http://ansinet.com/itj

ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Information Technology Journal 12 (21): 6350-6354, 2013
ISSN 1812-5638 / DOI: 10.3923/itj.2013.6350.6354

Simulation for Resource Availability Measurement on System Integration

Ningshe Zhao
Software Institute, Xi'an University, 710065, Xi'an, China

Abstract: To express explicitly degradation processes of resource and events of faults production, the issues about method and simulation of resources availability measurement are discussed, they are very meaningful to system integration. Because this is an explorative project item, some key creative things have been done. Firstly the change of system resource state is analyzed and the mechanism of transmission of failures is discussed based on resource faults. Secondly the method of resource faults-based health measurement and the representation of their classification and formalization for resources in system integration and the theoretical means of availability metrics of resources and resource platform are provided. Finally to verify the measuring method, simulation relative to resource availability metrics is proposed, where the formal representation of the resource structure is implemented, that embodies the managing properties including resource object type, nature and state. Moreover the algorithmic of availability measurement of resources and their platform is simulated in detail with highlighting the significance of resource integration to traditional management.

Key words: Integration system, resource availability, measurement, simulation

INTRODUCTION

The resource platform is the base of system tasks execution and the availability of resource components is starting point to achieve function and operation. System integration is a system optimization techniques orienting composition and characteristics of complex system (Wang, 2011). It's characteristics are resource sharing, highly variety sensor information fusing, multi-application result reusing, auxiliary tactics deciding and systematic managing. (Chu *et al*., 2009; Cong and Jing, 2013). Using computer modeling and simulating to depict the resource organization of system integration can support a base of formal expression for researching health management of electronic systems integration. Health measurement is to analyze the availability of current resources in according with current resource capacity structure and design capacity. Resource testing from resource characterizations to defects discovery belongs to BIT (Build-in Test) program business while derivation issues based on resource availability is class-ified to health metrics category (resource availability measures) (Algirdas *et al*., 2004).

PRINCIPLE OF AVAILABILITY MEASUREMENT OF RESOURCES INTEGRATED PLATFORM

In the traditional sense, based on the result of ASR (Availability of System Resource) described in mathematical form, the availability of resource platform abbreviated AR can be measured by Eq. 1:

$$AR = \sum_{i=1}^{x} (\alpha_i \cdot ASR(i)) \quad (1)$$

where, represents the proportion of scale of resource i in resource platform.

The availability of whole platform is measured by the integrated distance between current and designed availability. To acquire this integrated distance, an Algorithmic process is proposed: Suppose resource capability vector group is $R = [R_1: m_1, R_2: m_2, .., R_x: m_x]$, where x is number of resource type, n_1:n_x is scaling sequence. The designed resource capability vector is:

$$\hat{R} = [\hat{R}_1 : n_1, \hat{R}_2 : n_2, \cdots, \hat{R}_r : n_r]$$

where, r is number of resource type, N_1: Nr is scale sequence of designed resources, then AR is estimated in according with the degree Linear-Expressed of R to $\hat{R}$, namely according to the supporting degree of whole platform to resource R_i. The estimation matrix inequality (2) as follows:

$$(R_1, R_2, \cdots, R_x) \cdot Y \geq \hat{R}_i \quad (2)$$

where Y is supporting matrix which represents the description for supported situation of the current resources overall capability structure to the expected resource capability demands. If Eq. 4 has any solution, it shows that the demand support platform to resource R_i is satisfied.

