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PLATFORM DESIGN FOR THE VIBRATION CONTROL SIMULATION SYSTEM

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Abstract

The Vibration control simulation system is developed to optimize the vibration test design. In the simulation system, the mathematic models of the vibration generators, the transducers, and the data-acquiring system are stored in the database. The transfer functions of the control point on the test item are obtained in pretests. The platform is applied to support the vibration control simulation, in which different virtual test systems and different control methods and parameters are set, modifications are manually put on the transfer functions. In this paper, the structure and development process of the platform are introduced. The related key technologies such as the man-machine interface and the data communication in the platform are also discussed.

INTRODUCTION

Vibration testing is performed to provide the test item vibration environments expected in its shipment and application environments [1]. Vibration test devices such as vibration controller, power amplifier, and shaker and vibration measurement system are related to the test quality. It is necessary to optimise the parameters of the test devices to improve the vibration test control quality. The Vibration control simulation system is developed to optimise the vibration test parameters. The vibration control simulation system also provides an approach to understand phenomena appearing in the vibration test. To some extent, the vibration control simulation system has an advantage of reducing the risk of test item damage.

In the simulation system, the mathematic models of the vibration generators, the transducers, and the data-acquiring system are stored in the database. The vibration control arithmetic is simulated. The transfer functions of the control point on the test item are obtained through two ways. The simulation platform is applied to support the vibration control simulation, in which different virtual test systems and different control methods and parameters are set, modifications are manually put on the transfer functions.

In this paper, the structure and development process of the platform are introduced. The related key technologies such as the man-machine interface and the data communication in the platform are also discussed.

CONFIGURATION OF THE SIMULATION SYSTEM

Two computers connected through Ethernet construct the vibration control simulation system, in which one is a computing sever, the other is a client. The computing sever accepts the computing request and develops the simulation and sends the simulation result data to the client. The computing sever is programmed in MATLAB.

The client computer is the platform of the simulation system. It provides the man-machine interface to set parameters, receives simulation result data from the computing sever and saves data into the database. The client is programmed in Microsoft Visual Basic 6.0.

In the platform, computer communication technologies, visual program technologies, and database technologies are applied to achieve the following functions: setting parameters before the simulation, processing and communicating simulation data in the procedure of simulation.

To develop vibration control simulation, a series of parameters including model parameters and safe parameters and simulation test parameters should be set. First all a simulation item should be created (opened) which illustrated in the figure 1:

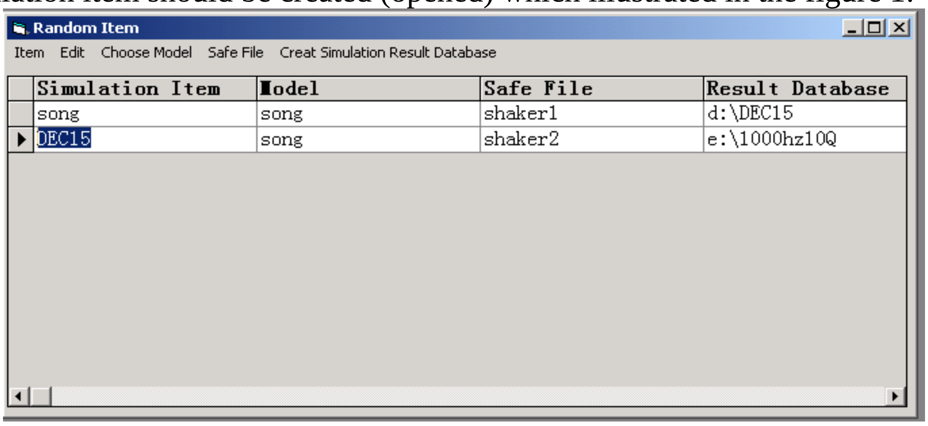

Figure 1 – Random item interface

In this interface, model file and safe file are loaded from database or to be created.The simulation test parameter is defined in the random (sin) test interface. In this interface, the power spectrum of the random simulation test or the sweep curve of sin simulation test is defined. For random simulation test, the cross frequency and the acceleration RMS and the velocity RMS and the displacement RMS are calculated. For the sin simulation test, the cross frequency and the acceleration or velocity or displacement are calculated. The random test interface is shown in figure 2.

