model can be used similar methods.

Simulation Strategy. To make this system model can be run in a computer; it will need to be converted to the simulation model, also known as computer models, which is an essential step from the model to computer demonstration[3]. Since the system under research is the randomness of the system, system state changes are occurring in the discrete time points, discrete event system simulation in this system. This system model is converted to a running computer simulation model, complete the following the three part work:

1) Design and simulation strategy. it determines the mechanism for promoting of the control logic of the simulation model and the simulation clock. The simulation strategy is the core of the simulation model, reflecting the nature of the simulation model, fundamentally determines the structure of the simulation model. The basic simulation strategy includes event scheduling, the active scanning method, three-segment scanning method; the process of interaction [5].The system uses the event scheduling, process modeling and implementation. Simulation step forward to deal with events that occur within each step in a discrete [7].

2) Construct the simulation model. namely the identification of the specific operation of the model. Complete the following work: Determine the control variables in the system state variables and statistical variables; event analysis system may determine the event handler that corresponds with the event; planning future events; to determine the priority of the execution of the event. Each virtual unit has event logging, event decomposition, the rules of judgment, the event handler function.

3) Simulation program design and implementation. It is some sort of programming methods and languages, simulation strategy and simulation models. The final form of the simulation model is a computer program, a simulation model must ultimately be achieved in some computer language, using VC 6.0 implements a discrete event system simulation model, implemented using object-oriented and Agent technology, the entire structure of the program clean clarity, easy to modify the simulation model and implementation.

Conclusion

The paper describes of topological structure, software structure and system of basic functions in plan demonstration system of the detection system. It focuses on the analysis of the detection plan system to set scenario demonstration engine of the basic principle and scenario demonstration processor, Agent, model design, key technologies. It can solve the system is running slow, realistic simulation of complex environmental problems. Based on VC + + 6.0 platform and the functional components of GIS development, it has advanced technical architecture, and more realistic simulation detection environment to meet the requirement of the detection demonstration system.

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