Corresponding Author: Ningshe Zhao, Software Institute, Xi'an University, Xi'an, 710065, Shaanxi, China

A function process is constructed as Eq. 3:

$$s(i)=\begin{cases}\omega_i & ,\text{if} \quad R\cdot Y\geq Ri \\ 0 & \text{else}\end{cases} \tag{3}$$

then

$$A_{PoR}=\sum_{i=0}^{r} f(i) \tag{4}$$

ALGORITHM DESCRIPTION FOR AVAILABILITY OF RESOURCE INTEGRATED PLATFORM

The problem for resource measurement is whether expected demand capability structure can be support by current resources capabilities. During measuring the whole availability of resources integrated platform, the support for resource demands depend on the integrated status of resource platform, so the tactics of resource integration will affect the result (Zhao *et al*., 2011). To solve the problem that resources capability degradation makes generating new structure, during the system running, resource integrated platform management software must integrate resources capability

Here is an algorithm for resource capacity integration:

- If the counter i is the number of types of existing resources, turn to ⑧, else to continue
- If the counter j reaches the companion number of resource class I, turn to ①, else to continue
- If capability structure of element (i, j) is not empty, turn to ①, else to continue
- To reset seek symbol mark as 0.
- To seek for other main element which is not i.
- If found, to set seek mark as 1, link resource R(i,j) to the main element, turn to ¢Ù.
- To generate new resource vector and let the number of main element companion of ith type resource as 1, turn to ①
- To delete redundant representation of resource and the resources which is exhausted (scale = 0)

DETERMINING THE WEIGHTS BETWEEN THE LAYERS BASED ON ENTROPY METHOD

Weights are quantitative indicators which indicate the importance of each evaluated project, it represents different roles items play in the overall evaluation. There are many commonly used method for determining the weight, such as *statistical integrated score*, AHP method and coefficient of variation method, etc. however, these methods either need more experience or not be suitable for this study. Entropy method is based on the recognition that when an item has small relative entropy (it has more effective information and more large weight. Otherwise, any item has a bigger entropy, which denotes has less effective information and corresponding little weight.

Because information entropy is a state variable which describes system information and measures the degree of system ordering and the lowers has pillar effect on the higher ones to platform availability for integrated system task-organization based on the layer management architecture, Entropy Method is a method suitable for of calculating objective weights in this study.

The steps for calculating information entropy matrix of resource availability to function availability as follows: at first, to calculate the availability probability of resource Ri to function Fj,. Next, to calculate its information entropy to get the information entropy matrix of Fj. And then to normalize the matrix. The relative effective probability is calculated by Eq. 5:

$$p(i,j)=\alpha_i\cdot\sum_{r_i=1}^{I_R} C_{r_i} \Bigg/ \sum_{f_j=1}^{I_F} C_{f_j} \tag{5}$$

where α_i is the absolute effective probability, r_i and f_j refer the ability item of R_i and F_j respectively,I_R and I_F are the numbers of the ablity items.

The next step is to calculate the weight of resource R_i according to information entropy. It can reflect the changing status to adopt entropy weight method to determine weight. The initial resource-function information entropy is shown as Table 1. The average information entropy of function member is shown as Table 2.

Table 1: Information entropy matrix for resource-function

	F1	F2	F3	F4	F5	F6	F7	…	F150
R1	3.1358	3.1429	3.1361	3.1303	3.1506	3.1774	3.1506	…	3.1762
R2	3.1738	3.181	3.1742	3.1683	3.1887	3.2155	3.1887	…	3.2142
R3	3.2215	3.2286	3.2218	3.2159	3.2363	3.2631	3.2363	…	3.2618
R4	3.1738	3.181	3.1742	3.1683	3.1887	3.2155	3.1887	…	3.2142
R5	3.2379	3.245	3.2382	3.2323	3.2527	3.2795	3.2527	…	3.2782
R6	3.2296	3.2367	3.23	3.2241	3.2444	3.2713	3.2444	…	3.27
R7	3.1284	3.1355	3.1287	3.1229	3.1432	3.17	3.1432	…	3.1688
…	…	…	…	…	…	…	…	…	…
R346	3.1816	3.1887	3.182	3.1761	3.1964	3.2232	3.1964	…	3.222