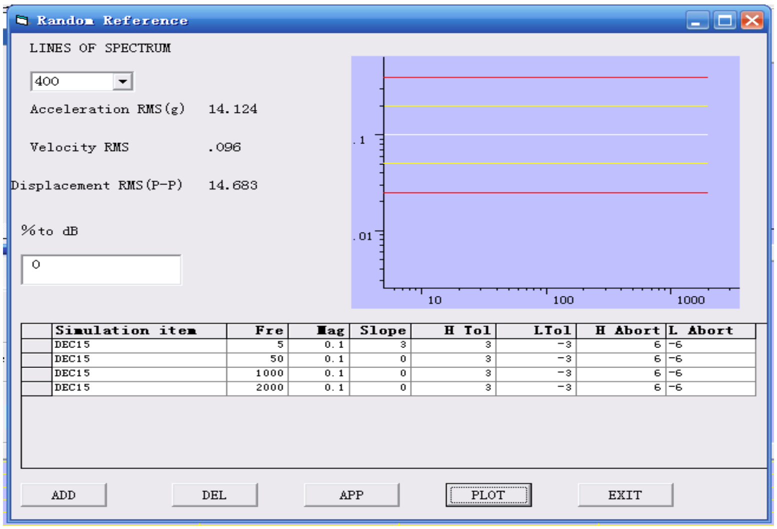

Figure 2 – Random test reference interface

Model parameter can be set through two ways. The model parameter can be reached through model identification of the test data in the server. The other way is through manually setup. For the common model can be simply described as seven basic units such as proportion unit, differential unit, and one-stage integrated unit, one-stage differential unit, two- stage differential unit and two-stage integrated unit. Through setting each unit parameter, a model can be created. The model interface is shown in figure 3.

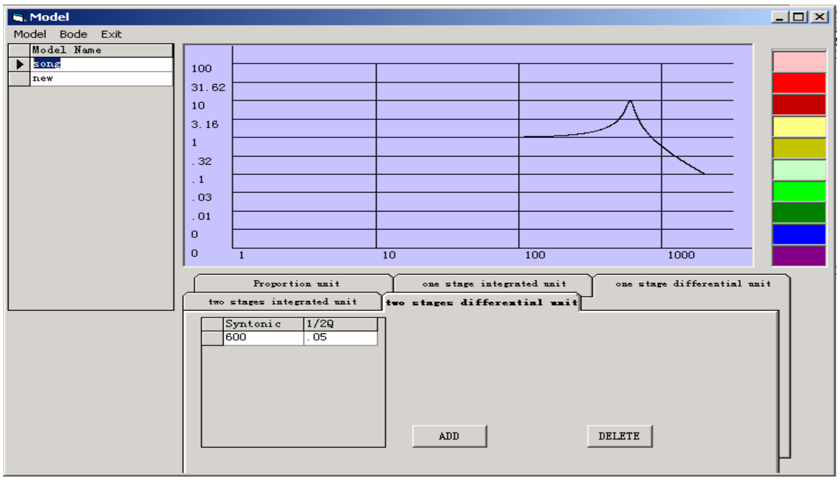

Figure 3 –Model setting interface

Safety parameters including the shaker limitations and test startup rate and test shutdown rate are set in safety parameter interface. The safety interface is shown in figure 4.

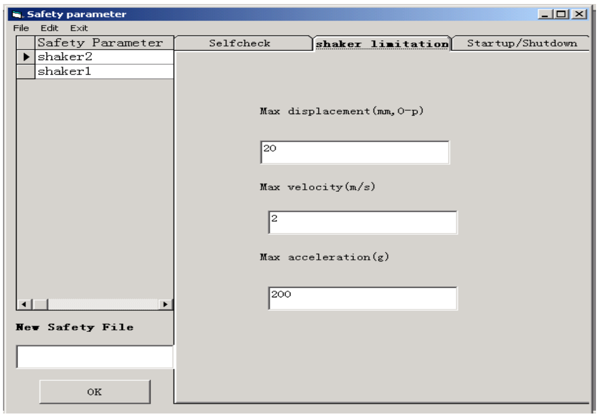

Figure 4 –Safety interface

Main interface is the interface when the simulation is carrying on. The simulation and reference data including history data and frequency domain data are shown in the main interface. The bode graph of test model is also shown in the main interface. The main interface is shown in figure 5.