Table 2: Distribution of information entropy for function member

F1	F2	F3	F4	F5	F6	F7	…	F150
63.5994	64.4274	65.0464	66.0982	63.8774	64.3279	64.9592	…	65.0028

Table 3: Resources ability structure

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	…	C250	Scale
R1	1	0	1	1	1	1	0	0	0	0	…	0	42
R2	0	0	0	0	0	0	0	0	1	0	…	0	10
R3	0	1	0	1	1	0	0	1	0	0	…	0	13
…	…	…	…	…	…	…	…	…	…	…	…	…	
R100	1	0	1	0	1	1	1	0	1	0	…	1	40

Table 4: Resource ability status snapshot

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	…	C250	Scale
R1	1	0	1	1	1	1	0	0	0	0	…	0	42
R2	0	0	0	0	0	0	0	0	1	0	…	0	10
R3	0	1	0	1	1	0	0	1	0	0	…	0	13
…	…	…	…	…	…	…	…	…	…	…	…	…	
R100	1	0	1	0	1	1	1	0	1	0	…	1	40
R101	0	1	0	0	1	0	0	1	0	0	…	1	2
…	…	…	…	…	…	…	…	…	…	…	…	…	
R346	1	1	1	0	0	1	1	1	0	0	…	1	1

Table 5: Change of resources redundancy after faults injection

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	…	R100
t1	42	10	13	26	31	11	21	19	50	30	…	40
t2	42	7	10	26	26	9	19	15	49	26	…	37
Mutation	0	0.3	0.23	0	0.16	0.18	0.1	0.21	0.02	0.13	…	0.08

SIMULATION

To verify the measurement process of resource availability based on the above model, a simulation process is developed for the resource organization modeling under MATLAB environment. The hierarchical architecture of integration system is adopted, where the resource capability dimension is 150, the expectation of capability dimension is 20, the number of resource category is 100. Here is a simulation demo of a resource integration platform supported by capability space generated by a group of resource capacity vector.

RESOURCE ABILITY STATUS SNAPSHOT OF SYSTEM INTEGRATION

A fault-injection method is used to simulate the degradation process during system run. Because of faults injection, the ability structure and scale of system resource may change, then the platform yet support task organization with the remaining effective ability. As Table 4 shown, there are 346 kind of resource after faults injection with average mutation rate 0.1.

Table 5 shows the contradistinction before and after the faults injection. It can be seen that there some diversification in resource ability structure after some faults injection.

RESOURCES AVAILABILITY MEASUREMENT FOR SYSTEM INTEGRATION

In the case of resource ability variation, in original form resources cannot support the demands. However resources ability can work in more effective way after integration.

The relative availability of the original resources ability to functions is shown in table 6. For example, the supported availability of resource R5 to F150.is 0.52.

Table 7 shows the relative availability of all manageable resource on system resource integration platform to all functions because of some faults injection which brings out the ability mutation.

Comparing with the original resources status in Table 3, the resources ability of managed objects of the platform is thinner. Figure 1 represents that the managed objects framework is different between before and after integration. Obviously system has more manageable objects in resources integration.

In integration system, resources ability is relative to some function, as shown in Table 6 and 7. The degree expressed with resources integration reflects support availability of resources to functions. In Table 8, the expression of availability estimation for resources integration platform to all functions demands. In this table there are three kind data, namely {‘1’, ‘0’, ‘-’}, where 1/0 denotes whether the given function demand is satisfied, ‘-’ denotes the item pointless.

Table 6: Resource-function relative availability

	F1	F2	F3	F4	F5	F6	F7	...	F150
R1	0.50	0.51	0.52	0.50	0.52	0.51	0.51	...	0.52
R2	0.52	0.52	0.51	0.50	0.52	0.49	0.51	...	0.53
...	...	...	...	...	...	...	...	...	...
R100	0.49	0.48	0.48	0.49	0.49	0.49	0.49	...	0.49

Table7: Resource-function relative availability of resource integration

	F1	F2	F3	F4	F5	F6	F7	...	F150
R1	0.50	0.51	0.52	0.50	0.52	0.51	0.51	...	0.52
R2	0.52	0.52	0.51	0.50	0.52	0.49	0.51	...	0.53
...	...	...	...	...	...	...	...	...	...
R346	0.48	0.48	0.48	0.48	0.48	0.48	0.49	...	0.49

Table 8: Availability to functions of resources integrated ability

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	...	F150
C1	1	1	1	1	1	-	1	1	1	1	...	1
C2	-	1	1	1	1	1	1	1	1	1	...	1
...	...	...	...	...	...	...	...	...	...	...	...	...
C250	1	1	-	1	1	1	1	1	1	1	...	1

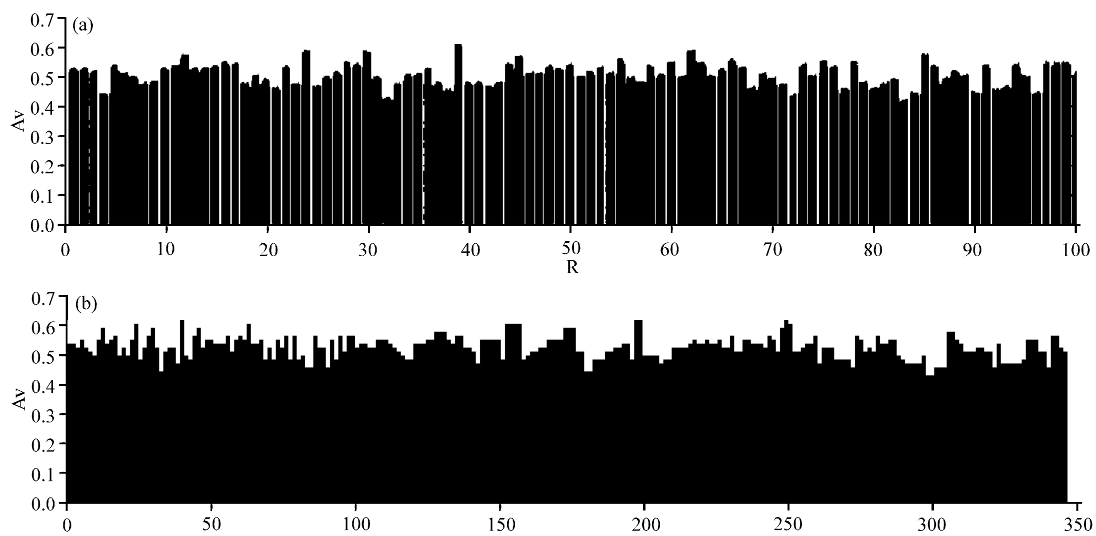

Fig. 1: Ability comparing of resource integration

CONCLUSION

The several issues are settled by means of simulation process for resource availability measurement: (1) Resource degradation to faults occurrence and the expression, where the degradation of resource platform is simulated with the introducing random ability mutation, (2) The difference between resource integration management and traditional management is simulated, (3) The construction algorithm process for availability measurement of resources and resource platform are implemented, which gives the effective result of resources to functions.

ACKNOWLEDGMENT

I would like to show my deepest gratitude to my supervisor, Prof. WANG G.Q., who has walked me through all the stages of the writing of this study.

REFERENCES

Algirdas, A., R. Brian and L. Carl, 2004. Basic concepts and taxonomy of dependable and secure computing. IEEE Trans. Depend. Secure Comput., 1: 11-33.

Chu, W. K., F.M. Zhang and X.G. Fan, 2009. Overview on software architecture of integrated modular avionic systems. Acta Aeronautica Et Astronaut Ica Sinica, 30: 1912-1917.

Cong, W. and B. Jing, 2013. Failure prediction of integrated avionic system. Electron. Optics Control, 20: 53-57.

Wang, G. Q., 2011. Thinking about developing integrated avionics system. Int. Aviation, 8: 55-58.

Zhao, N.S., G.Q. Wang and H. Wang, 2011. Demand-oriented health measurement method for integrated system. Comput. Eng., 37: 267-269.