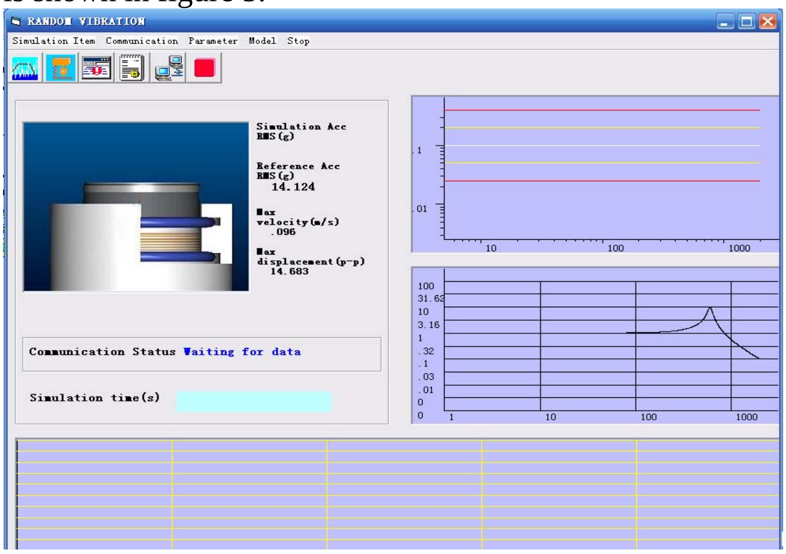

Figure 5 – Random simulation main interface

DATABASE DESIGN OF THE SIMULATION SYSTEM

In the vibration control simulation system, databases are devised and programmed to manage the simulation item effectively. It provides convenience to create and query simulation items, set and load each parameter, save simulation data. For relational database (RDB) has advantages in keeping the integrity and consistency of data, RDB is adopted to design databases in the simulation platform. Designing relational database concerns designing the relation mode besides defining the relation properties and data field. Restriction of data integrity should also be defined through programming the database.

In the simulation platform, there are two levels of data management. The lower level data management is item management, and the higher-level data management is parameter management. At the lower level, simulation item can be opened and deleted and created and renamed and copied. The safe parameter datasheet can be created and choose. The model can be created and choose. The key field of the lower level is simulation item name. The structure of the lower level is shown in figure 6.

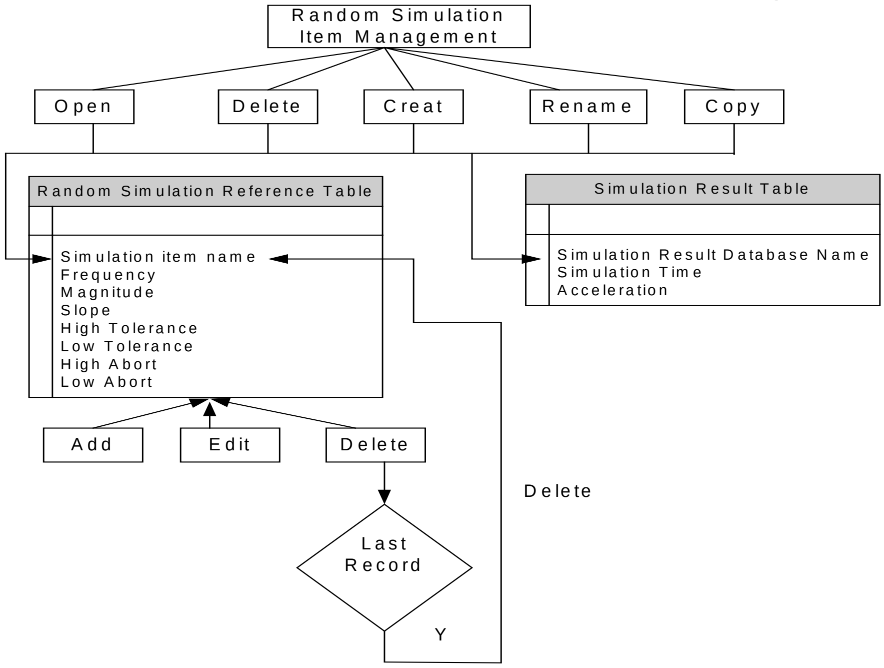

Figure 6 –Structure of the lower level

Operations of the item level are transferred to the parameter level through the key field. At the level of parameter, record can be added and edited and deleted. The structure of the lower level is shown in figure 7.

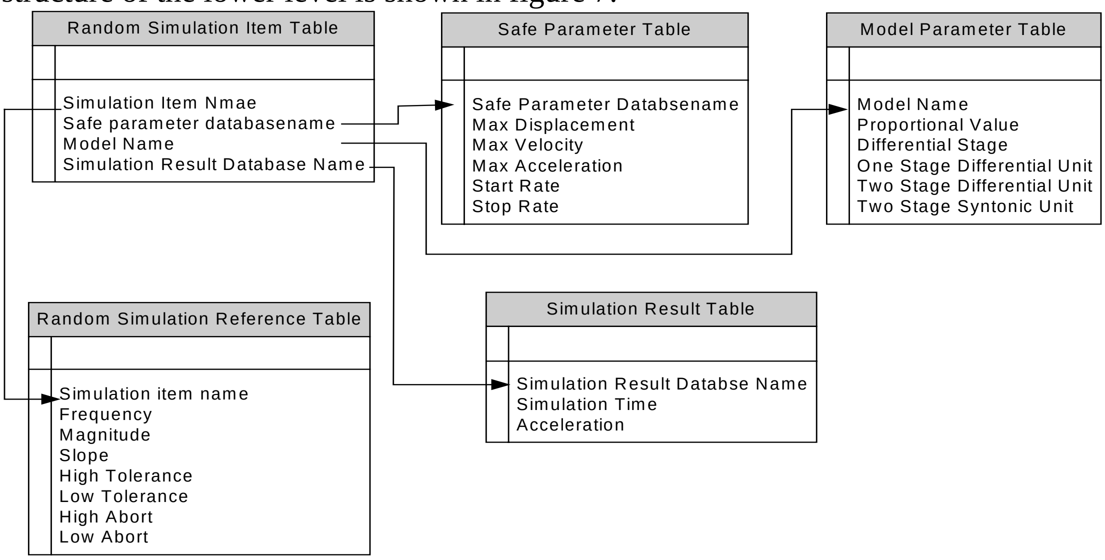

Figure 7 –The structure of the higher level

To keep the integrity of records, platform will transfer the delete operation to the item level to delete the whole item, when the last record is deleted in the parameter level.To save and inquiry and delete data, database programming is needed. In the simulation platform, the database system is Microsoft Access. All data disposals are actualized through DAO (Database Access Object).

DATA COMMUNICATION IN THE SIMULATION SYSTEM

In the simulation platform, data communications take place in the client sending simulation parameters before simulation and in the server sending simulation result data to the client. The simulation platform in client is programmed in VB. Communication program is developed through Winsock control provided by VB. Through setting properties of the control and calling the event of the control data communications are achieved.

The simulation program is built in the SIMULINK environment of MATLAB. SIMULINK provides no data communication module. It is more difficult to actualize the data communication in the server than in the client. Considering MATLAB is C language applied program, data communication is reached through calling Winsock API to create applied program. As C language has no directly called WINSOCK module, all WINSOCK functions are import trough DLL. The C language applied program is then connected into the toolbox of MATLAB to create M function, which can be directly called in SIMULINK environment.

Before simulation, client sends simulation test parameters and safe parameters and model parameters to the server. The simulation test parameters are dimension changeable multidimensional matrix. Sending those data to the server directly, those data would not be identified automatically. In the simulation platform, parameter data are packed as the figure 7 shown.

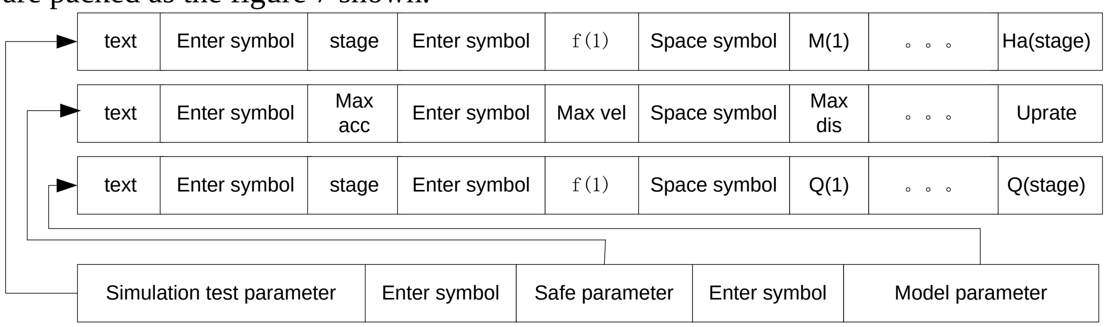

Figure 8 – Data structure of parameters

Each kind of simulation parameter is packed with a text and a symbol in the front of package. If the parameter is a matrix, the row number is listed. Between columns, there is a space symbol. Between rows, there is a enter symbol. The server gests data from the buffer then disassembles the data package into the workspace of MATLAB.

In the procedure of simulation, the server sends simulation result data to the client. Simulation result data is multidimensional. To reduce connection time, the result of each simulation step is packed in a character string like figure 9 shown.

“t”	Simulation time	“h”	History data

Figure 9 –Data structure of simulation result

CONCULUSION

The Vibration control simulation system has been applied to simulate random vibration test and sin sweep test. The platform works well.

REFERENCES

[1] “Vibration”, MIL-STD-810F Method 514.